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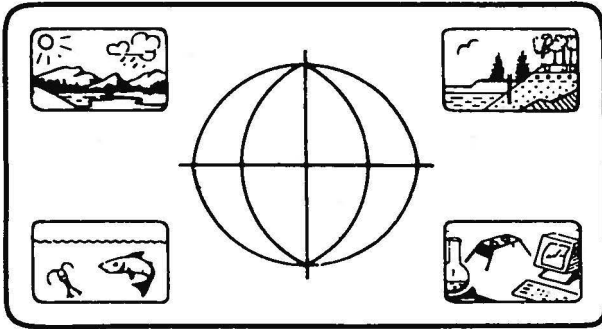
CATCHMENT FORESTRY IN TANZANIA

STATUS AND MANAGEMENT

Consultancy for NORAD (Norwegian Agency for International Development).

**Prepared by:
John E. Hermansen
Faye Benedict
Tore Corneliussen
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FEBRUARY 1985



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Preparatory study for actions limiting destruction of the remaining natural forest on hills and mountainsides in Tanzania.

**Prepared by:
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Vegetation and Land Use. Himo watershed, Kilimanjaro Region.
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I

FOREWORD

In a letter of January 13, 1984, the Forest Division of the Tanzania Ministry of Lands, Natural Resources and Tourism requested NORAD help in establishing management plans for the remaining natural forests in the most important catchment areas. The Institute for Environmental Analysis, Bø, in Telemark, Norway, was contacted by NORAD via FORINDECO (Forest and Forest Industries's Development and Consulting Company (Norway) A/S) in June 1984 regarding the Tanzanian request. In early October NORAD gave the Institute for Environmental Analysis and FORINDECO the task to provide consultancy services to NORAD. Olav Hesjedal, Institute for Environmental Analysis, was named project coordinator.

A multiprofessional team from the Institute and FORINDECO made a 6 week excursion to the Catchment Forest Projects from Nov. 4 - Dec. 16, 1984. The mission members were:

Tore Corneliussen (Senior Forestry Consultant, FORINDECO)
John E. Hermansen (Ecology/Botany. Project Secretary)
Johnny Hofsten (Ecology/Mapping)
Dr. Hans Venvik (Ecology/Regional Planning)
Dr. Faye Benedict (Ecology, helped with briefings for the
field trip and report-writing)

This report summarizes the activities and findings of the field excursion.

The Institute for Environmental Analysis is responsible for the professional work. FORINDECO administered the mission on behalf of NORAD, and has provided some of the forestry input.

II

SUMMARY

The Forest Division of the Tanzanian Ministry of Lands, Natural Resources and Tourism has requested that NORAD establish management plans for the remaining natural forests in the most important catchment areas. This is a consultancy report to NORAD from our safari to the Catchment Forest Project in Tanga, Kilimanjaro, Arusha, and Morogoro, with a discussion of current status and recommendations.

1. Deforestation and catchment forest management.

A very serious situation exists in Tanzania regarding water supply, deforestation, and erosion. Exploitative forest utilization, especially in catchment areas, has greatly reduced forest cover and caused widespread erosion and degradation of soil resources. Estimates of annual deforestation in Tanzania are very variable, ranging from 190 000 to 400 000 ha of forest cover per year, about 0.5-1% of the total forest cover (including miombo and other woodland types). The percent of moist montane forest removed per year may be considerably higher than this. The main causes of deforestation are shifting cultivation, fuelwood collection, fire, overgrazing, and logging.

The catchment forests serve three important functions:

- a. Regulate and conserve the water supply in the catchment area. Reduce runoff and soil erosion. This function is especially important in moist montane areas.
- b. Gene-pool conservation. Prevent extinction of rare and endemic plant and animal species in the diverse, moist high forests.
- c. Produce timber from indigenous species and supply forest products (e.g. medicinal plants) for local consumption.

Forests are often said to be renewable resources, but this is so only if they are managed in an ecologically proper way so that the amount of forest materials removed is balanced by regeneration and regrowth. The natural forests in important catchment areas will function best to capture and regulate the flow of water through an area if they are left undisturbed. The greater the degree of forest utilization on these areas (even if balanced by replanting and/or natural regeneration), the greater the disruption of water dynamics one expects to find. The goal of catchment forest management is to find a level and type of forest utilization which will not seriously or permanently disrupt the water dynamics of the catchment. Inherent in this is the development of silvicultural practice whereby the forest is regenerated in such a way that its ecological and commercial value is maintained.

2. Forest administration.

The forests in Tanzania can be grouped according to how they are administered:

A. Forest on public land. These forests are without any management. Anyone can use the area and the forest resources.

B. Registered (gazetted) forests, or Forest Reserves. Administered by the Ministry of Lands, Natural Resources and Tourism, Forest Division.

a. Production Forest Reserves (11 500 000 ha). Includes much miombo woodland.

b. Protective Forest Reserves (1 600 000 ha). This includes most of the forests commonly known as "catchment forests" (900 000 ha) and all of the catchment forests defined by the Catchment Forest Project (716 000 ha in Tanga, Kilimanjaro, Arusha and Morogoro). These two categories overlap, but not entirely.

c. Industrial plantations (74 000 ha).

C. Administered locally by the Regional and District authorities. Includes some of the forests commonly known as "catchment forests".

Gazetting of all catchment forests is an important first step to protecting them. Tanga region, for example, is losing good catchment forests that are not gazetted, due to cultivation and fuelwood cutting.

How the catchment forests are administered appears to be a central issue in how well and toward what goals the forests are managed.

The Regional Government and District Councils are deeply in need of funds and generate revenue by selling logging licenses for the catchment forests. It is a political aim to balance this with forest planting (for example, the Moshi District Council). The local administration is responsive to the short-term needs of the people in their districts (fuel, fodder and farmland) even though these may be in opposition to their welfare in the longer term (assured water supply and forest productivity).

3. Conditions in the Catchment Forest Project reserves.

Our group visited 11 Catchment Forest Project reserves and interviewed forest officers and others involved in the management and protection of the catchment forests. Our main impressions of the Catchment Forest Project reserves are as follows:

a. Mature trees of commercially valuable indigenous species are mostly logged out in many places.

b. Forest regeneration, either natural or by planting out nursery seedlings, is very limited. Many species (for example, the valuable indigenous timber tree loliondo) are difficult to regenerate naturally. As a result, forest regeneration after selective logging is often species-poor compared to the original forest. East African camphorwood (hereon called camphor) has been successfully regenerated to obtain nearly-pure stands (monocultures) of camphor. However, it is not clear whether this modified forest, which lacks shrubs, climbers and other tree species, retains the beneficial catchment properties of the original, diverse forest.

c. There has been a complete stop on issuing logging licenses in many of the reserves. However, there is considerable encroachment from the local people. Grazing and collecting grass from a belt along the inside of the reserve boundary prevents regeneration of the shrub and tree layers. In places people may even establish small cultivated fields (shambas). Usually the local forest officers manage to move the people out again. It is a more complex problem to prevent cutting of wood and fodder collection. It is at present very difficult to quantify the extent of encroachment.

d. The forest reserves are often small and fragmented. They are usually limited to the uppermost slopes and ridges. Frequently it is also the land use outside of the reserve, on the slopes below the reserve boundary, that determines streamflow and water quality at the base of the catchment area. The scope of watershed management should therefore be broadened to include management of these zones as well as protection of the catchment forests.

e. The local forest officers are aware of the importance of catchment forestry, but they are not able to carry out the management plans due to lack of funds. Some areas that are particularly weak at present are transport, guarding, boundary demarcation, enrichment planting, and silviculture. There is a lack of comprehensive management plans based on both inventory of commercial timber and ecological considerations.

4. Research and education.

Very little research has been done on catchment forestry. The emphasis has been on production forestry, especially in softwood plantations. Forest research is at present being reorganized. The Forest Research Institute is formally founded, but lack of funding has delayed administrative appointments, building activities, and starting-up of research.

Both higher and lower-level forestry education emphasizes softwoods and production forestry. Only a minor part of the coursework takes up natural forest.

III

RECOMMENDATIONS

To solve the problems of erosion and assure an adequate water supply in Tanzania will require a wide spectrum of forest management programs. Short-term approaches are necessary to protect the remaining forests on hillsides and mountains. Long-term approaches involve training, research, and reducing demand or finding alternatives for fuel energy, building materials, and animal feed. The increasing population press around the moist forest reserves need not necessarily lead to widespread deforestation.

Solutions to the problems must be many-sided: political, organizational, technical, and attitudinal. Inventory, planning, implementation, and funding are key elements to achieve the goals. The political basis for solving the problems is already present. It is official government policy to protect the forest reserves, manage the forest properly, and give top priority to ecological considerations such as catchment dynamics and erosion control. Because of this, the situation is much more hopeful in Tanzania than in many other developing countries.

Our recommendations are grouped in five categories:

1. Responsibility for forest management and administration.
2. Recommendations for the Catchment Forest Project.
3. Development of a watershed management program.
4. Research and education.
5. Mobilizing the local population.

Group 1 is concerned with present administrative and funding problems. Group 2 includes concrete, immediate tactics to protect the existing forest reserves. Group 3 and 4 are long-term programs to develop Tanzanian competency in watershed management. Group 5 concerns the human sides of the problem: how to involve and work with the local population in finding solutions to their need for water, land, fuel, feed, and building materials.

1. Responsibility for forest management and administration.

All forest in Tanzania is the property of the state, but the responsibility for forest management is split between the Forest Division of the Ministry of Lands, Natural Resources and Tourism, and the regional and district authorities. Large areas of forest fall under the category "public lands" and are not formally managed or administered by anyone. This includes large areas of miombo woodland and some areas of "high, dense" forest. All forests should be managed by one or another administrative agency, whose responsibility it is to see that harvesting of forest resources is followed up by planting if necessary and appropriate silvicultural practice so that the forest

regenerates.

The Forest Division should be responsible for all forest that is important from a catchment standpoint. This includes forest that controls erosion along rivers, hills, and mountainsides, that contains important timber resources, and that falls under the category "high, dense forest". There are many fragments of high, dense forest in Tanga Region, for example, that should be included in the Forest Division's Catchment Forest Project as soon as possible.

2. Recommendations for the Catchment Forest Projects.

A. Immediate projects.

a. Border demarcation.

In areas with high population, border planting projects must be given priority so that they can be completed as soon as possible. Border planting includes operation of nurseries, clearing the boundary line, transport of seedlings, planting, and tending according to the recommended silvicultural practice for at least 2 years. In areas with particularly heavy population pressure, it may also be necessary to plant a 10-50 m zone of fast-growing exotics from which fuelwood and poles can be harvested under the direction of the Forest Officer. At present there is far too little funding allocated for border planting. This has created problems with, among other things, purchase of plastic pots and transport.

b. Better patrolling.

More effective border patrolling can be achieved by increasing the forest guards' visibility, mobility, and authority. They need uniforms, boots, and bicycles. Their area of responsibility should be coverable in one day. Forest officers and possibly their assistants should report violations and the existing laws put into force.

B. Management of the Catchment Forest Project reserves.

Much work is needed to establish management plans for the forest reserves based on inventory, prioritizing, and reporting. This work should be begun at once, but the plans should take into account both short-term and long-term goals.

a. Inventory.

A standardized system of inventory should be developed. A program for inventorying the forest reserves should then be set up, giving priority to the most threatened reserves. The purpose of the inventories is to describe and map the prevailing conditions as a first step in the planning process. The inventory of each reserve should include aerial photo interpretation with field checking, vegetation description, and periodic assessment of the

most important stands using the "diagnostic plots" method. Vegetation types should be mapped in on base topographic maps for use in planning. Soil type and the most important soil characteristics (for example, certain hydrological parameters) should also be included in the inventory and mapped, when possible. The extent and consequences of various types of human impacts should also be included in the inventory.

b. Management plans.

A management plan based on the inventories should be drawn up for each reserve by the Forest Division. Large reserves can be divided into several smaller sections for management purposes. All plans for the Catchment Forest Project reserves should have the same basic structure. The management plans should include the following elements:

- Thematic map (e.g. of vegetation) on a base topographic map.
- Description of the climate and vegetation.
- The amount and species of commercial species. Current status from the inventory.
- Plans for cutting, including detailed information on harvesting sites, timetables, tree species, and volume to be taken out.
- Plans for replanting and silvicultural operations following cutting. Specification of who is responsible for these operations.
- Description of special precautions to be taken and/or restrictions on cutting along the reserve borders, at the upper and lower forest boundaries, on steep terrain, and in ravines.
- Plans for fire prevention and control.
- Plans for guarding and control of encroachment.

The management plans should be well-thought-out, specific documents that will cover a period of 5-10 years. They should include timetables, maps, and as much quantitative information as possible. This is necessary if the Forest Officers in the districts and on the reserves are to successfully carry out the plans. The national and district authorities should allocate increased funds for the development and enactment of the management plans. These funds should be supplemented by funds from international development aid.

c. Reporting system.

It is essential to develop an effective and standardized reporting system. This system will up-date information from the inventories and diagnostic plots, and supply the up-to-date information Forest Division must have to coordinate national forest planning. The information will also be useful for forest research. The following data should be recorded for each reserve:

- Precipitation. Recorded daily with simple equipment in each forest reserve.
- Water flow volume and turbidity in selected rivers and streams.
Forest Division should plan a program whereby the hydrologic status of particularly threatened catchment areas can be monitored. Forest Division should be responsible for supplying simple equipment and instructing forest officers on its use, and for determining where and how often data should be taken.
- Volume and species of timber removed. A rough estimate of illegal cutting (based on observation of new stumps, people's movement, etc.) as well as more accurate data on legal cutting should be reported monthly.
- Number and species of trees planted and follow-up silvicultural operations.
The status of afforestation programs should be described briefly in a monthly report.
- Road-building, fire, and other forms of forest disturbance. To be reported yearly with estimates of the affected area.
- Changes in the forest boundaries. The forest guards should report monthly on the status of the boundaries of their area, and this information should be passed on to the District Forest Officer and Forest Division.
This will provide information on the current area of forest, and will also hopefully lead to quicker action in response to serious encroachment and better evaluation of how effective the guarding is.

C. Strengthening the administration of the Catchment Forest Project.

It is necessary to strengthen the administrative organization responsible for carrying out the proposed projects. A special section or subsection (in Section for Development and Management) could be established within the Forest Division, or else a separate administrative structure for the projects could be formed. A project leader with a high level of competence in catchment forestry or watershed management

should be employed to coordinate the projects. This is especially important if watershed management projects are begun.

Foreign assistance to carry out the proposed projects should include an expert position in the Forest Division and Volunteers engaged in projects in the districts, as support to the Catchment Forest Project. These should have relevant background in forestry/environmental science, but the most important qualification is the ability to organize and lead practical work, to report, and to communicate with co-workers.

Scholarships should be given for study abroad in the fields mentioned to qualify Tanzanians in these areas rapidly.

D. New Catchment Forest Project in Iringa Region.

For some time there has been discussion of starting a new Catchment Forest Project in Iringa Region. Lack of funds has delayed its establishment. The project should be started as soon as possible. Large investments have been made in hydrologic power (Kidatu Dam) and water-dependent industry (Mufindi Pulp Mill) in this region. Protection of the forest reserves in Iringa is important, both to assure a future water supply for the population, power works, and industry, and to hinder erosion and prevent silting of the reservoirs.

3. Development of a Watershed Management Program.

It is not enough to have good management of the catchment forests themselves. The most difficult problems regarding water supply lie outside the forest reserves. A management plan for the entire catchment area should be established. We suggest that when the Catchment Forest Project in Iringa is begun, a watershed management program be started also. Working out this kind of plan can be difficult, and requires a competent, multi-disciplinary team. The experiences from Iringa can be useful when additional watershed management projects are begun. In the long term, watershed management of this kind should be an important part of the planning system in most areas of Tanzania.

4. Research and education.

The level of understanding of catchment forestry and water management in catchments is not good enough. Research projects should be begun to investigate the catchment properties of different forest types and the effects of various human impacts. The Forest Research Institute needs to get funds as soon as possible for staff, buildings, and equipment so that they can begin work on these questions. Stipends should be given that are earmarked for research and increasing competence within the field of catchment forestry.

Up to now, the teaching at the university and technical level has concentrated on production forestry, especially in softwood plantations. The natural forests' ecology, management, and role in catchments must be given higher priority, especially at the university level.

To meet the need for personnel trained in watershed management and soil erosion control, a new line of study in Environmental Science should be established at Sokoine University of Agriculture. Some areas of emphasis in the study line would be watershed management, soil erosion control, and rehabilitation of vegetation.

There is a great need for up-grading courses and adult education at several levels and within several fields in catchment forestry.

5. Mobilizing the local population.

The attitudes and involvement of the local population are factors that may determine the success or failure of a program to protect and improve the forest environment. The local authorities must work together with the local Forest Project regarding forest protection, land use, planting, cutting, and information. All efforts must be made to develop alternatives so that illegal cutting, grazing, and fires will be greatly reduced. It must be made clear that the local population bears the responsibility for protecting the resources.

IV

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- In the Forest Division, Ministry of Lands, Natural Resources and Tourism, Dar es Salaam: Assistant Director Mr. P.E. Kimariyo, Section Head B. Kessy, and Section Head Mr. S.B. Mbwana.
- Catchment Forest Officer Mr. O.R. Mndambi (Tanga), Forest Project Officer Mr. S. Rumbeli (Lushoto), Catchment Forest Officer Mr. S.W.N. Malingilla (Moshi), Forest Project Manager Mr. S.S. Kashenge (Arusha), and Catchment Forest Officer Mr. S.M. Mkwiza (Morogoro).
- Assistant Catchment Forest Officer Mr. R. Kajuna (Tanga), who was our guide on the field excursion.
- All of the people we met and talked with during our field excursion, including those listed in Appendix 3 and many others too numerous to list.

Two previous reports on catchment forestry in Tanzania were exceptionally useful to us as groundwork for this report:

- Lundgren, L. 1984. Catchment Forestry in Tanzania. A report prepared for the joint Tanzanian/Swedish review 1984.
- Tosi, Jr. J.A., G.S. Hartshorn, and C.A. Quesada. 1982. HADO Project Development Study and Status of Catchment Forestry, Tanzania. Tropical Science Center, San Jose, Costa Rica.

1

INTRODUCTION

Water supply and wood supply are in a critical state in many African countries today, including Tanzania. Water availability is Tanzania's major limiting physical factor for sustained social and economic development. It is a serious dilemma that the forests and vegetation that are essential in catchment areas to supply water to people, agriculture, industry and hydroelectricity, now are exploited by the same people.

Improper use of fragile environments usually causes erosion. Water is often the main erosive agent in mountainous areas. Deforestation of hills and mountains slopes causes erosion, loss of fertility and water resources degradation. In addition, siltation of hydroelectricity dams may become a serious problem.

The practical solutions to this problem are complex. It is not enough to create good management plans for the forests. The local people must have alternatives to meet their increasing demands for fuelwood and timber. The number of cattle and goats has to be reduced considerably to protect the vegetation. There is a chronic shortage of food in Tanzania and the population is expected to double in 20 years. Limited water supply is the main obstacle to increasing the food production.

1.1 Deforestation

Nobody knows the exact rate of deforestation in Tanzania. In 1981, the United Nations Environmental Programme in collaboration with FAO conducted a project under the Global Environmental Monitoring System and the project indicated that Tanzania is losing about 0.5% forest cover annually (UNEP, FAO, UNESCO 1982). This corresponds to about 190 000 hectares lost annually, mainly through shifting cultivation, fires, overgrazing and woodfuel collection (Mbwana 1983).

The Tanzanian Five Year National Village Afforestation Plan (Kaale, 1983) estimated fuelwood consumption and potential supply, and concluded that Tanzania will lose about 400 000 ha annually. Discussion of these figures at a recent symposium, however (Symposium on Use of Local Timber for Building Purposes, Arusha, Nov. 1984) revealed disagreement on the actual rate of deforestation.

Research is needed to determine the actual deforestation rate, but the need for action to reverse the trend of rapid deforestation is readily apparent.

1.2 Catchment Forest Project - Catchment Forestry

This study is concerned mainly with the Catchment Forest Project. These projects are a result of the Iringa Declaration

on Agriculture (Siasa ni Kilima) where both the political and government leaders realized the importance of intensive agriculture in dry areas by means of water irrigation schemes. It was directed that high forests be managed and improved as catchments. A National Project was established in 1976 with this goal.

The making and administration of management plans by the Senior Officers of the Forest Division requires certain basic information which today is gravely lacking. Some of the elements that can form the basis for successful catchment forestry are: a practical working forest classification system; information on the need for conservation tactics for various species and areas; and acceptable forest management strategies, including possibilities for enrichment planting with indigenous species.

1.3 Watershed Management

It is necessary to make good management plans based on inventory for each forest reserve. But it is not enough to have a catchment forest management plan. To solve the real problems, watershed management plans must be made. To demonstrate the possibilities of a "watershed approach", we have made a vegetation/landuse map for Himo watershed in Kilimanjaro Region. This map shows how inventory and aerial photography can aid in local planning.

1.4 Terms of Reference

The Terms of Reference is enclosed as Appendix 1. Only the primary goal is quoted here.

"The purpose of the study is to get the best possible base for the realization of a project with the aim of forming a plan for forest management and forest conservation and protection in the most critical water catchment areas in Tanzania. The study will reveal to what extent the existing data can be used; what is needed of supplemental investigations; how these can be carried out; how the necessary silvicultural and protection efforts must be formulated and implemented; in what way the management plan can be integrated in the national planning; necessary training and how the monitoring best can be set up."

2

FOREST IN TANZANIA

2.1 Climate

The vegetation of Tanzania belongs to several natural vegetation zones, due to variations in physical and climatic conditions.

Rainfall depends primarily on convergence between and within air streams. Two monsoons (low-level, moisture-bearing air streams) are recognized: the south-easterlies from November to April and north-easterlies from May to October. Rainfall over northern Tanzania is therefore biseasonal, and occurs when the direction of the prevailing wind changes. The heaviest rainfall is in March, with a lesser rainy season in October - November. Within Tanzania, however, there is considerable deviation from this pattern, both geographically and from year to year. The total annual precipitation also varies greatly, ranging from less than 500 mm in the driest part of the country (e.g., the Masai Plain) to over 2000 mm on the southeast side of Mount Kilimanjaro.

Temperature regimes are governed largely by altitude, with infrequent frost below 2 500 m. Monthly variation in temperature is small along the coast and relatively greater in the inland area. From observations in East Africa the following relations have been calculated (Lundgren 1978):

$$\begin{aligned} \text{Max.temp. (}^{\circ}\text{C)} &= 34.0 - 0.55 \times \text{altitude in hundreds of meters.} \\ \text{Min.temp. (}^{\circ}\text{C)} &= 24.5 - 0.64 \times \quad \quad \quad - \quad \quad - \end{aligned}$$

2.2 Vegetation. A short survey











No final classification system and terminology for natural vegetation have been generally agreed upon. For small scale maps (1:1 mill. or smaller) the classification and terminology used by Trapnell and Langdale-Brown (1969), which in turn is the synthesis of the classic works done by Greenway (1943. Published 1973) and Gillman (1949), seem to be the most accepted system. In this classification system the vegetation types are separated on the basis of their physiognomic characteristics (height, density, growth form, stratification, and ground cover). The different vegetation types are a result of the many ecological factors, mainly precipitation (or water availability), fire, temperature, human impact and soil. Lundgren (1975) gives a summary and discussion of the vegetation. Lind and Morrison (1974) and Pratt and Gwynne (1977) are recommended to those who want to know more about East African vegetation and ecology. Polhill (1968) gives a survey of the vegetation in Tanzania, including conservation value and status in some forest reserves. White (1980) and Knapp 1973 describe the vegetation in the whole of Africa.

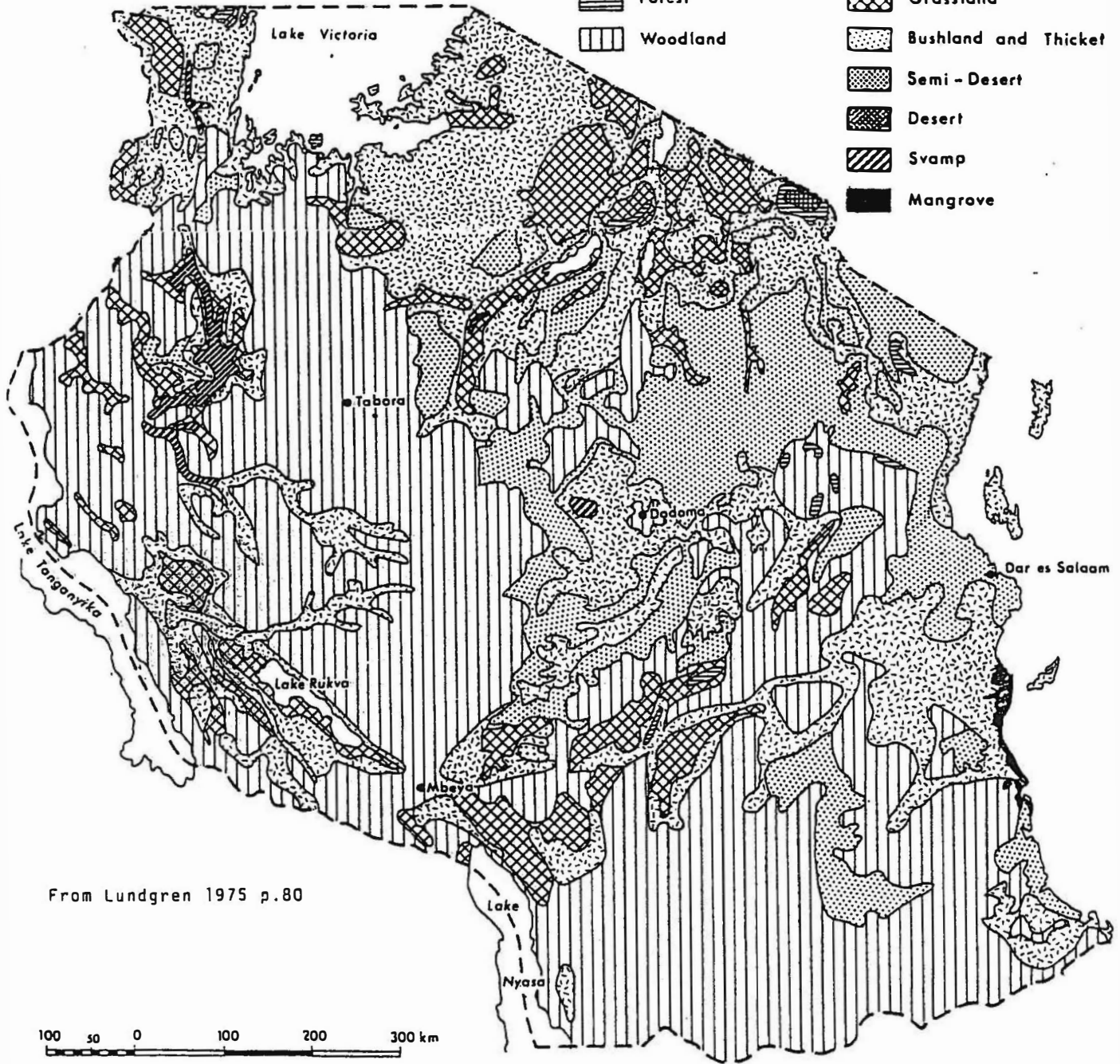
Closed canopy forest covers only about 1% of Tanzania's land area, but is the most important vegetation type from the standpoint of water management. Woodlands, having more open

Figure 1

VEGETATION

(After Langdale-Brown and Trapnell, 1969)

- | | |
|--|--|
|  Afro-alpine Heath and Moorland |  Savanna |
|  Forest |  Grassland |
|  Woodland |  Bushland and Thicket |
| |  Semi-Desert |
| |  Desert |
| |  Swamp |
| |  Mangrove |



From Lundgren 1975 p.80

canopies, cover a much larger area; the so-called miombo woodland type covers about 1/3 of Tanzania. Other types include coastal mangrove forest, bushland, thicket, wooded grassland (savanna), bushed grassland, grassland, swamp, afro-alpine heath and moorland. (see Figure 1) Only woodland and forest are mentioned here. More detailed descriptions are given for the locations we visited in Chapter 3.

2.2.1 Woodland

Woodland trees often reach a height of 18 m. Since they do not form a closed canopy, they are usually more branched than columnar. Miombo, the most extensive form of woodland in Tanzania, is dominated by the genera Brachystegia and Isoberlinia. Other variants are dominated by Combretum, Acacia, Commiphora spp., and in some places pure stands of Borassus palm may occur. A continuous groundcover of grass and herbs is present. Miombo occurs on well-drained red and gray hill soils with rainfall from 800 to 1200 mm per annum. The vegetation may be a fire climax. The forest yields some valuable timber (e.g., Pterocarpus angolensis) and is heavily exploited for fuelwood.

2.2.2 Forest

Several types of closed-canopy natural forest occur in Tanzania, most belonging to the upland and lowland evergreen types. The classification systems of forest are based on two gradients of change. The first is along altitude and the other is a moisture gradient. Different terminologies are used and the authors mentioned above do not always agree. Backeus (1982) summarizes and discusses the different systems.

Upland (montane or highland, but not always synonymously)

evergreen forest is the most important type of catchment forest and occurs at elevation of 1300 - 3000 m on Mt. Kilimanjaro, Mt. Meru, Usambara Mts., Pare Mts., Uluguru Mts., and Southern Highlands. Annual rainfall in these forests is normally greater than 1000 mm and the soils are relatively fertile. Important species in moist or wet upland forest include Ocotea usambarensis, Podocarpus, Rapanea, Olea, Aningeria, Pygeum, Croton, Albizia and Macaranga species. On drier sites, e.g., in rain shadows, Juniperus procera, Podocarpus, Olea, Nuxia, Dombeya and Cassipourea dominate. Hagenia abyssinica, Hypericum, and mountain bamboo (Arundinaria alpina) often occur from the upper forest limit and merge into the Ericaceous belt above 2500 to 3000 m.

The intermediate and lowland forests are of very limited extent due to shifting culture and population pressure. These forests are of great phytogeographical interest as indicators of the previous, wider distribution of lowland rain forest in East Africa. They are very rich in species. Important species in East Usambara Mts. are Cephalosphaera, Allanblackia, Isoberlinia, Newtonia and Parinari. Dry semi-deciduous and evergreen types are found in flat coastal plains in the north-east and on the lowest slopes of some inland mountains

and on the Makonde Plateau. Evergreen forest types encompass small areas with groundwater and riverine (riparian, gallery) forest along rivers and streams. They are edaphically controlled forests like the semi-swamp forest in Bukoba District and the mangrove forest on the coast. Mangrove forests are also heavily exploited and threatened.

2.3 Area of the forest and forest estates

Land classified as forest land in Tanzania covers about 440 000 sq.km or 45% of the total land area. The forest area depends on how we define forest land and the estimates may be uncertain.

Table 1 shows the area of the official forest reserves (Figure 2) and the total forest area. It is important to notice that closed forest covers only 7.1% of the forest reserves, 2% of the total forest area, and slightly under 1% of the total land area.

Table 1 INDIGENOUS FOREST TYPES IN TANZANIA
(after Mbwana 1983 and Mlowe 1984)

Type of forest	Area in Official forest reserves (ha)	Total area (ha)
Closed forest (incl.rain forest)	951 886	936 000
Woodland (mostly miombo)	11 375 685	32 641 000
Intermediate woodland (grassland)	945 759	10 714 000
Mangroves	81 795	80 000
Total	13 355 125	44 371 000

Only about 12% (1 602 600 ha) of the forests in reserves are set aside for watershed management. Most of the forest reserves with closed forest (951 886 ha) are included in this percentage.

2.4 The plantations

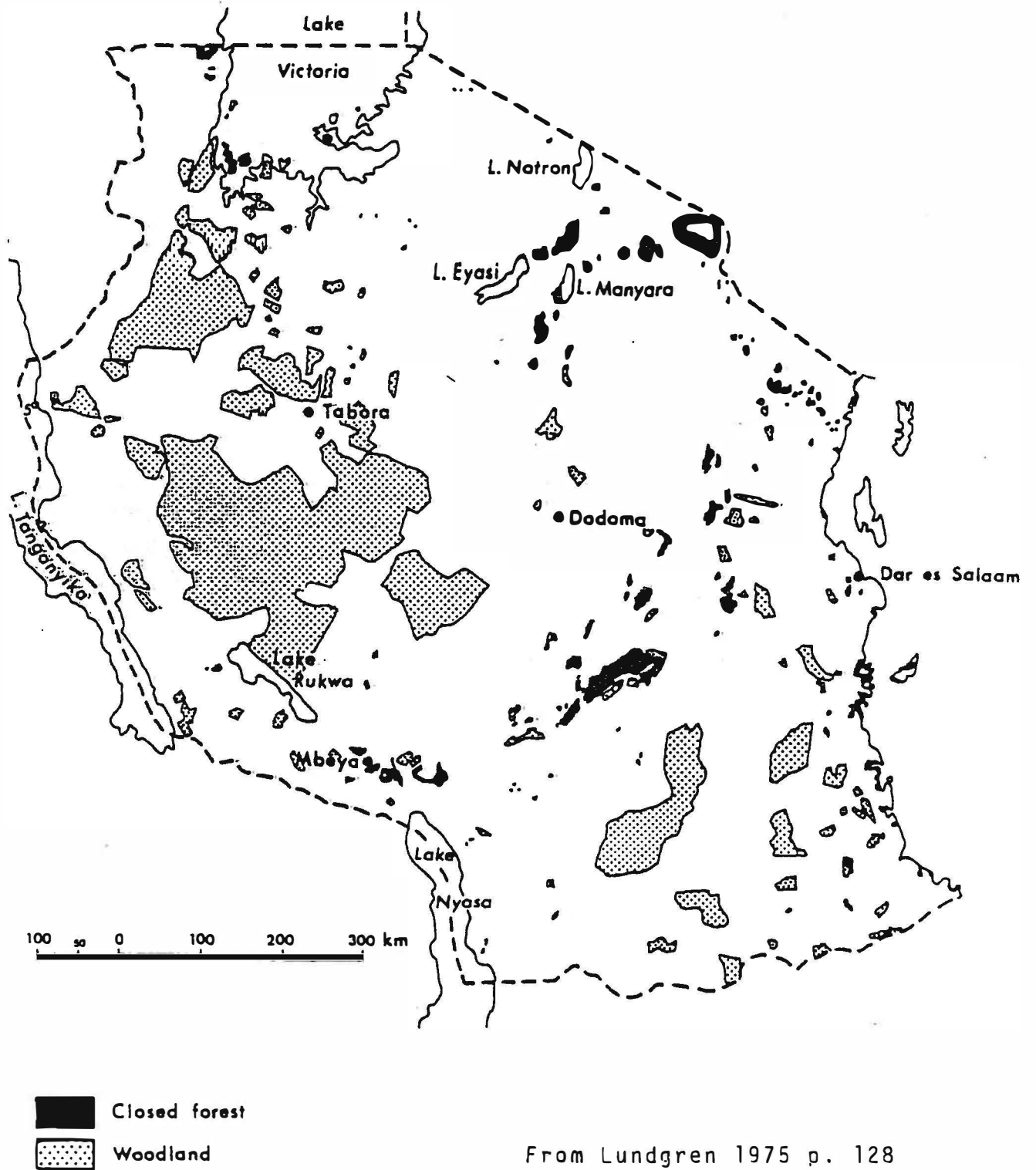
There are fifteen plantation projects, presently covering a total of 70 000 ha. The annual planting target for the next five years is 7000-8000 ha.

The main species are Pinus patula, P. caribaea, P. elliottii, Cypressus lusitanica and Tectona grandis. The planting of indigenous species on a larger scale is still at the experimental stage. Species involved are Chlorophora excelsa, Pterocarpus angolensis, Cephalosphaera usambarensis and Dalbergia melanoxylon.

Figure 2

FOREST RESERVES

(After Atlas of Tanzania 1967)



From Lundgren 1975 p. 128

2.5 Fuelwood plantations and village woodlots

There are 8 000 - 10 000 ha of fuelwood and woodlots. We have insufficient information and statistics about these forests. These resources are meagre compared with the rapid population increase, and there have been many problems associated with these forests' development and management. The information for section 2.4 and 2.5 was taken from Mlowe (1984).

2.6 Forest outside forest reserves

Of the total forest area, as much as 310 000 sq.km (approx. 70%) is not included in any forest reserve. Most of this is miombo and other woodland types, but some is closed, high, indigenous forest on mountain sides and on hills without any kind of administration or management plans. The most valuable forests, in the sense of catchment properties and timber, should soon obtain reservestatus.

2.7 Proposals for classification of the forest reserves

In order to manage forest resources optimally both in terms of production and ecology, it is necessary to have a good quantitative and qualitative description of the forests on a national and local scale. The forests must be measured and classified according to a suitable system. The concept of "forest reserve" is used in Tanzania to refer both to forests that are to be exploited and those to be conserved. The concept needs to be clarified. The reason for this is that there is increasing conflict between the different management goals. The management goals for each reserve must be prioritized according to what is ecologically defensible. The forests may be divided into three groups:

1. Conservation forest reserve

Biologically important forests that contain rare plants, trees, vegetation types, or animals/animal communities that should be protected either nationally or internationally. These are most often forests with high diversity. In Tanzania, these forests often contain many endemic species. These are species with limited geographic distribution and isolated evolution due to physical barriers that prevent migration or exchange of genes with nearby species, subspecies, or varieties. These forests contain large and irreplaceable genetic resources (gene-pool). Many calculations have been made as to how many species are on the verge of extinction partly because of, among other things, habitat destruction. There are many indications today that 15 - 20% (500 000 - 2 000 000) of the earth's estimated number of plantspecies will disappear total by the year 2000. (The Global 2000 Report to the President from Council of Environmental Quality 1980.). Ashton (1978) says that the minimum area of a given piece of undisturbed tropical forest necessary for effective conservation of tropical species is 2000 ha. Lundgren (1984) notes that forests in Uluguru, Usambara, and Uzungwa are on the International Union of Conservation of Nature (IUCN) and World Wildlife Fund (WWF) short list of priority

projects for its Global Forest Conservation Program.

2. Catchment forest reserves

These forests are important in watershed management. They are often located on mountain- and hillsides. The first priority in management is to protect and/or rehabilitate good catchment properties. Cutting may be allowed where the negative consequences are acceptably small and silvicultural practices are good.

3. Production forest reserves

These forests contain commercially important tree species, and logging may be allowed when efforts are made to reduce the environmental impact and when cutting is followed up by proper silvicultural management. It is important to have good inventories and management plans for these forests. These forests are normally also important as catchments and may be in danger of or may already have high rates of erosion. This must obviously be taken into account in the management plans.

Ideally, all forests, including miombo and other woodland types, should be classified into these three groups. Other uses of the forests, (for example, conversion to cultivation) would require a formal reallocation of the forest based partly on ecological criteria. The forests presently in greatest need of classification are the high, closed forests on mountain- and hillsides, but groundwater forest, lowland forest, and mangrove should also be classified. It is unrealistic to expect that one could complete a national inventory and survey before classifying the forests.

In groups 1 and 2, especially, one should begin by using experts with experience in Tanzania, together with descriptions in reports and published literature, to select the forests. It is advisable to be quite restrictive in the classification now, with the thought that some of the forests could later be released for other uses when one has a better overview and experience with different types of management.

3

C A T C H M E N T F O R E S T R Y

3.1 Definitions

When discussing the value and management of water catchments, one must first define a few commonly used terms. These definitions are based on Tosi et al. (1982 pp. 74-78).

A catchment or catchment area is used about the land surface from which water flows to a given watercourse. Water quality and water balance are often analyzed for a given catchment area.

Catchment forestry is the management of forest resources to enhance the beneficial uses of water resources generated within the catchment. It is a basic component of watershed management.

Watershed management is the wise use of soil, climate and vegetation within a given catchment area in order to achieve maximum precipitation and minimum runoff. Watershed management deals with distribution of water in time and space, water quality, and soil water storage.

3.1.1 Catchment forest

In a wide sense every forest may be called a catchment forest since all forest plays a role in water balance of some watershed. Slightly less than 1% (900 000 ha) of the total land area in Tanzania is covered with closed, high, indigenous tropical forests. These occur at intermediate to high elevations, and are commonly referred to as "catchment forest" in Tanzania. 12% (1 602 600 ha) of the forest reserves are set aside for watershed management (Mlowe 1985).

The German administration (1888-1920) was the first to establish the principle of catchment forestry in Tanzania to protect the water catchment areas. Even then, the importance of forests as water sources in the drier areas was evident. The British administration (1920-1961) followed up by protecting the catchment forests. After independence, many forest areas were converted to cultivation or deforested. Now, however, protection of the most important water catchment areas is one of the three main objectives in the government's forest policy (see Appendix 7).

3.1.2 Objectives of catchment forestry

The catchment forests serve three main functions:

- A. Water conservation and watershed management. The catchment forests are important to regulate runoff, prevent soil erosion, and assure a good water supply to human populations at the base of the catchment area.
- B. Gene pool conservation. Tropical moist forests are diverse and contain many endemic species. Forest conservation can

prevent extinction of rare plant and animal species.

- C. Production of timber from indigenous species and other forest products (e.g. medicinal plants) for local consumption.

3.2. The Catchment Forest Project

The rapid population growth in Tanzania in recent years has put great pressure on the forest resources. In the West Usambara Mountains, for example, the population has increased from 15 000 in 1900 to 286 000 in 1978 (Lundgren 1978), and these mountains have been largely deforested as a result.

The Iringa Declaration stated that water resources from the high forest are essential for any kind of intensive agriculture in the drier areas. Following up on this, the government and political leaders established a National Project in 1976 to manage the catchment forests both properly and efficiently (Kashenge 1984). The original Catchment Forest Project included many of the most important catchment forests in four regions, and was divided into four regional projects, called the Catchment Forest Project for Arusha Region, Kilimanjaro Region, Tanga Region, and Morogoro Region. Plans also exist for establishing a Catchment Forest Project for Iringa Region, but lack of funds has delayed its establishment. The four existing Catchment Forest Projects are based on management plans where the main objects is to protect the forests' "catchment properties".

Synopsis of the Forest Reserves included in the Catchment Forest Projects.

We have not located any up-to-date and complete list of the forest reserves included in the Catchment Forest Project. We have, however, made such a list by combining and adjusting two previous listings according to information we got from the Catchment Forest Officers (Table 2 and Appendix 4). The two previous lists are the review of forest reserves in Lundgren (1984) and the Forest Division's List of Protective Forest Reserves (given to us in December 1984). It is difficult to make an accurate list of the reserves and their areas due to the following conditions:

1. The status of the reserves may change. Recently, many have gone over from administration by Forest Division to administration by the District Council or regional authorities.
2. The area of forest in some reserves may be so reduced that they are now described as "not existing".
3. There is confusion between the generally used term "catchment forest", and the Catchment Forest Project reserves.
4. There are several conflicting lists of the forest reserves and their areas.

5. Some of the reserves have been divided up and/or changed name.

Our adjusted list is based primarily on Lundgren (1984), but we have substituted information from the Catchment Forest Officers where there was disagreement. We got written information about the reserves in Arusha and Kilimanjaro regions, and oral information in Tanga and Morogoro. Appendix 4 includes Lundgren's list, the Forest Division list, and our adjusted list of the reserves and their areas. In addition, a few notes are made about changes in status, encroachment, and other special conditions. Table 2 gives the total area of the reserves in the four regional Catchment Forest Projects. Our estimate of total area in the reserves is 28 505 ha (about 4%) less than Lundgren's. The area of reserves in the Morogoro Catchment Forest Project shows an increase, but the area of reserves in the other 3 regional projects decreased.

Table 2 Area of forest reserves in the four regional Catchment Forest Projects.

Catchment Forest Proj.	For.Div.84	Lundgren 84	Adjusted Dec. 84
Arusha	241 386	145 767	122 704
Kilimanjaro	102 892	135 292	132 954
Tanga	86 920	88 724	75 870
Morogoro	369 556	374 868	384 618
	800 754	744 651	716 146

3.2.2 Classification of impacts on Catchment Forest Projects reserves

1. Legal human activities. Licenses and permission are given by Catchment Forest Officer.
 - a. Logging 1) to sawmill and 2) pit-sawing.
 - b. Fuelwood cutting. Only cutting of dry wood is normally allowed.
 - c. Grazing or collecting fodder for cattle or goats.
 - d. Beehunting/honey collection.
 - e. Collecting medical herbs/roots.
2. Encroachment. Illegal human activities.
 - a. Cutting fuelwood.
 - b. Logging for private use or illegal sale.

- c. Grazing or collecting fodder for cattle or goats.
- d. Cultivation 1) extra patch of field,
2) establishing shambas or 3) growing specialty crops
such as cardamom.
- e. Fire 1) beehunting (driving out bees to collect honey,
2) gamehunting (fire used to frighten animals and clear
grazing land) or 3) clearing fields for cultivation or
grazing land for cattle.

3. Impacts from animals.

Animals, particularly elephants and buffalo, graze on leaves, small branches and bark in some of the forests. Young trees are often heavily grazed and this can do a great deal of damage to the forest.

3.3 CATCHMENT FOREST PROJECT - TANGA REGION

The project is administered from Tanga, but most of the project reserves are located in the West Usambara mountains and the smaller mountain area in the East Usambaras. Previously established Forest Projects are also engaged in patrolling and managing catchment forest. This applies to:

Magamba Forest Project, Lushoto District in West Usambara, which is independently responsible for six reserves with an area of 29 249 ha.

Longuza/Kwamkoro Project, Muheza District in East Usambara, which is assigned to Kwamkoro Forest Reserve for patrolling and management. It is administered from Tanga. The project is a center for several reserves.

In addition to these projects, we also visited Lutundi Forest Project in Korogwe, which is administered direct from Tanga.

A summary of the reserves in Tanga Region is given in Appendix 4. Lundgren (1984) gives a total area of 88 724 ha, whereas our information indicated an area of 75 870 ha. This is a decrease of 14%. Eight previous forest reserves do not exist any more either as reserves or as forest. We don't know exactly how much has become farmland or grazing land, but it is probably a significant amount. Mtumbi Forest Reserve (304 ha) has been transferred to the District Council.

The forest vegetation in the area is very species-rich, and varies in structure and floristic composition according to the precipitation and altitude. The forests are among the best-described in Tanzania. Polhill (1968) reports 150 woody species that are endemic to the West Usambara rain forest. Rodgers and Homewood (1982) reports additional endemic and rare plant and animal species in these unique forests. The higher-lying areas in these forests act as cool and moist islands surrounded by warm, dry plains. Plants and animals evolve in isolation from other areas, and the number of endemic species is high. The area is therefore important as a gene-pool resource.

3.3.1 Lushoto District - Magamba Forest Project

3.3.1.1 Topography, climate, and vegetation

The forest reserves cover portions of the ridges and hillsides from 1600-2400 m. Land lying outside of the reserves is mostly cultivated. Large areas are badly eroded.

Precipitation varies widely within the area. In the rain forest it is from 1000-2000 mm. The northwest area lies in the rain shadow of the mountain and receives significantly less rainfall. Readings taken at Lushoto by the German Tanga Integrated Rural Development Programme (TIRDEP) and Soil Erosion Control and Agroforestry Project (SECAP) show that rainfall has decreased by 25% during the last four years.

About 85% of the annual precipitation falls during the two rainy seasons. Maximum temperature is relatively low (26.5°C), and the minimum temperature in August is 7°C. Frost occurs in the valleys in the higher-lying areas. Only Mazumbai Rain Forest Reserve (400 ha) in the southeastern part of Lushoto District is protected from all disturbance, being donated to the University of Dar es Salaam. The reserve is one of the few remaining undisturbed mountain forest areas (although there has been a little logging the last 80 years). It is considered one of the best examples of midelevation rain forest (1200-1900 m) in Africa. The forest is protected for research and educational purposes, and is a reference area for studying catchment dynamics, water balance, and runoff from natural rain forest.

Major forest types.

Most of the forest is at an elevation of 1600-2400 m. Many systems for classifying the forests have been proposed. These are summarized in Backeus (1982) and Lundgren (1976), the latter of which describes the soil and climatic conditions in detail.

Moist montane forest.

East African camphorwood forest is dominated by the camphor tree (Ocotea usambarensis), which is also the most economically important tree species. At lower elevations Macaranga kilimandscharica, Syzygium guineense, Rapanea spp. and Chrysophyllum spp. are common, whereas Podocarpus usambarensis and P. milanjanus are more common at higher elevations. Other common species include Entandrophragma spp., Newtonia buchanaui, Ficalhoa laurifolia, Albizia gummifera, Cassipourea malosana, Olea hochstetteri, Parinari excelsa, and Fagaropsis angolensis.

Ocotea-Podocarpus forests can be further divided according to the structure and composition of the bush layer and ground flora. At least three types can be distinguished: one almost lacking ground cover, one dominated by members of the family Acanthaceae, and one wet type having a thick cover of balsam (Impatiens spp.).

Ocotea, Ficalhoa, Podocarpus, and Syzygium, which occur mostly on hillsides, and Chrysophyllum, Newtonia, Parinari, and Albizia, are more common in valleys and along rivers.

Dry montane forest.

African pencil cedar forest is dominated by Juniperus procera. This forest type is poorly described and occurs as small stands in the drier areas of Shume Magamba Forest Reserve. Stands of pencil cedar forest lying outside the reserves are either totally cut over or greatly reduced by cutting, grazing, and cultivation.

3.3.1.2 Management of the Magamba Forest Project.

The Forest Project Officer has developed a management plan

which covers the period 1981-86.

Heavy emphasis is placed on regeneration of camphor in this project. The main objectives of the project are as follows:

1. Regeneration of camphor.
2. Protection of the forest as a catchment area.
3. Controlled logging of mature trees.
4. Logging, planting, and proper silvicultural management of softwoods.
5. Production of tannin for dye from the bark of black wattle (Acacia mearnsii).

3.3.1.3 Camphor regeneration.

East Africa contains only three stands of camphor forest that are large enough to be logged commercially: on Mount Kenya and Mount Kilimanjaro, and in the Usambaras. These stands are already under heavy pressure. In addition, camphor appears to regenerate very poorly under the present forest conditions. The mature stands that exist today became established under different conditions than those that prevail today. Camphor seeds rot very rapidly, and are a choice food item for many insects and larger animals. Even in good seed years, the seeds rarely germinate and become established in the forest, and they are also difficult to germinate in nurseries. Young shoots are grazed upon by many types of animals.

Camphor regenerates willingly from stumps and roots, but careful management is needed to establish a new stand by vegetative reproduction. Bushes and vines must be cleared away and economically less important tree species killed by ringbarking. Trees that are allowed to stand include, in order of their desirability, camphor, Podocarpus, Ficalhoa, Pygeum africanum, and Entandrophragma.

The goal in Magamba Forest Reserve is to regenerate 8 900 ha of the total area of 29 000 ha as a relatively pure stand of camphor. 3 000 ha has been regenerated so far. The effect of this management on the forest's catchment properties has not been investigated. The project leaders feel that it has little significance. A note on camphor regeneration written by the Forest Project Officer is included as Appendix 5.

3.3.1.4 Mkusu Forest Reserve, Compartment 4.

Our estimate of the area of this reserve is 3 674 ha, compared to 7 360 by Lundgren (1984). The reason for the large difference is unclear. The reserve is divided into compartments, and the emphasis is on camphor regeneration.

The compartment we visited was almost a pure stand of camphor that was columnar, 20-25 m high, and 20-50 cm in diameter. Bushes, vines, and less valuable tree species had been removed. The project staff would like to continue with regeneration,

tending, and enrichment planting, but lacks funds. The forest will be harvestable in 40-50 years (camphor is harvestable at 70 years age). A local sawmill was closed down in 1953.

3.3.1.5 Ndelemai Forest Reserve.

Area: 1 422 ha. Camphor-Podocarpus forest. Logging was discontinued in 1980 and it will be about 15 years before the reserve will contain harvestable trees.

3.3.1.6 Balangai Forest Reserve.

Area: 988 ha. Heterogeneous forest with several important timber trees besides camphor. Large individuals of Entandrophragma stolzii are presently cut by pit-sawyers. Five licenses are given per 45 days, and each license gives the right to fell from 1-5 trees.

When a large tree is felled, several smaller trees also fall and a forest opening of 1 000-3 000 m² is created. When 2-5 trees are felled at the same spot, an opening of 0.5 ha may result. These openings are quickly colonized by a thick bush and herb layer (for example, Impatiens spp.).

3.3.1.7 Shume Magamba Forest Reserve.

Area: 12 276 ha, 500 ha of which is softwood. We visited the pine plantations in the Shume Forest Project, which are under separate management. This area is managed intensively. After cutting, the area is burned and replanted. Local farmers are allowed to grow potatoes, beans, and maize for several years after burning and replanting.

3.3.1.8 Discussion and evaluation.

Harvestable forest:

We visited relatively small areas, but got the impression that camphor is largely logged out. Mr. Goebel, a forester with TIRDEP/SECAP, thought there would be little to cut in the next 40-50 years. He felt that the current level of legal pit-sawing of other species was not great enough to destroy the forests, even though the composition of the forests would change somewhat. He was more worried about the cutting of softwoods and the concomitant dangers of erosion and leaching there.

It is essential that logging be followed up by management for renewal of the forest. Adequate funds must be given for silviculture.

Encroachment:

According to the Forest Officer, encroachment in the form of illegal logging and grazing is not significant. Mr. Woytek from TIRDEP/SECAP was of the opinion that there was considerable illegal cutting; vehicles loaded with timber had been seen driving out to Tanga at night. Signs of grazing can be found in the reserves, and we saw cattle tracks leading from

the road into the forest. Some illegal fuelwood collection occurs.

Patrolling:

It is impossible for the Forest Project Officer with assistants and forest guards to patrol the entire area.

Border demarcation:

The Forest Project Officer emphasized the need for border plantings. Lack of funds is stopping the current plans for border planting from being carried out. People can enter the reserve areas unawares when they are out collecting firewood due to the poor boundary marking.

Funds and equipment:

The project lacks funds for border planting, camphor regeneration (with clearing and ringbarking), and enrichment planting.

3.3.1.9 Forests outside of the reserves.

The population increase in the West Usambara mountains has been enormous (15 000 in 1900 and 286 000 in 1978). This is somewhat higher than the annual population growth rate of about 3% for Tanzania as a whole. The population pressure has led to much clearing of forest for agriculture, cutting for fuelwood and timber, and conversion to grazing land. As a rule only small remnants of forest are left on the ridges and steep hillsides. Agricultural fields are planted higher and higher on the hillsides. Serious erosion problems are evident, and much of the rainfall (especially the intense cloudbursts) runs off the surface, carrying away soil and nutrients.

Population pressure has also resulted in the release of previously protected forest reserves to supply the people with fuelwood, timber, and agricultural land. For example, 12 000 ha of Shume Magamba Reserve were released in 1963. Ten years later the area was completely deforested and had serious erosion problems. Deforestation and erosion are particularly serious in the drier areas toward Malibwi, Mbwei, and Mlola. The German Agency for Technical Cooperation (GTZ) has conducted a very comprehensive and promising project on soil erosion and agroforestry in this area. Among other things, the project has produced scientific reports on natural history (with maps), agroforestry, and social anthropology. A short outline of the project, from TIRDEP/SECAP, is reproduced as Appendix 6. This type of project is important, not least because it seeks to find alternative resources for the people in an area when restrictions are made on the use of natural forest.

3.3.2 Muheza District - Longuza/Kwamkoro Project

The Forest Reserves in this district are administered from the office in Tanga, but the Longuza/Kwamkoro Project is a center for several of the reserves in the East Usambara mountains.

The project is located in Longuza at the foot of the southern side of the mountain area 17 km from Muheza on the way to Amani. There are no management plans for these Catchment Forest Project reserves.

3.3.2.1 Topography, climate, and vegetation

The East Usambara mountains rise 1 000-1 200 m above sea level and are separated from the West Usambara mountains by the Lwegara Valley. The range is divided by valleys at differing elevations, with varying degrees of slope on the valley sides. The area is densely populated, and cultivated fields are found on the valley sides all the way up to the reserve boundary.

Precipitation varies with elevation and exposure to the prevailing winds. Most of the area receives 1 300-1 500 mm distributed over two rainy seasons. During the dry season rainfall is less than 40 mm per month. The vegetation is not as well described as in the West Usambara mountains. Following the elevational gradient from Longuza to Amani, one can summarize the vegetation types as follows: 150-400 m: Teak plantations (Tectona grandis). Natural forest with Khaya nyasica (African mahogany), Terminalia spp., Antiaris toxicaria, Chlorophora excelsa, and others. Well supplied with flowing groundwater from higher-lying areas. 400-800 m: Heterogeneous, species-rich forest. Includes a botanical reserve with no exploitation. 800-1 050 m: Allanblackia stuhlmannii, Maesopsis eminii. Maesopsis, originally from Bukoba district, was first planted in 1912 and now regenerates naturally. There is very little continuous forest area below 400 m elevation. The hillside forests are also often discontinuous, with agricultural land between the forest stands.

3.3.2.2 Longuza/Kwamkoro Project

The project is responsible for patrolling and management of Amani Sigi, Kwamkoro, and Kwamsambia Forest Reserves in addition to plantation forestry. The Longuza project lies at an elevation of 150-400 m, and consists of 9 106 ha, of which 2 036 ha are planted: 1 743 ha with teak, 237 ha with Terminalia, and the remainder with various other species. The project has its own nursery, which is in good condition, but lacks funds to buy plastic pots for seedlings. The last good planting year was 1979. They produce mainly teak, Terminalia, and some Eucalyptus. They have a good supply of seed produced at the nursery. The seedlings are watered twice a day with water flowing down from the higher-elevation rain forests. During the dry season there is a shortage of water, which is then pumped up from a nearby river. Teak and Eucalyptus are now planted along the boundaries (the Project is considered a forest reserve), while Terminalia is planted along rivers to protect against erosion. 91 people are employed by the project.

3.3.2.3 Cardamom and encroachment

A special kind of encroachment has developed in the East Usambara mountains. Cardamom requires moist and shady conditions. By clearing the bush and ground layer in the upper

part of the moist forest (above 300-400 m), ideal conditions for cardamom are created. Cardamom is a valuable cash crop, and is sold for about 80 Tsh per kg. Local growers illegally clear the bush layer in the forest and plant cardamom, often with banana. This is frequently the first step in clearing and burning the forest for cultivation. The forest authorities take this form of encroachment seriously, and have repeatedly cleared many areas of illegal cardamom. Frequently the growers return and replant.

3.3.2.4 Amani Sigi Forest Reserve

Area: 1 141 ha. Elevation: 200-500 m. Near Matombo village, the forest reserve boundary lies quite high up on a hillside. Below the boundary is a deforested zone of public land that has been cultivated. Below this is a teak plantation. Efforts are being made to lower the forest boundary, but people must then be moved out. In cooperation with the local political authorities, and with support from the Government, people are being moved to a nearby village. The area will then become part of the reserve and will be planted with Terminalia ivorensis, Cedrela odorata, and the oilseed tree Trichilia emetica.

The pit-sawyers are licensed to fell Chlorophora excelsa and Khaya nyasica. 50-60 cubic meters of trees greater than 2.2 m diameter are logged legally each year. The timber is transported 68 km to Tanga with trucks. Illegal cardamom cultivation is a big problem in this reserve. The growers have been escorted out several times, but they come back. The violators are not legally prosecuted. Bananas are also planted illegally within the reserve boundaries. Fires, grazing, and illegal cutting are not serious problems. The reserve lacks an up-to-date, usable management plan. Cutting is not followed up by planting or silvicultural management.

3.3.2.5 Kwamkoro Forest Reserve

Area: 2 260 ha. Elevation: 800-1 000 m. Montane rainforest. 703 ha have been logged and replanted, mostly with Cephalosphaera usambarensis and Maesopsis eminii. Newtonia sp., Parinari excelsa, and Allanblackia stuhlmannii are also common. A sawmill owned by TWICO has been operating within the reserve for 15 years. All timber is sawed here. There is an area near the sawmill that was clearcut 8 years ago and replanted with Maesopsis. It appears to be well managed. Otherwise there is very little regeneration or silvicultural management of logged areas. Logging is mostly selective cutting of the most valuable species.

Encroachment to grow cardamom and establish shambas is a great problem here. There is very little grazing and fire.

3.3.2.6 Lutundi Forest Reserve - Korogwe District

Area: 2 176 ha. Elevation: 800-1 000 m. Montane rain forest on the ridges with Chlorophora excelsa, Newtonia buchanani, Cephalosphaera usambarensis, and Khaya nyasica. Heavy growth of epiphytes, sparse bush layer. Precipitation about 1 500 mm annually.

There is no commercial cutting in the forest, except for a little pit-sawing. Encroachment is a serious problem here. Cardamom and banana-growing have developed to the point that agricultural fields are established in the reserve. About 1/3 of the reserve's area is cultivated, and about 100 people are engaged in farming within the reserve. No houses have been built within the reserve. Forceful eviction will be required to move the farmers out.

Fire is also a big problem. Fires are often started at the reserve boundaries to clear land or drive out game. Large areas of the reserve have been converted to grassland because of fire, and if this trend is allowed to continue the entire reserve will be deforested within 5-10 years.

The forest is an important catchment area for the river Hundu which supplies water for rice irrigation. Widespread deforestation has occurred during the last few years due to the population pressure. Erosion is not a particularly serious problem at this point.

The existing management plan is old and unusable. One forest guard who lives in the nearest town, Kwakole, is responsible for guarding the entire area. He patrols the reserve once a week, and the Forest Officer from Tanga visits the reserve 1-2 days every other month. In 1975-77 they tried to move out the cardamom growers, but this worked only temporarily. There has been no legal prosecution for the illegal activities.

The Catchment Forest Officer believes the people in the area understand the dangers of deforestation and of, for example, cardamom growing. They would be willing to participate in planting projects if they were properly organized.

3.3.2.7 Discussion and evaluation

Harvestable forest:

It is difficult for us to evaluate how cut-over the areas are. We got the impression that legal cutting was under control within the reserves but that logging outside the reserves was uncontrolled and destructive.

Encroachment:

Very serious, especially in Lutundi, where cultivation and fire had claimed large areas of forest within the reserve. Amani Sigi and Kwamkoro also had problems with cultivation, but there was better control there and they had managed to move people out again.

Patrolling:

Not at all sufficient to prevent encroachment. Moving cultivators out of the reserves is also very difficult, since it creates bad relations between the local people and the forest guards. Violators should be reported more often to the authorities.

Border demarcation:

The borders of the reserves need to be made more visible by planting exotic tree species.

Funds and equipment:

The forest guards lack equipment and transport. Lack of funds for plastic pots (among other things) has seriously hindered planting efforts. Both border planting and enrichment planting should be given high priority for funding and equipment.

3.3.2.8 Forests outside of the reserves

There are significant areas of forest outside the reserve boundaries, but they are being rapidly deforested. No one has responsibility for these forests, and the hillsides are being cut and burned to make new agricultural land. One can often see sugarcane, bananas, or maize growing among charred stems of good quality logs that are simply left lying on the ground. Significant amounts of timber are cut commercially outside the reserves. There are 8-10 important species in the forests at 1 000 m elevation. We visited an area near Kwamkoro that had been logged for Cephalosphaera, Newtonia, and Allanblackia. A 1-2 ha area had been rather thoroughly razed by bulldozers and trucks. The bush and ground layers of vegetation were also severely damaged. Bananas and cardamom were already planted among the logging debris. Normally this kind of cutting is not followed up by planting or other management to bring back the forest.

3.3.3 SUMMARY - TANGA REGION

East Usambara

- Extensive deforestation on public lands
- Catchment Forest Project reserves lack management plans
- Extensive encroachment within the reserves. The project is not able to enforce the laws. Few violations are reported.
- The hillsides are being deforested and cultivated. Increased risk of erosion.
- The populace is aware of the problem and willing to participate in planting projects, etc.

West Usambara

- Encroachment is generally under control.
- Forest on public land is being burned and cultivated. Use of these forests is neither controlled nor managed.
- A management plan exists for the reserves for 1981-86. The emphasis is on regeneration of camphor, with little

emphasis on the forests' catchment properties.

- There are serious erosion problems in the deforested areas.

Both areas lack funds for silviculture, enrichment planting, border planting, and guarding.

The population pressure is high in both areas and the authorities are working with possibilities for moving people out to other areas.

3.4 CATCHMENT FOREST PROJECT - KILIMANJARO REGION

The project is supervised from Moshi, and includes 7 reserves (see overview in Appendix 4), of which Kilimanjaro Forest Reserve is clearly the largest.

We visited Rau Forest Reserve at Moshi, West Kilimanjaro Forest Station (softwood plantations, not included in the project), and Kilimanjaro Forest Reserve at Marangu and Kilema. Some of our experiences from Kilimanjaro Forest Reserve are included in the accompanying map of Himo watershed.

3.4.1.1 Management of the Catchment Forest Project

A two-part management plan has been worked out that covers the period 1981-1986. The more important part is called Kilimanjaro Region Natural Forests, Catchment, Management Plan. This part encompasses a total of 132 954 ha and 7 reserves (see Appendix 4), of which Kilimanjaro Forest Reserve comprises 107 828 ha. The other part is called South Kilimanjaro Forest Project, Natural Regeneration, Management Plan. It includes 19 922 ha camphor forest, mostly on the south side of Kilimanjaro, but also in Chome Forest Reserve.

Of this camphor forest, 6 552 ha are divided into compartments with logging and regeneration since 1941. In addition, 8 670 ha are commercially valuable, but not yet divided into compartments (as of 1981). 4 700 ha is inaccessible forest in ravines. The forest resources in this project are included in the Catchment Forest Project. In all, about 58% of the Project's area is productive forest, including 9 370 ha of Podocarpus that is not divided into compartments. Jaako Poyry Industrial Inventory surveyed the south, west and east sides of Kilimanjaro in 1977/79 (60 000 ha) and estimated the standing volume of commercially valuable species. 56 300 ha are accessible for harvesting, and total volume without bark for the whole area is 4 844 800 cub.m. (24.9% camphor, 14.8% podo and 10.3% Macaranga). The greatest volumes are located in areas that have not been cut before, and will be logged by pit-sawyers. Albizia spp., Ilex mitis, Syzygium guineense, Rapanea rhododendroides, and Hagenia abyssinica are also commercially important species here.

The objectives of the management are:

- a. Conserve water resources
- b. Preserve and maintain the local climate
- c. Maintain and improve the economic value of the forest by controlled harvesting, regeneration, and tending of a crop of hardwoods (camphor)

3.4.1.2 Topography, climate, and forest vegetation on Mount Kilimanjaro

Mount Kilimanjaro is one of many volcanoes occurring along the Rift Valley. Both the soil and the underlying parent material are of volcanic origin, and are relatively nutrient-rich, with pH 4-6.5. The mountain is basically conical, with two peaks. The highest is 5 895 m. The slope on the sides of the cone

varies greatly, but typically flattens out from about 1500 m down to the plains at about 600 m. The forest covers a belt from approximately 2000-3000 m. elevation. The slope also varies greatly in the forest belt, and deep ravines divide the mountainside lengthwise.

Climate

Rainfall is greatest on the south side at Kibosha and Uru in the forest belt, with over to 2000 mm annually. Precipitation decreases both to the west and the east. Precipitation also decreases above about 3000 m, and is only 200 mm annually on the peaks. Precipitation also decreases from the lower forest boundary down to the plains, where it is under 700 mm annually. About 70% of the precipitation falls during the two rainy seasons, the "short rains" in November-December and the "long-rains" in March-June. It is relatively cool but frost-free in the forest belt.

Vegetation

Natural, dense, high forest occurs in scattered localities in Kilimanjaro Region, but the largest stands are found around Mount Kilimanjaro. These forests are generally restricted to mountain- and hillsides from 1000-3000 m elevation.

The vegetation on Mount Kilimanjaro can be roughly divided in three: the highest, alpine belt; the Ericaceous belt; and the forest belt. Except for the Juniperus procera forest, which is dry montane forest, the forests are of the moist montane type.

The composition of the forest belt varies with elevation and rainfall. The uppermost forest zone at 3000 m contains much Hagenia abyssinica, Erica arborea, and Hypericum sp.. The zone from 2500-2800 m is Podocarpus forest with, among other species, P. milanjanus, P. usambarensis, P. gracilior, and Rapanea pulcra. The zone from 2000-2500 m is East African camphorwood forest. Common species include Ocotea usambarensis, Macaranga kilimandscharica, Albizia gummifera, Croton spp., Syzygium guineense, Ilex mitis, and Ficus spp. In the bush layer, Maesa lanceolata, Crumiliea spp., Lasianthus kilimandscharica, Pauridiantha holstii, Paveta spp. are common. Camphor may also occur as almost pure stands (for example, in the compartments). Camphor grows best with precipitation above 1500 mm. This forest type has a lower elevation limit of about 1200 m.

On the west and north sides, which are drier, there are smaller areas of Juniperus procera (African pencil cedar) between Garagua and Kitindi rivers, and some Olea welwitschii on the north and east sides. There is also some bamboo (Arundinaria alpina) on the north side.

The southeast-facing slope also receives less rainfall. Ocotea grows between the Garagua river in the west and the Ona river in the southeast. From this point, Cassipourea malosana becomes dominant.

The ravines also have characteristic vegetation, with tree ferns and Lobelia in a thick bush layer.

3.4.1.3 Rau Forest Reserve

Area: 520 ha. The reserve lies on the plains just south of Moshi. The forest is supplied with water from the river Rau (from Mount Kilimanjaro) and springs that also originate from Kilimanjaro. Moshi receives ca. 880 mm rainfall annually, and Kahe which lies 10 km southeast of the forest receives 390 mm annually. The Catchment Forest Officer has observed that it rains more frequently over the forest than in Moshi. This should be investigated. It would be interesting if this forest, which is based on groundwater from Kilimanjaro catchments, functions to increase rainfall on the plains. If this is the case, it would serve as an inspiration to plant similar forests, for example, further east on the plains.

Vegetation

The vegetation is of the lowland, groundwater forest type and includes many rare tree species, for example, Oxystigma msou (known only from Rau and there only in a 5 ha area) and Tapura fischere (rare in East Africa). Other important species are Chlorophora excelsa (among which one of Tanzania's largest trees, 49.5 m tall and 140 cub.m volume), Khaya nyasica, Cordia abyssinica (planted), Croton spp., Ficus spp., Newtonia buchanani, Macaranga spp., and Diospyros. The teak plantations were planted in 1961 and are now 15-25 m high. From a silvicultural standpoint it is desirable to thin the teak stand.

Encroachment

The reserve is encroached upon considerably, especially on the west side where the forest has been cleared for cultivation (shambas). Many families in Moshi collect fuelwood illegally in the forest. We saw many trees with scars from cutting, and when we came out of the reserve at 4:00 P.M., we met 15-20 women with sickles and machetes (pangas) on their way into the forest. Oxystigma is in danger of extinction. In addition, the forest is in danger of being eliminated. A nursery has been established in the forest.

3.4.1.4 Kilimanjaro Forest Reserve

Area: 107 828 ha. The reserve lies in a belt around Mount Kilimanjaro at a elevation of 2000-3000 m. Six corridors belonging to Kilimanjaro National Park run lengthwise through the reserve at different locations spread around the mountain. Kilimanjaro National Park also includes the area above the forest boundary.

Our impressions of the reserve are based on several days in the field between Kilema and Marangu. During this time we made observations later incorporated into the accompanying map, "Vegetation and Land Use, Himo Watershed" which describes the vegetation and land use in a catchment that reserve crosses through. The following is a summary of our impressions of the

various vegetation types in the reserve.

a) The area overlying the Podocarpus forest boundary (> 2800 m). The lower part of this zone consists of Erica forest, the upper part Erica shrub, grassland, and moorland. Fires are set by beehunters and gamehunters, and this has pressed the forest boundary down in elevation and stopped the natural vegetational succession. Tutzauer (personal communication) believes that an attempt should be made to raise the forest boundary and that this will improve the catchment. Fires are more common on the west and north sides than on the south side.

b) Podocarpus forest

This zone is not presently being cut. Significant amounts have been cut previously. There are difficulties with natural regeneration, and we saw very few new shoots, except in open border areas with greater light. Fires can occur near the upper boundary, where one has an increasing number of Erica individuals.

c) Camphor forest

This is the most important forest in Kilimanjaro for timber production. Below 2500 m, this belt is divided into compartments at 6 locations. The first of these was established as early as 1941; most of them are now logged and attempts at regeneration are being made (see Chapter 3.3.1.3). Above 2500 m, selective logging of camphor has occurred.

"Half mile strip"

On the southern and eastern sides, the lowest part of the reserve (a strip about 0.8 km wide) is administered separately and is called the "half mile strip." This area has long been administered by the District Council, Moshi District, but was transferred over to the Forest Division when the Catchment Forest Project was established. Now the District Council would like to regain administrative control of the area. There is some uncertainty about the future status of the strip, but sources in the Forest Division indicated to us that it would go back to the District Council. This zone is a very important part of the reserve for three reasons: it covers a large area, it has high rainfall (up to 2000 mm annually), and it borders on a cultivated area with high population and is therefore seriously encroached upon. The half mile strip is divided up lengthwise into areas with natural forest, grass, plantations, logged and fallowed black wattle stands, and areas that have been illegally cut.

Encroachment

There is widespread encroachment in the "half mile strip", which can be summed up as follows:

- Cultivation within the strip occurs, due to high population pressure.

- Illegal cutting of camphor, selected trees, and small patches occurs, either for personal consumption or for illegal sale. We observed many newly felled trees as far as 500 m from the boundary, plus a ca. 0.5 ha clearcut area (cut 1982). The illegal cutters have been known to carry weapons.
- Illegal fuel collection occurs. Dry trees and branches are taken out, and living, healthy trees are also felled or ringbarked. They are taken out of the forest when dry. Damaged trees are a common sight.
- Illegal collection of leaves and grass for cattle occurs. The upper part of the cultivated zone that borders the reserve is zero-grazing (cattle are kept in stalls). Much of the fodder required for the cattle is collected in the forest.
- In places, cattle and goats are released to graze in the forest.

The Catchment Forest Officer does not allow fodder and fuelwood collection, but a few licenses for fuelwood collection have been given to the mission. Cultivated fields were established illegally at Kidea in 1980. In 1981 the intruders were escorted out and the area planted randomly with Albizia, Rauvolfia, Newtonia, and other species. Nearly 30 people were brought to court. Most of them were fined 500 shillings. None went to jail. There has been a lot of movement into an area just east of Marangu (the National Park Gate). These people have been escorted out now. Many have been fined or have been jailed for 3 to 6 months.

Elephants, buffalo, and other animals have damaged parts of the forest on the west and north sides. The animals come in from the reserves between Mount Kilimanjaro and Mount Meru.

Old Moshi Nursery

Elevation: 1600 m. The nursery's capacity is 60,000 seedlings per year, but in 1984 only 30,000 were produced. Production is primarily of indigenous species for enrichment planting, for example Newtonia buchanani, Syzygium guineense, Ocotea usambarensis (very difficult germination), Albizia spp., Ficus spp. and Rauvolfia inebrians. Eucalyptus saligna and Cupressus lusitanica are also produced for border planting. Up to 20 000 seedlings per year are given away to the local population.

The project also has a nursery in Same, but there are no funds to operate it. There is also a nursery in Rau Forest Reserve, which produces Leucaena leucocephala and Cassia siamea for fuelwood and fodder production and for planting at the airport.

The District Council also has a nursery that produces about 30 000 seedlings per year.

Recent measurements of rainfall and runoff

The project has measured rainfall and runoff since 1979 in connection with Old Moshi Nursery (see Table 3).

Table 3. Rainfall and runoff measurements at Old Moshi Nursery

Year	Mean temp.	Total rainfall	Mean waterflow
1979	26 °C	1 300 mm	600
1980	29.5	900	700
1981	29	1 100	650
1982	29.5	1 000	530
1983	30.2	700	-
1984	-	approx. 800	-

We do not know how or where the waterflow measurements were taken, or what the units are.

The precipitation measurements show a clear decline. In November 1984, the newspaper "Daily News" reported that a spring in Kilimanjaro had gone dry for the first time during the 1984 dry season. Several other sources have indicated to us that about half of the rivers that previously ran during the dry season, are now dry in the dry season.

Border planting

The Catchment Forest Officer gave us the following information about the amount of work and money that goes into border planting.

Seed is inexpensive and is readily available. This includes drought tolerant species such as Acacia spp.

	Cost per plant
Production costs (seeds, soil, pots, watering, transport in loads of 100,000 and 8 months work)	2.00 Tsh
Boundary planting, 200 seedlings/km	
Clearing, 14 work days	2.45
Pit-digging, 10 work days	1.75
Transport (rented truck)	1.00
Planting, 1 work day	<u>0.18</u>
TOTAL	<u>7.38 Tsh</u>

In addition, the plants must be tended for about 2 years until they are 2 m high. The costs will be about 7.38 Tsh x 200 = 1.476 Tsh per kilometer of border planting. The project has planted the boundary on the whole southern side, but still needs to plant about 75% of the total boundary around the reserve.

Enrichment planting

One of the project's goals is to plant all open areas in the forest and along the reserve boundary with indigenous species. This work has not progressed very far due to lack of funding. At Kilema they have harvested large areas of black wattle

(Acacia mearnsii) to make room for more natural forest, but these areas are still in fallow and the stump sprouts from the cut wattle are now 1-4 m high. On the south side, all plantation forest will be replaced with natural forest when mature. On the north and west side, pine and cypress will be replanted in plantations. On the east side, some black wattle will be planted.

Staffing

The project has in all 71 employees: 10 trained forest officers or assistant forest guards, 11 experienced but untrained assistants, 17 guards, 23 skilled laborers, 4 nursery workers and 6 administrative employees.

3.3.1.5 Discussion and evaluation

Harvestable forest:

The forests we saw seemed to be either immature or cut over, but there is some mature forest in areas that have not been cut previously. Mr. Tutzauer felt that the management plans for camphor at Kibosho were to some degree exploitative. He also said that cedar (Juniperus procera) is cut over on the northwest side. He has only seen old, poor individuals of this species there.

Encroachment:

Significant areas of forest are damaged or destroyed and must be reforested by enrichment planting. Other areas are in danger of being destroyed in the course of a few years.

Patrolling:

There are entirely too few forest guards to patrol the whole area, and they have poor shoes and clothes. They are unable to stop encroachment. The project is only able to stop people from moving into the forest to live. There are only 17 guards for 132 954 ha.

Border demarcation:

Physical boundary demarcation and border planting is necessary. Where the population pressure is greatest, a more dramatic border demarcation is needed, for example, 10-50 m border zone planted with exotic trees.

Funds and equipment:

The forest guards lack equipment and transport. There is also a shortage of pots at the nursery. Funding for enrichment planting, border planting, and tending is not sufficient in view of the pressing need for these activities.

3.4.2 SUMMARY - KILIMANJARO REGION

- The local people do not understand the importance of catchment forest and lack alternatives.

- Guarding and patrolling are very weak.
- Significant encroachment in the reserve occurs up to 1 km in from the boundary.
- Rau Forest Reserve must be protected because of gene pool considerations.
- Funding is insufficient.
- An existing management plan covers the period 1981-1986.

3.5 CATCHMENT FOREST PROJECT - ARUSHA REGION

The project is administered from Olmotonyi, near Arusha, and encompasses 18 reserves. A summary of the reserves in this region is given in Appendix 4. Lundgren (1984) gives a total area of 145 767 ha, whereas our information indicated an area of 122 704 ha. Four reserves were transferred to administration by local authorities in July 1984.

We visited a part of Meru Forest Reserve and Marang Forest Reserve. The climate and vegetation vary considerably in this region. Natural conditions are therefore described separately for each reserve. Relatively many of the reserves are at elevations below 2 000 m.

3.5.1.1 Management of the Catchment Forest Project

A management plan has been worked out for the whole project and for the project called Loliondo Forest of South East Meru (part of the Usa Forest Project). Both cover the period 1981-1986. The catchment project is divided up by district, with District Project Officers for Hanang, Mbulu, Monduli, Loliondo, and Arumeru Districts.

The following are the main objectives of the management plan:

1. Water conservation
2. Soil conservation
3. Improve the climatic conditions
4. Where possible, carry out limited selective cutting in selected areas where this will not interfere with the catchment objectives (1-3 above). This is to supply the allowable amount of forest products to the villagers and income to the government.

The major activity of the projects is to protect the forests by patrolling against illegal activities, consolidating boundaries, and preventing fires.

Staffing

The project has about 40 employees. Of these are 8 Forest Officers or Assistant Forest Officers. There are 12 forest assistants or attendants and 19 skilled laborers. Most work in the districts. Only the project administration is at Olmotonyi.

3.5.1.2 Meru Forest Reserve

Area: 26 433 ha. The reserve is divided into 5 sections (beats) that are spread around the volcano.

Topography, climate, and vegetation on Mount Meru

Mount Meru is a young volcano 4562 m high that rises steeply from the surrounding plains at about 1500 m elevation. The last eruption was a minor one about 100 years ago. A large,

horseshoe-shaped piece of the volcano wall was blown out from the eastern side about 6000 years ago. Also on the eastern side is Ngurdoto crater, which is a part of Arusha National Park. The soil is young and is derived from lava and volcanic ash. It is black or dark brown, well drained, and rich in calcium and phosphorous but relatively poor in nitrogen. The pH is 5.5-6.5. The soil is easily eroded when the vegetation is removed or degraded. During the dry season the soil becomes powdery.

Rainfall is greatest (about 1800 mm per year) on the south and southeastern side between 1800 and 2000 m. On the northwest side rainfall is about 600 mm per year. The area has two rainy seasons.

Forest vegetation

Above 2700 m: Erica-heathland 2300-2700 m: Bamboo zone (Arundinaria alpina) 1700-2300 m: Moist montane forest with Podocarpus gracilior, P. milanjanus, Ficus spp., Olea welwitschii, Ekebergia rueppeliana, Entandrophragma stolzii, Lachnopylis sp., and Croton megalocarpus. The drier western and northern sides are covered with a dry montane forest dominated by Juniperus procera, often with Nuxia congesta. In wet hollows at higher elevations, Hagenia abyssinica is common. On the southeastern slope and around Ngurdoto Crater, loliondo (Olea welwitschii) and O. hochstetteri are common. The main source for this information was Lundgren (1978).

3.5.1.3 Usa Forest Project (Meru East Forest Reserve)

This project lies from 1300-1900 m and is subdivided into 4 projects:

Softwood project	398 ha
Hardwood project	954 ha
Natural forest	7 937 ha
Part of Arusha Nat.Park	11 655 ha

The area is divided up into many smaller forests (beats). We saw natural forest and regeneration of loliondo in Ngongongare beat.

Much of the forest in this area is secondary because widespread cutting has occurred over the last 50 years. Rainfall has been measured since 1969 and is 1000-1500 mm per year. The forest may be described as one of the drier types of moist montane forest. The most valuable tree species are loliondo (Olea welwitschii), O. hochstetteri, O. africana, Diospyros abyssinica, Albizia sp., Entandrophragma stoltzii (rare), and Podocarpus spp. Other important tree species are Fagaropsis angolensis, Ekebergia ruepelliana, Croton macrostachyus C. megalocarpus, Rauvolfia sp., Ficus spp., Conopharyngia sp. and Neuboutonia macrocalyx. Common species in the bush stratum include Dodonea viscosa, Stoebe sp., and Vernonia sp. There are very few epiphytes and lianas.

Management of the Loliondo Forest of Southeast Meru Project

The objectives of management are:

1. Protection to maintain soil and water
2. Maintenance of the forest, particularly for loliondo
3. Obtain an economic yield by setting up controlled harvesting followed by compensatory planting and silviculture
4. Provide habitat for wild animals

Staffing

This project employs a total of 47 people: senior and subordinate staff (17), skilled laborers (23), research staff (3) and catchment staff (4).

Border plantings

Since 1980, most of the forest boundary has been planted with eucalyptus. 12 km out of a total of 36 km still need border planting.

3.5.1.4 Regeneration of loliondo

The project is very concerned with loliondo (Olea welwitschii), which is a very valuable tree species that is now mostly cut out. The most important stands of loliondo are in East Meru, and it seems that the tree is regenerating poorly in the remaining stands. We saw very few new shoots. Loliondo requires 150 years to be mature for harvest, and most of the trees cut so far have been about 250 years old. To get new stands of loliondo, this species has been planted together with fast-growing exotic trees (for example, Grevillia robusta) in some areas. The fast-growing tree provides sufficient shade for the young loliondo plants.

There has been some research on loliondo regeneration done in these forests, both natural (from 1946) and by various experimental methods (from 1959). Study plots have been laid out. Usa sawmill (privately owned) has in the past sawed the loliondo timber from these forests, but will now be shut down since loliondo is no longer being cut.

Problems with loliondo regeneration:

1. Animals. Elephants and buffalos from the National Park trample and eat shoots, leaves, and bark of young loliondo. It is very difficult to keep animals out of the research plots. Many techniques have been tried, including electric fencing. Other animals also graze in the plots.
2. Diseases.
 - a. Stem bases swell in three year old plants, probably because of fungus or insect attack. Investigations have not clarified the reason for the disorder.
 - b. On northfacing, drier sites, Bostrychid borers attack the trees where elephants have damaged the protective bark.

3.5.1.5 Marang Forest Reserve in Mbulu District

Area: 23 328 ha. The reserve is south of Lake Manyara National Park. The vegetation is a dry type of moist montane forest, at an elevation of 1600-1800 m. Rainfall is reported to be about 750 mm annually. The most important tree species are Olea hochstetteri, O. africana, Fagaropsis angolensis, Ekebergia rueppielana, Pygeum africanum, Podocarpus sp., Croton sp., Acacia spp., and Ficus spp. The area is relatively flat, with some small undulations. It has not been harvested since 1938 except for a little pit-sawing. Elephants, buffalos, and pigs damage some of the forest. At the place where we drove into the forest there was sparse, young natural forest on the outer side of the reserve boundary. The forest is considered worthy of protection as a botanical reserve (Polhill 1968).

3.5.1.6 Discussion and evaluation

Harvestable forest:

It is difficult for us to independently estimate how much of the forest can be harvested without negative ecological effects. Exploitation in Meru Forest Reserve has been heavy (see the management plan), and three sawmills previously cut the timber from the natural forest. In addition, there has been widespread pit-sawing. All cutting was stopped in 1981, effective until the end of the management plan in 1986.

There is some pit-sawing in Marang and Nou Forest Reserves. We feel that few logging licenses should be given until we know more about catchment forestry and regeneration.

The project seeks information on regeneration and on evaluating how much can be harvested without reducing the forest's catchment properties.

Encroachment:

Encroachment has occurred continuously despite patrolling. The local population has come into the reserve and tried to establish fields, especially on the north side of Mount Meru. The Masai in Arusha drive their cattle into, for example, the softwood plantations on the west side of Mount Meru to graze. The ground vegetation in these forests is very easily damaged, and erosion is common. This is a difficult political question for the Tanzanian authorities since it involves issues of minority rights and land use rights. Confrontations between the forest guards and the Masai can easily occur. Violence and even killings may occur.

Patrolling:

It is completely impossible to patrol the entire area. Some of the reserves farthest from Arusha are visited by the administrators only once a year.

Border demarcation:

We do not have information on how much is planted and how much remains to be planted along the reserve boundaries.

Funds and equipment:

The current funding is insufficient to maintain an adequate patrolling system. The project has three Land Rovers, of which two are inoperable because of unavailable spare parts. They have one motorcycle. This is too little to cover the large area involved. The project also lacks its own headquarters, and rents offices at the Meru Forest Project at Olmotonyi. None of the employees lives near their place of work, partly because of lack of housing.

Fire:

The project has had especially many problems with fires set by bee- and gamehunters. They have had an information campaign about forest fire with, among other things, film showings and preventative fire patrolling. Judging from the fire statistics, this seems to have had some effect.

3.5.1.7 Forests outside of the reserves

There is little forest outside the reserves. The region is in many areas densely populated, such as around Mount Meru. Dry grassland covers large areas. The large herds of cattle in the region do damage to the vegetation and erosion is the result. The region has just above 1 million people, 2.2 million sheep and goats, and 2.3 million cattle. Shortage of grazing land increases the pressure on the forest. The grazing problem must be solved, or else the other measures to protect the forest will be useless. Fires are also a great problem. They are not registered, and are often very destructive in the drier forest types. The vegetation is often a fire climax.

3.5.2 SUMMARY - ARUSHA REGION

- The project has a management plan for 1981-1986.
- Nearly all cutting in the Catchment Forest Project Reserves has been stopped.
- Grazing and traditional cattleherding (the Masai) is a very serious problem
- Fire is also a serious problem.
- There are difficulties with natural regeneration of loliondo.
- The project needs better funding, especially for patrolling.

3.6 CATCHMENT FOREST PROJECT - MOROGORO REGION

The project is administered from Morogoro. We only made a short visit to the Project and mainly discussed the number of reserves and their size.

A summary of the reserves in this region is given in Appendix 4. Lundgren (1984) gives a total area of 374 868 ha, whereas our information indicated an area of 384 610 ha. In our adjusted list we had to add 6 reserves. Data from the management plan for Morogoro Forest Project indicate a total area of 255 732 ha.

Total area and the number of reserves included in the Project, then, have increased.

A group from the joint Tanzanian - Nordic Review Mission and Seminar on the Forestry Sector of Tanzania 1983, wrote a report "Management of natural forests and forest plantations" with special reference to Kilombero District. We refer to that report for further information.

4 FOREST ADMINISTRATION

4.1 Outline of the central administration.

Agriculture, livestock and forestry are organized in two different ministries, following the British system: the Ministry of Lands, Natural Resources and Tourism and the Ministry of Agriculture and Livestock. Forestry matters fall under the first of these, where the Forest Division is one of four divisions. An outline of the present official forest policy by Senior Forest Officer Mr. Mlowe is printed in Appendix 7.

In 1971 the Tanzania Wood Industry Corporation (TWICO) was formed as a parastatal institution. Most forest industry matters fall under TWICO, although the Forest Division in principle is responsible for forest industry planning.

In recent years Tanzania has carried out a reform in local government. It is the intent of these reforms that the responsibility for regional planning and development should fall on the regional and district offices of the Prime Minister's Office (the Regional Commissioner's and District Commissioner's office) rather than the ministries. One exception is agriculture and livestock, which are still administered by the Ministry of Agriculture and Livestock.

The shift of forest administration from the Ministry of Lands, Natural Resources and Tourism to the Regional Commissioner's offices has been the source of much discussion within the Forest Division. The Forest Division has proposed that forest administration on the regional and district level could be organized after the pattern of the Ministry of Agriculture and Livestock: a Regional Forest Officer reporting to the Forest Division. Centralized forest management through the Forest Division is exemplified by the Catchment Forest Projects.

4.1.1 Organization of the Forest Division

The Forest Division was reorganized by a ministerial reform in 1973 to include sections for sectorial planning, forest development and management, survey and inventory, research and training, and beekeeping. Since 1973 a new section for information and publicity has been established. In our contact with the Forest Division, we met the sections most involved with "catchment forestry". A short description and evaluation of these sections follows.

4.1.1.1 Section for Development and Management.

This section is responsible for development and management of both plantations and natural forests. The section also carries out some very important projects:

- the village afforestation program, whose main objective is self-sufficiency in fuelwood and building poles in the rural areas.

- soil erosion control (Hifadhi Ardhi Dodoma, or HADO, project in Kondo)
- the Catchment Forest Project (which is the subject of this report)

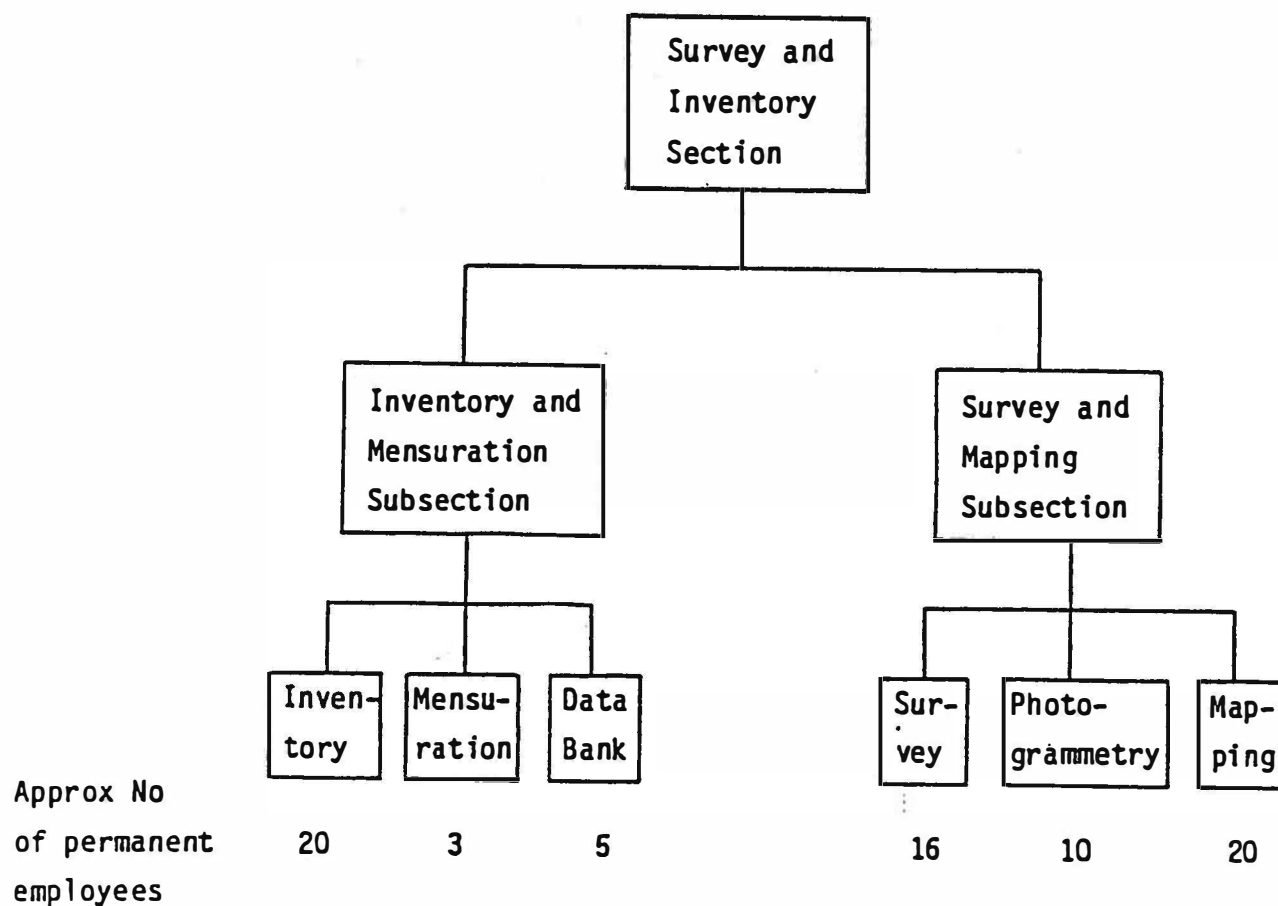
This section seemed to be well-staffed with competent people in industrial plantation forestry. The section is now strengthening its competence in village afforestation and erosion control. It seems to us that they still lack specialists in natural catchment forests.

4.1.1.2 Section for Survey and Inventory.

This section surveys the boundaries of both plantations and natural forests and carries out inventories in both kinds of forests. Until now the surveyors have been stationed in Dar es Salaam but they will now, mainly because of shortage of transport, be decentralized and stationed in the regions.

It seems to us that the section is sufficiently staffed with competent people in surveying and inventory in industrial plantations, but lack people trained in inventory of natural forests. The organization of the section is shown in Figure 3.

Figure 3. Organization of Section for Survey and Inventory From Svenson, 1984. Report on Survey and Inventory. App. 7. in Joint Tanzania/Swedish Forestry Mission 1984.



4.1.1.3 Section for Training and Research.

Olmotonyi School in Moshi and the Silvicultural Research Station, Lushoto, are organized under this section. The number of students at Olmotonyi School has gone down in recent years from 100 to 50 students, mainly because of the shortage of lecture rooms. It is not clear whether this is a temporary or permanent reduction.

It is planned that the research activity in forestry will be reorganized in the near future, and this will have a very strong impact on this section.

4.1.1.4 Section for Information and Publicity.

This section was established recently. One of its main objects is to inform villagers about the village afforestation program. They are also concerned with attitudes in the villages toward forest and forest products.

4.2 Organization of the Regional Commissioner's Office.

Large areas of natural forest are managed by the local authorities.

The Regional Commissioner reports to the Prime Minister's Office through the Regional Development Director. Within the Regional Commissioner's office, the Regional Natural Resource Officer is responsible for the management of forest reserves. He normally has four professionals in his staff: forest officer, game officer, fish officer, and beekeeping officer. There is often little contact between the Regional Natural Resource Officer and the Forest Division, with the result that the Forest Division has very little influence on the management of many forest reserves.

4.3 The District Council

The local forest administration consists of three levels under the Regional Commissioner's office:

- District Council
- Division
- Village

A reform in local administration, with increased emphasis on local participation in planning and development programs, was carried out in January 1984. The results are promising so far. The local administration has a wide range of responsibilities: family planning, increased food production coupled with agricultural reforms (for example, use of contour-planting, intercropping, and zero-grazing), forest planting to assure an adequate fuel supply, and reducing erosion due to overgrazing and deforestation.

The District Council is central in this work, together with the party apparatus, CCM (Chama Cha Mapinduzi), because much of the work involves education and changing peoples' attitudes.

4.3.1 Impressions from meetings with the District Council, Moshi.

There is a good understanding of the problems, and work on solutions has begun, including the following:

- The District Council has passed a by-law that will be used to fight deforestation and erosion (Appendix 8).
- They have begun a local treeplanting project, as part of a national project.
- They have started to work on a by-law that will regulate grazing.

These are elements in a "land use plan" for the district. The District Council is the central political organ when one decides, for example, which areas will be converted to forest reserves from public land. The District Council must have the local population behind them, and must also have support for the plans from the Regional Commissioner and the Prime Minister's Office.

4.3.2 Impressions from meetings with leaders in Sakila Village, Arumeru District.

Our impression, after meeting with leaders of the village council and representatives for important village organizations in Sakila Village, is that they are very well oriented regarding the important ecological problems. A clear willingness to make efforts for their solution was present. They have already done a lot of tree planting in the fields, along field edges, and on hillsides. The efforts must increase. Up to now, they have concentrated on fast-growing, exotic trees, but they would like to start planting indigenous trees. They asked for information about which trees could be best planted together or in specific areas. They also expressed the desire for courses and guidance in tree-planting. They have problems getting indigenous trees from the nursery. Funds are lacking, and consequently there is a shortage of equipment (for example, plastic pots) and seed.

The people we met did not feel that the new plantings were threatened by cattle or encroachment, because the villagers understood that it is to their own benefit to restore the forest. They asked for information about managing the forest. The village leaders want to motivate the villagers in the planting efforts, and this is also the policy of the government and CCM.

4.4 The use and ownership of land.

All land in Tanzania belongs in principle to the government, but there is a common law regarding land use.

- When a person or a family has used the same area for a certain period, it is considered to be his property. The person can then sell it. If the authorities want to use the land for some other purpose, they must give the farmer

compensation. A family can have several shambas spread over a wide area. One or a few of these are normally intensively cultivated.

The tribe can in some areas take the role of landowner, but this is becoming more and more rare.

- As a result of the Ujamaa program, collective cultivation is common. An Ujamaa village normally contains both collectively- and privately-cultivated shambas.
- Many estates are government-owned corporations, but there are a few private estates also.
- Public land is common property. Most of the land in Tanzania is public land. Large areas of public land in Tanzania are unsettled because of the tsetse flies. Areas without tsetse fly are subject to extensive land use activities: grazing and shifting cultivation with fallow.

Because of the rapidly growing population, the demand for land both for grazing and farming is increasing beyond the carrying capacity of the land. This leads to conflicts between cattle-holders and farmers. Increasing pressure on the land has also led to severe degradation of many shrub- and woodland areas due to the farmers' and grazers' habit of burning the grass in the dry season.

4.5 Protection of Land.

Three categories of protected land exist in Tanzania.

- National Parks are conserved in as near-natural condition as possible. This is the greatest degree of protection for an area.
- Conservation area. Grazing and some other human influences may be allowed in these areas.
- Reserves. Includes game reserves and forest reserves. These are under management to preserve the area's intrinsic natural values, such as rare species or catchment properties.

4.6 Revenues and funds.

Forest activities bring in important revenues both to the District Councils and to the National Treasury. Earnings from commercial activities by the Forest Division go to the Treasury rather than being channeled directly back to the Forest Division for forest management. It is clear that the funds allocated for forest management are insufficient. The result of this system is that commercial activity is not stimulated and forest management is weak. To alleviate this problem, TWICO was founded in 1971, an important positive step. In the catchment forests, TWICO is involved only with the wood industry matters (not forest management).

In the long run, the local authorities should be economically self-supporting. Revenues from the forest (logging and

charcoal making) is an important source of revenue for the District Councils. It is very important that the councils allocate enough means to manage the forest properly. The District Council can pass and enforce by-laws, and these can be used as tools in forest management. The Moshi District Council, for example, passed a by-law that when a person cuts down a tree (by license), he must plant four new ones.

4.7 Discussion and recommendations

It is evident that the area and value of natural forests have decreased significantly in recent years due to poor forest management. Both politicians and professional foresters in Tanzania are aware of the problem and have initiated programs to improve the situation. The most important of these is the Catchment Forest Project. Based on experience to date with the Catchment Forest Project, the Forest Division has made the following two proposals:

1. The Catchment Forest Project should be expanded to include a fifth region, Iringa. One or two people are now engaged on this project, but it has been delayed due to shortage of funds and personnel.
2. The forest sector should be reorganized on the regional and local level by having Regional Forest Officers that report to the Ministry of Natural Resources and Tourism, after the model of the Ministry of Agriculture and Livestock.

We feel that both of these proposals are good ones that should be supported. It is clear that a Catchment Forest Project is needed in Iringa to protect the catchment forests that feed the Great Ruaha and Rufiji rivers. We also support the proposal to shift the administration of catchment forests now under local authorities so that they are administered by the Forest Division through a Regional Forest Officer.

Ideally the people should govern their own local resources through the local government, but we feel that this system simply is not working in the forests now administered by the local authorities. Most of these forests have either been completely cut down, or have been selectively logged over, and erosion is a serious problem in many of these areas. Furthermore, there was no evidence of adequate management plans or silvicultural practice for these forests. Part of the problem is that the local authorities do not report to the Forest Division and therefore do not have the professional competence in forestry to draw up and carry out good management plans. The problem of maintaining the catchment properties of forests while allowing some degree of forest utilization is sufficiently difficult from a forestry standpoint that it requires professional competence. Centralizing the administration of the catchment forest through the Forest Division is also desirable so that management and silvicultural practises can be standardized and results evaluated on the national level.

In addition to supporting these two proposals for administrative changes suggested by the Forest Division, we

propose two additional changes.

1. Establish a new sub-section of the Forest Division Section for Development and Management. This sub-section should specialize in watershed and natural forest biology, hydrology, inventory and management.

The Section for Development and Management is quite weak in these areas now, and the new proposed sub-section will need both personnel and funding. In the beginning this office may be staffed with expatriates if necessary, but scholarships should be given for study abroad in the fields mentioned to qualify Tanzanians in these areas rapidly. The goals of this subsection would be to establish acceptable rates of logging for various species, work out procedures and recommendations for replanting and enrichment planting to regenerate at least moderately diverse forests, and to coordinate and administer efforts at interdisciplinary watershed management. This sub-section would, for example, administer the proposed Watershed Management Project for Iringa Region.

The field of watershed management encompasses much more than catchment forestry, and includes

- catchment forestry
- management and inventory
- management of water supply and irrigation
- management of agriculture and livestock - land-use planning

An attempt to represent all of these areas should be made when staffing the new sub-section office.

2. Increased funds must be made available for forest management and regeneration. We propose that revenue from forestry in the Catchment Forest Project reserves be earmarked for catchment forestry-related programs. This is an area where foreign assistance funds could also be used.

5

MANAGEMENT, INVENTORY AND MONITORING5.1 Existing management plans

We have seen some of the management plans for the projects and some of the reserves. They normally include a short description of the ecological conditions (climate, geology, soils, and vegetation), management goals, areas of the various land categories, and general information about the catchment forests. They often contain more detailed information about administration, patrolling, fire prevention, border planting, and enrichment planting. They sometimes include analysis of previous cutting, historical developments, and results of previous forest assessment. Often a map is included showing the compartments and coups with borders. These maps are generally well-made and give a good overview, and make good use of the available information. They are made by the Catchment Forest Officer or another project leader, with the endorsement and approval of the Forest Director. They are copied with carbon paper. One copy goes to the Forest Director and another to the Silviculture Research Station.

5.2 Management based on inventory, and strengthening of administrative organization

The greatest problems with the present management are lack of funds to carry through the plans, lack of necessary baseline data, and lack of expertise in the field of catchment forestry. The organization of the forest administration also needs to be strengthened. We propose therefore in Chapter 4.7 that a position be established within the Forest Division to coordinate and lead the projects and the activities of volunteers in the various projects.

A standard inventory should be taken of each forest that covers diverse aspects of the forest's ecology. These inventories can then be the basis for making serviceable management plans. Svenson (1984) analyzed the available inventory data and found that there is insufficient data for management and strategic/operative planning within the forest reserves, and that the situation is much worse for forests outside of the reserves.

Inventory-work and drafting of new management plans should be prioritized such that the forests that are presently being cut, or in which cutting is desirable, are taken first.

5.3 Management plans

The following is a first draft of some points we feel should be strengthened in the management plans.

- A. Descriptive part
 - 1. Description of the location
 - 2. Climate

3. More thorough description of the vegetation (including physiognomy and flora). A short description of the animal life should also be included.
4. More thorough description of soils and hydro-geological conditions, with an analysis of their significance for production, erosion, drainage, and water balance.
5. Quantification of the commercially harvestable timber, by species.
6. Survey of the forest's area and marking of borders, both on the map and in the field.

B. Management and monitoring

1. Goal-setting. Specification of which goals are strategic (long-term) and which are operative (short term).
2. Specification of concrete, feasible work projects in each forest. Results from research should be the basis for these projects, aimed at maintaining/improving the catchment.
3. Detailed plan for cutting, with timetables and follow-up silvicultural practise (planting, tending, etc.).
4. Use of aerial photos and maps is advisable when making the plans.
5. Advisory service for the local population and tactics to improve cooperation. Proposals for helping to find alternatives (for fuelwood, etc.).
6. Plan for measuring climatic data, hydrology (including runoff), and erosion.
7. Reporting system to the Forest Division (and possibly also Forest Research Institute) about the status of the project and the forest reserve. Updating of maps and data summaries.

In addition, the management plans must include plans for patrolling, border planting, nurseries, enrichment planting, up-grading courses for personnel, and fire prevention/firefighting.

Which of these measures, factors, and types of data registration should be emphasized must be decided on the basis of available funds, equipment, and feasibility.

5.4 Inventory

An all-inclusive inventory is essential as a basis for drafting the management plans. A standard inventory to be taken in each individual forest should be worked out by an interdisciplinary team. It is very advantageous to use aerial photos and to map some of the inventory information for certain areas. The inventory can include the following points:

- A. Vegetation analysis. Flora (species, dominance), physiognomy/structure (canopy layers, canopy type, canopy cover, age and size distributions).

- B. Topography. Slope, elevation, presence of rivers, etc.
- C. Soils. Nutrient content, structure (particle size and type, aggregate structure), hydrogeologic properties (drainage, field capacity, water balance), soil profile description, susceptibility to erosion.
- D. Water balance. Precipitation (amount, distribution), runoff.
- E. Commercially exploitable timber (volume, species, availability, transport)
- F. Cultural impacts. Encroachment (type and extent); population pressure; alternatives to, for example, use of fuelwood from the forest.

An inventory should draw conclusions as to what extent the given forest is:

Biologically conservation-worthy
 Subject to erosion
 Important as a catchment
 Productive in terms of commercial timber-species
 Source of important medicinal plants and other resources
 Essential for the fuelwood/fodder needs of the local population
 Encroached upon

Thorough preparation is necessary before the inventory is taken. One must decide which factors will be investigated and how thoroughly and precisely they will be measured. Funding and expertise are important factors that will limit the inventories.

5.4.1 Some remarks on inventory

Many of the factors must be investigated in research plots laid out in the forest. In studies of vegetation, for example, plots may be laid out in areas that are representative of the various vegetation types. Several plots should be laid out in each vegetation type (25 x 25 m is a size often used in forest analysis).

The plots must be large enough and numerous enough that one takes an adequate sample of the diversity both within each vegetation type and among vegetation types in a certain forest. It is noteworthy here that diversity is not a linear function of area, that is, a plot of 200 sq.m will have somewhat less than twice the number of species than a plot of 100 sq.m.

Ecological productivity is usually expressed as g/sq.m day or kg/ha.yr total dry matter production, and is therefore not synonymous with the term production as used in commercial forestry.

Plots to measure the amount of harvestable timber may be laid out by standard statistical methods. These plots give data on the timber volume of each species per unit area, and can be multiplied by the appropriate area to give the total volume in

a given stand. Some of these plots may be laid out with permanent markers to give long-term data on the growth increment and on yields of each species. Svenson (1984) discusses and makes recommendations regarding inventory in the Forest Reserves. He notes that the measured volume often deviates substantially from the actual volume.

5.4.2 Mapping

It is important that plots and forest stands are mapped, along with boundaries between vegetation types, roads, compartments, and topography. Aerial photo interpretation allows one to draw in forest stands belonging to the same vegetation type. This can then be transferred to a base map, preferably a topographic map. The various vegetation types that are recognized by their tone and texture in aerial photos, must be "ground truthed" in the field. If the vegetation types can be reliably identified on aerial photos, it is then not necessary to analyze all the forest stands by field inventory. The map's scale should be from 1:10 000 to 1:50 000. Encroachment and areas that should not be exploited for ecological reasons (steep terrain, ravines, and other high-erosion areas) may also be marked on the map.

5.4.3 Inventory staff

It is natural that the inventories be carried out by the Section for Survey and Inventory. However, the section needs to be strengthened in the area of natural forests. Up to now, the section has been most concerned with plantations. The inventories should be carried out in close cooperation with the Catchment Forest Project. The section lacks staffing to carry out the inventories, funds for essential transport, and equipment for photogrammetry and map production.

5.5 Monitoring and data-reporting system

It is very important to establish a data-reporting system so that the information from the inventories may be kept up-to-date. The reporting must be efficient, so that the results are rapidly available to administrators and researchers. The data should be computerized for rapid processing. It is natural that the Forest Research Institute be responsible for processing the data.

The data should be collected in the field on standardized forms. The Catchment Forest Officer should have responsibility for datacollection, but could delegate some of the field work to colleagues at each forest reserve, who had been trained in the appropriate measurement methods and in use of the forms.

The following is a suggested list of items that should be reported:

1. Precipitation, runoff (for example, water level or flow rate in selected rivers) and temperature measured daily. Reported monthly and yearly.
2. Border planting, enrichment planting, and nursery

- production. Reported monthly and yearly.
3. Encroachment: type, extent, confrontations, and notification of the authorities.
 4. How well the resources (funds, equipment, staffing, and management plans) correspond to the projects to be undertaken and the problems to be solved.
 5. Fires: extent (area, forest type), cause.
 6. Forest cutting, amount by species. Reported monthly and yearly.
 7. Informational campaign and cooperative projects with the local population. Reported annually.
 8. Actual, total forest area. Area and changed patterns of use of areas that have shifted status. Reported annually.

6 USE OF VEGETATION AND LAND USE MAPS IN LOCAL PLANNING

To demonstrate how aerial photo interpretation and field inventory can be used for planning and management of natural forest and human-impacted areas, we have made the map "Vegetation and Land Use, Himo Watershed, Kilimanjaro Region, Tanzania". The map accompanies this report.

From a water-management point of view, it is desirable to administer each watershed separately. This may be difficult, however, when the natural borders of a catchment do not coincide with administrative units. The concept of the watershed should include elements such as water consumption in irrigation and agriculture, afforestation efforts, erosion, and water supply to power works as well as the area's natural resources (climate, vegetation, soils, etc.).

6.1 Objectives for vegetation and land use maps

The main objectives for a vegetation and land use map for a given watershed include:

1. To give a well-arranged view of the landscape elements on a topographic base map.
2. To present the main types of vegetation and soils.
3. To illustrate the current use and conditions of the area.
4. To illustrate rivers, lakes, rainfall and if possible surface runoff and infiltration.
5. Give long-term and short-term proposals for action especially aimed at reducing deforestation and erosion.
6. To educate and give general motivation for action.

The map should be based on scientific data, but this should be summarized and organized in such a way that the map can be easily interpreted for practical planning purposes.

It should be possible to use the map to answer the following questions:

1. Which parts of the catchment receive the most precipitation and should therefore be considered for protection as catchment forests?
2. Which areas are most suitable for cultivation, and what precautions should be undertaken to prevent erosion?
3. Which forest areas are most susceptible to erosion and should therefore be protected against deforestation?
4. Which areas are suitable for fuelwood planting and what tree species should be used?

6.2 Summary of watershed management issues in Himo Watershed

The major issues of watershed management in Himo Watershed are discussed in detail on the accompanying map. The issues may be summarized as follows.

The forest reserve is an important catchment area and should be managed as such. To protect and improve the catchment, the forest zone should be extended. Several possible ways to achieve this are by preventing fires (particularly in the upper forest zone adjoining Erica vegetation), by enrichment planting, and by planting open areas in the forest and particularly along the lower forest edge.

Agricultural land use below the forest zone is very intensive. The system is characterized by zero-grazing, intercropping, and irrigation. There are indications that there is significant erosion and loss of nutrients from this zone. Rivers and streams that run clear through the forest are red with soil as they run through the agricultural zone. The upper part of the cultivated zone uses a large amount of irrigation water, reducing the supply for downstream areas. This reduces the production potential of the lower-lying areas and is a source of conflict among people.

The Nyumba ya Mungu reservoir and hydroelectric power plant are supplied with water from the slopes of Mount Kilimanjaro. There are indications that the dam is in danger of becoming silted-up due to deforestation and erosion. Reforestation of the erosion-susceptible ridges and ravines with a diverse vegetation cover should reduce this problem.

Protection of the mountain forest zone has many beneficial side-effects. Good infiltration of water into the soil in the forest zone increases ground water supplies downhill and on the plains. This water supply may then be the basis for permanent forest on the lower hills and plains (for example, Rau Forest Reserve) as well as for generally increased fertility on the plains. This in turn can help reduce the population pressure on the mountain slopes.

7 RESEARCH AND EDUCATION

7.1 Research

7.1.1. The research structure

The national research activities are organized under UTAFITI, Baraza la Taifa la Utafiti wa Kisayansi (Tanzania National Scientific Research Council). According to Professor Msangi, UTAFITI, research activities within the fields of ecology, deforestation, and watershed management have been very limited up to now, but these problems are now being taken up by several research organizations.

7.1.1.1 Forest Division

The Ministry of Lands, Natural Resources and Tourism, Forest Division, has a Section for Research and Training (see Figure 4). This Section operates two research stations:

- Forest Utilization Section, Moshi, and
- Silvicultural Research Station, Lushoto, which has field stations in Dodoma, Moshi, Malya (Shinyanga), Ruvu, and Sao Hill.

The Silvicultural Research Station has concentrated on softwood and plantation forestry up to now, but wishes to expand and increase research on natural forests and ecological assessment of impacts of logging and deforestation. They are interested in starting up two specific research projects:

- a) Agroforestry Research Program, Forest Division. To be led by Mr. Steven T. Mwokomeka in cooperation with The International Council for Research in Agroforestry (ICRAF), Nairobi.
- b) Effects of catchment forests on water resources and soil conservation in Tanzania.

These projects are in the planning stage and lack funding to start up the research.

The Silvicultural Research Station does not have its own laboratory to analyze, for example, soil samples, but uses the agricultural laboratory in Tanga. The total staffing is about 60, of which 15 are research officers connected with the station. The station has one of East Africa's largest arboreta, with more than 160 tree species.

7.1.1.2 Institute for Resource Assessment (IRA)

Institute for Resource Assessment (previously BRALUP) is an independent research institute of the University of Dar es Salaam. It is interdisciplinary, and is particularly engaged in research on soils (including methodology and mapping), land use, and changes in vegetation cover. They have their own

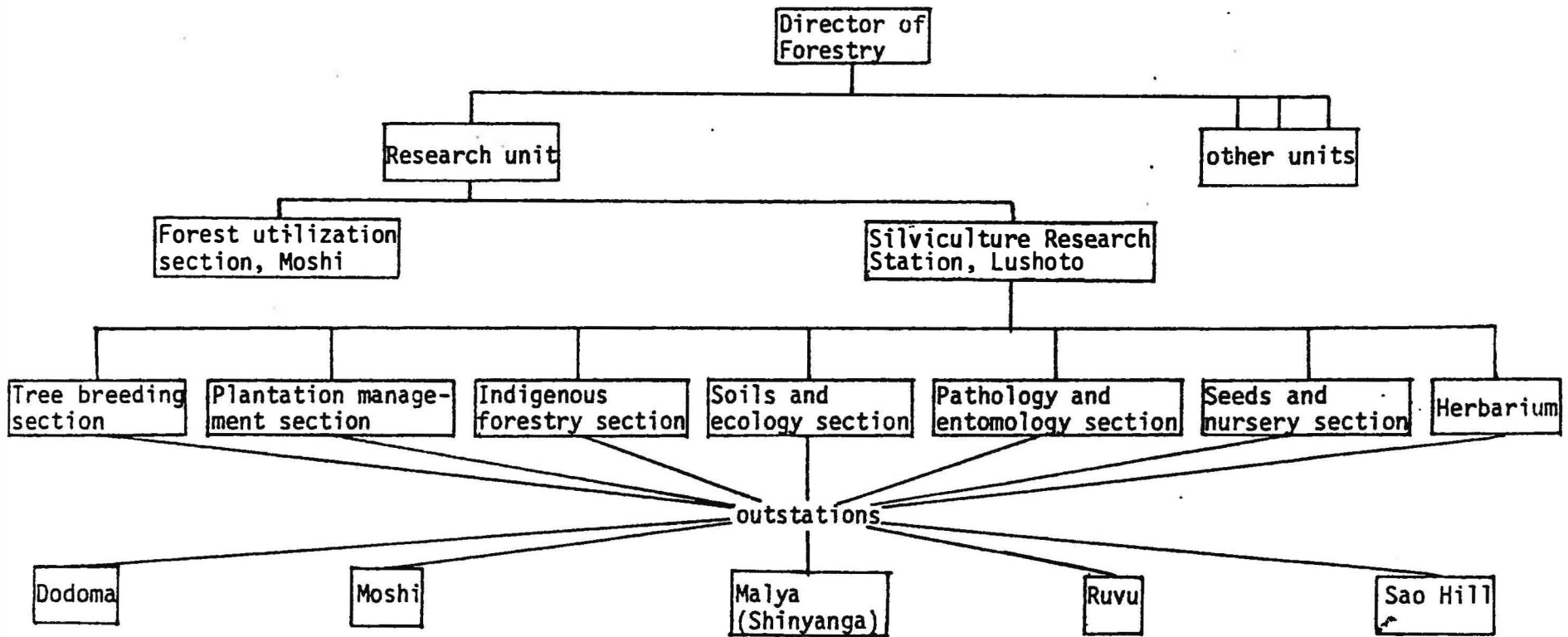


Figure 4. Organization chart of the Research Section, Forest Division. From Svenson (1984)

aerial photo archive which includes photos taken by the English before independence. They use LANDSAT imagery (at present, photographic versions, but they plan to purchase a computer for digital analysis). See Chapter 8 for a discussion of vegetation mapping.

7.1.1.3 Faculty of Forestry, Sokoine University of Agriculture

This University changed names in 1984. The Faculty of Forestry was previously called the Division of Forestry, Faculty of Agriculture, Forestry, and Veterinary Sciences, University of Dar es Salaam. It is located in Morogoro. In addition to offering coursework in forestry, the Faculty of Forestry also conducts research. This research as well as the teaching emphasizes production forestry, but the Faculty has also conducted research on agroforestry and development of higher-efficiency wood stoves.

7.1.1.4 Forest Research Institute

This institute is officially established, but has not begun to function yet. It will be an independent research institute at Morogoro with 7 field stations located around the country. The research activity now going on through the Division of Forestry will be shifted to this institute. The Silviculture Research Station, Lushoto, will therefore be included as a part of the new institute. Professor Mascarenhas is the chairman of the board.

7.1.2 Research activities

7.1.2.1 Evaluation

We feel that the research activity in Tanzania has not been aimed at the ecological crisis large areas of Africa now face due to deforestation, drought, erosion, and famine.

Information about the current situation is not systematically gathered or analyzed.

When trial projects are carried out, they often lack proper reference points (scientific controls) so that changes due to treatments can be objectively evaluated. For example, in the HADO project, no control plots were laid out in the vegetation. This project has given very positive results, and shows that it is possible to rehabilitate the vegetation. However, it is difficult to analyze which management techniques have given the greatest effect. As a result, the projects results are more difficult to apply to future rehabilitation efforts.

Research activities within forestry strongly emphasize commercial (production) forestry, especially in softwood plantations. The research at the Faculty of Forestry, Sokoine University of Agriculture, illustrates this. Of 30 projects during the period 1979-83, only 4 deal with natural forest. These four projects are concerned with commercial use of the forest.

The emphasis that is now given to the economic sides of forestry must not occur at the expense of long-term, ecologically responsible forest management. The forestry research activity should reflect this basic principle. This is not the case at the present.

7.1.2.2 Proposals

In general, research on catchment forestry should be started as soon as possible. The forests' catchment properties should be evaluated under various types and degree of alteration, compared with undisturbed forest. The effects of various silvicultural practises should also be investigated.

Monitoring systems should be developed. Existing data on natural conditions (soils, climate, vegetation), impacts (for example, logging) and encroachment must be collected and presented in summary form so that they can be compared with the data from inventory and reporting that we propose in Chapter 5. It is important that the data can be easily processed and summarized so that it is readily available. The data collection system should be computerized.

There is a great need for a classification system based on genetic, ecological, catchment, and productivity criteria. This is needed to place the various forests in appropriate management-groups.

Tanzania lacks a complete flora and literature on botanical identification. Plant identification is a necessary step in understanding forest ecology. Old works may be reprinted or, preferably, new works may be written.

Encroachment, cutting, conversion to agriculture, and erosion must be monitored. Repeat aerial photographs (preferably infrared) and satellite data from the new high resolution sounders (SPOT and Space Shuttle Observation Programme) should be brought into use as soon as possible to gain experience.

The Forest Research Institute should receive funding as soon as possible for staffing, buildings, equipment, and research projects. Scholarships should be given in the fields of catchment forestry, soil conservation, and watershed management to build up Tanzanian competence in these areas. Tanzania needs assistance, both specialists and funding, to bring about these projects.

7.2 Education

7.2.1 Higher education in forestry in Tanzania is organized as follows:

- a. From the Secondary School level (Form IV) one can take a Certificate in Forestry. Training is at Olmotonyi, near Arusha, and lasts 2 years. The program includes coursework in forest production, engineering, biochemistry, statistics, administration, and forest policy.
- b. After 5 years in the field one can take a Diploma course

at Olmotonyi. This lasts 16 months. After 2 years practical work one can continue at the University.

- c. From High School (Form VI) one can start directly at the University.

Faculty of Forestry, Sokoine University of Agriculture, Morogoro. The study plans for B.Sc. and M.Sc. in Forestry are presently being revised. About 26 students per year enter these two programs; about 80% are Tanzanians. The University forestry study line includes both theory courses and practical exercises, for example at Olmotonyi Training Forest and Mazumbai Natural Forest. Forest biology, ecology, and climatology are included in the study program, but constitute a relatively small part of the study material.

7.2.2 Lower-level forestry training

There is a need for improved education at all levels within the fields of catchment forestry, watershed management, and afforestation. Most people we met expressed the desire for up-grading courses in various fields. Some of the areas people expressed interest in were: production of seedlings from indigenous trees, enrichment planting (especially species composition and silviculture), natural forest botany and ecology, measurement of rainfall and runoff, data reporting, catchment forestry, and erosion control.

These topics should also be included in primary and secondary school education in order to improve understanding of and attitudes toward the natural forest resource.

7.2.3 Discussions and recommendations

In our opinion the emphasis of the study is heavily biased toward industrial forestry and in particular towards softwood forestry. Too little emphasis has been given to the management of natural forests, which should have been given higher priority according to political aims stressing catchment forestry. We recommend that support be given in order to develop the study of catchment forestry, especially on M.Sc. level. This is needed to secure the supply of experts on a high level to conduct the of forestry and watershed management programs.

It is not sufficient to extend the study of natural forest management. There are preliminary plans for a new study emphasizing erosion control, water management, rehabilitation of landscape etc. In our opinion, a such environmental study line should be initiated as soon as possible in order to fulfill the requirements for skilled experts in watershed management. Tanzania does not have a sufficient supply of teachers qualified to teach in such a study line. Foreign assistance to build up Tanzanian competence in these areas is badly needed.

8 SATELLITE DATA, AERIAL PHOTOS, AND VEGETATION MAPS

8.1 Interpretation of photographic satellite images.

Two separate and independent projects are currently working on making maps of Tanzania based on interpretation of the photographic version of data from LANDSAT. Both projects use a vegetation cover system. The Forest Division Section for Survey and Inventory is working on a 1:2 000 000 map with ten mapping units, five of which are forest types (in a broad sense). The work is being done at the Regional Centre for Services in Surveying, Mapping, and Remote Sensing, Nairobi. The map is expected to be printed in the first half of 1985. The Institute for Resource Assessment (IRA), University of Dar es Salaam, is working on a similar map which is expected to be printed in 1986.

The Section for Survey and Inventory is also working on regional maps for Dar es Salaam, Morogoro, Iringa, and Ruaha in a 1:250 000 scale. These are expected to be completed by the end of 1985.

8.2 Digital satellite technique

The Section for Survey and Inventory began to use digital satellite techniques in 1983, financed by SIDA and supported by foreign consultancy. The computer work is being done in Sweden. The work is being done on an area near Tabora.

8.3 Aerial photos

Aerial photos have been and still are an important tool in mapping vegetation and land use (see the text on the accompanying map). Several series of aerial photos are available for Tanzania, and this material can be used to analyze changes in the landscape. The Catalogue of Maps, Tanzania (Dec. 1983), published by the Survey and Mapping Division, Ministry of Lands, Housing, and Urban Development, contains an overview of some of these aerial photo series. The Survey and Mapping Subsection also has an aerial photo archive, but it is somewhat difficult to locate the photos needed. The photo indexing system is incomplete, and better archive equipment is needed. IRA has photo material from before Independence.

8.4 Discussion and evaluation

We examined the possibility of using satellite images (at a scale of 1:500 000 and resolution or pixel size 60 x 80 m) for evaluation and mapping of forest reserves for management purposes. We feel that these do not have good enough resolution to be used for this purpose, but digitally-analyzed satellite data will probably be useful for mapping of watersheds at a somewhat smaller scale.

For the time being, aerial photos at a scale of 1:15 000 to 1:50 000 are the best material to use for mapping and field

inventory. Use of infrared film and repeated photography is recommended to follow ongoing changes in the landscape due to encroachment, logging, erosion, etc.

The new satellite data with resolution (pixel size) down to 10 x 10 m will probably be very useful. However, use of these data requires thorough field work as a basis for identifying the various vegetation/land use units. Geographic placement of the images can also be difficult, and this is of course essential for the purpose of local forest management. The American "Space Shuttle Observation Program" has in operation a satellite that in the near future can give data of this type, as will the European SPOT satellite, scheduled to be launched in 1986. With digital analysis techniques, these data will be very useful in survey and registration of landscape changes.

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South Kilimanjaro Forest Project (Natural Regeneration)
1981-1986. Compiled by G.W.N. Malingilla.

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Compiled by G.W.N. Malingilla.

Catchment Forest - Arusha Region. 1981-1986. Compiled by
S.S. Kashenge.

Loliondo Forest of South East Meru. 1981-1986. Compiled by
A.L. Mrema.

Morogoro Forestry Project.

Other documents:

Brief notes - Longuza/Kwamkoro Project. Maulid Athumani and
Lyimo.

Camphor regeneration - West Usambara, Lushoto. S. Rumbeli.

Short outline of TIRDEP/SECAP.

A brief report on Kilimanjaro Natural Forests Catchment to
NORAD Mission. G.W.N Malingilla.

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T e r m s o f R e f e r e n c e

PREPARATORY STUDY FOR ACTIONS LIMITING
DESTRUCTION OF THE REMAINING NATURAL FOREST
ON THE HILL AND MOUNTAIN-SIDES IN TANZANIA.

1. Background: In a letter of Feb. 13, 1984 Tanzania requested NORAD for technical assistance for establishing management plans for the remaining natural forests in the most important water catchment areas.
2. Scope: This study includes only one part, which represents the basis data collection of the complete request received from Tanzania.
3. Primary goal: The purpose of the study is to get the best possible base for the realization of a project with the aim of forming a plan for forest management and forest conservation and protection in the most critical water catchment areas in Tanzania. The study will reveal to what extent the existing data can be used; what is needed of supplemental investigations; how these can be carried out; how the necessary silvicultural and protection efforts must be formulated and implemented; in what way the management plan can be integrated in the national planning; necessary training and how the monitoring best can be set up.
4. Secondary goal: A further aim of the study will be to establish contacts between the team and possible co-operative groups on different professional and management levels in Tanzania.
5. Main project: The collection and organization of the data, to be done during the preparatory study, will build a base for the development of a more detailed Terms of Reference for the main project to come later; with specification of work tasks and schedule of operation, together with the necessary personnel, resources and costs.

The report from the preparatory study may also serve as a preliminary environmental report, based on the available information, evaluated and systemized by the multi-professional team.

6. Organization: The Institute for Environmental Analysis at the District College in Bø is responsible for the professional work. FORINDECO will administer the study on behalf of and after authorization from NORAD.

7. Personnel: The team will collect data through libraries and other data sources. They will supplement this data collection through contacts and field visits in Tanzania, and their evaluation and report will form the basis for the main project. The team will consist of personnel with earlier experience from Tanzania as well as professional people without such background, but with relevant specific knowledge and experience from Norway and other countries. NORAD shall approve each team member as well as each individual trip to Tanzania.

8. Elements in the study:

Collection of data.

Identification of relevant sources (libraries, data banks, individuals).

Geographical localization of all the forest areas concerned.

Maps and/or satellite pictures will be used as documentation base.

Documentation to establish the conditions in each individual area. As far as possible this will be done on the basis of existing data. Field checks will however be necessary in areas of major importance and where existing data are inadequate. Systematization of information on variation in utilization of the area, will be carried out. The influence of the cultural background will be checked. The degree of legality in the use of the areas, i.e. the relationship with the existing laws and the practicing of these laws in the different areas will be investigated.

Illustration of clear ecological interrelationships.

Where this can be unambiguously documented by the existing data, it is important to get this

clarified as soon as possible with the thought of starting information and attitude-changing activities.

Listing of hypothesis for potential ecological cultural relations tied to conditions where the interrelationship is ambiguous. Specification of necessary remedies for clarification.

Appropriateness of utilizing remote sensing:

The possibilities for mapping of the actual areas through a combination of field work for establishing "ground truth" and the use of analogous techniques, and later digital analysis, will be investigated.

The development of tables/matrix illustrating the problems of the actual theme in the different areas. A number of conditions will be investigated such as: local climate, soil type, soil condition, composition of the vegetation, geohydrology, degree and extent of the influence of the cultural background, extent of erosion and mineral dilutions, changes in the water supply and increased soil acidity.

Specification of special problems for the management in the different areas. Clarification of especially difficult or sensitive conditions regardless whether these can be listed as ecological, sociological, legal etc..

A plan over the areas/regions where the conditions are specially critical, with the view of setting up priorities for the work later to be done in the main project.

Reporting, conclusions

Terms of Reference for the main project.

The report of the environmental conditions will conclude with a detailed plan for the main project. Elements in this will be suggestions for supplemental data collection; outlines for protection and management plans for each area; a plan for integration of all these in the national planning, information efforts and a program for monitoring; schedule of operations, personnel and resource requirements.

APPENDIX 2

ITINERARY

The catchment-forest project team, NORAD mission was in Tanzania (and Kenya) from Nov. 4 to Dec. 15, 1984.

- Nov. 4-7 Arusha.
Symposium on Use of Local Timber for Building Purposes, Arusha International Conference Centre, Nov. 5-7, 1984.
- Nov. 8-11 Nairobi.
Briefing at SIDA.
Visit to Regional Centre for Services in Surveying, Mapping, and Remote Sensing.
Visit to NORCONSULT A/S
- Nov. 9-15 Dar es Salaam.
Briefing and discussions at NORAD, UTAFITI and Forest Division of the Ministry of Lands, Natural Resources and Tourism.
Preparation for site visits.
Visit to Institute of Resource Assessment (IRA).
Discussions with members of the Board of the Forest Research Institute.
Selection of maps and aerial photos at Drawing Office, Section for Survey and Inventory of the Forest Division.
Visit to the Library of Ministry of Water, Energy and Minerals.
- Nov. 15 Travel to Tanga.
- Nov. 16-18 Catchment Forest Project - Tanga.
Programme coordinated by Catchment Forest Officer.
Visit to Ministry of Lands, Natural Resources and Tourism, Tanga Regional Officer.
Excursions to Bombani village;
Research Nursery, Longuza; Longuza/Forest Kwamkoro-project, Malaria Research Institute, Amani; Amani Sigi Forest Reserve; Kwamkoro Forest Reserve.
Keywords: Enrichment planting; dense population; encroachment; clearcutting of high, dense forest on ungazetted (public) land.
- Excursion to Kwamkole village: Lutindi Forest Reserve.
Keywords: Deforestation; large scale encroachment; insufficiently guarded.
- Nov. 19 Travel to Lushoto

- Nov. 20-22 Magamba Forest Project.
 Programme coordinated by Forest Project Officer.
 The forest reserves belong to Catchment Forest Project, Tanga, but they are administered from Magamba.
 Excursion Mkusu Forest Reserve; Ndelemai Forest Reserve, Balangai Forest Reserve, and Shume Magamba Forest Reserve.
Keywords. Camphor regeneration; pit-sawing; Heavily populated public land with large scale deforestation and erosion on hillsides.
- Visit to the German Tanga Integrated Rural Development Programme (TIRDEP), Soil Erosion Control and Agroforestry Project (SECAP) in Western Usumbaras. Excursion to the project area and villages (e.g. Malibwi village).
- Visit to Silviculture Research Station, Lushoto.
Keywords. Research, funds and facilities; lack of catchment forestry research.
- Nov. 22 Travel to Moshi.
- Nov. 23 -
 Dec. 2 Catchment Forest Project - Kilimanjaro.
 Programme coordinated by Catchment Forest Officer.
 Excursion to Kilimanjaro Forest Reserve and Old Moshi Nursery.
Keywords. Camphor regeneration; commercial trees partial cut out; encroachment; water supply. Boundary tree planting.
- Excursion to Rau Forest Reserve.
Keywords. Located on the plain near Moshi; forest based on underground water supply from Mt. Kilimanjaro; endemic species; serious encroachment; nursery, Chlorophora excelsa, Oxystigma msou.
- Excursion to West Kilimanjaro Forest Station.
Keywords: Softwood plantations; mobile sawmill; animal damage to trees.
- We undertook a pilot management study of Himo river watershed. Development of vegetation and land use map based on aerial photo interpretation and field study.
 Meeting with District Council, Moshi.
Keywords. Local management; water and fuelwood supply; erosion control in shamba-land.
- Dec. 2 Travel to Arusha.
- Dec. 3-5 Catchment Forest Project - Arusha.
 Program coordination by Forest Project Manager - catchment.

Excursion to Usa Forest Project;
Ngonongare natural forest and loliondo regeneration;
Usa sawmill; tour Ngurdoto range; Ngurdoto crater
and Arusha National Park.

Keywords. Difficulties with loliondo regeneration,
shut down sawmill; boundary planting; animal damage
to trees.

Excursion to Catchment Pond, Sakila.

Meeting with members of the village assembly and
leaders of different authorities and organization
in Sakila village.

Keywords. Water supply; afforestation; protection of
forests; livestock grazing; attitudes for environ-
mental protection.

Excursion to Marang Forest Reserve.

Study of erosion along the road.

Travel to Ngorongoro Crater late Nov. 5.

Dec. 6 Ngorongoro Crater.

Dec. 7 Travel to Kondoa.

Dec. 8 Visit to HADO (Hifadhi Ardhi Dodoma), a soil
conservation project, Kondoa.
Excursion to erosion-controlled areas and to heavily
eroded areas.

Dec. 9 Travel to Morogoro.

Dec. 10 Catchment Forest Project - Morogoro.
Meeting with Catchment Forest Officer.
Keywords: Current status in the reserves.

Visit to Faculty of Forestry, Sokoine University
of Agriculture, Morogoro.

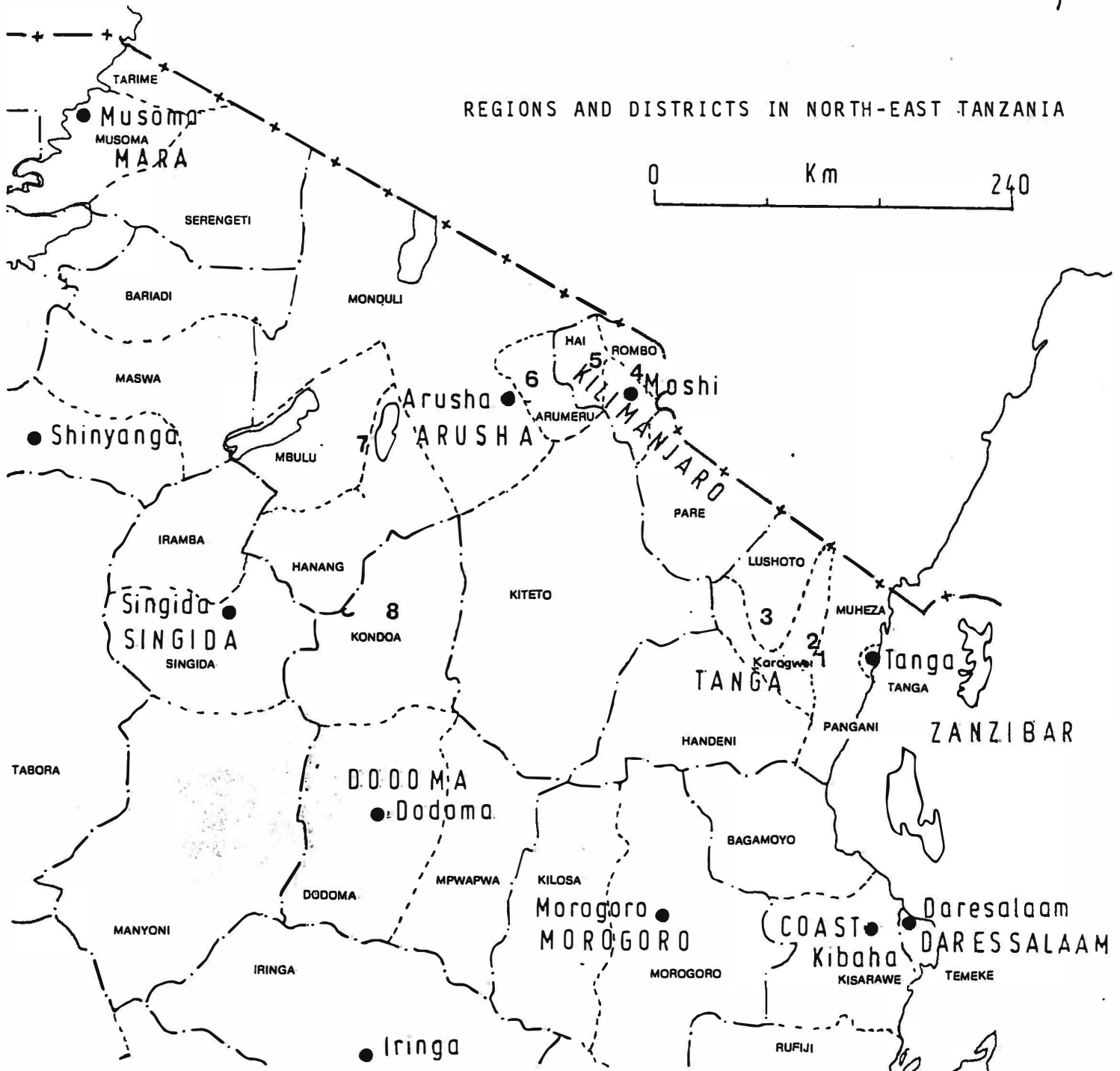
Keywords: Education and research must give more
emphasis to natural forests.

Travel to Dar es Salaam.

Dec. 11-14 Dar es Salaam.
Follow-up meetings with Forest Division; SIDA; TWICO.
Obtained necessary aerial photos and map folies for
the production of the land use map from Kilimanjaro.

Dec. 15 Travel to Oslo.

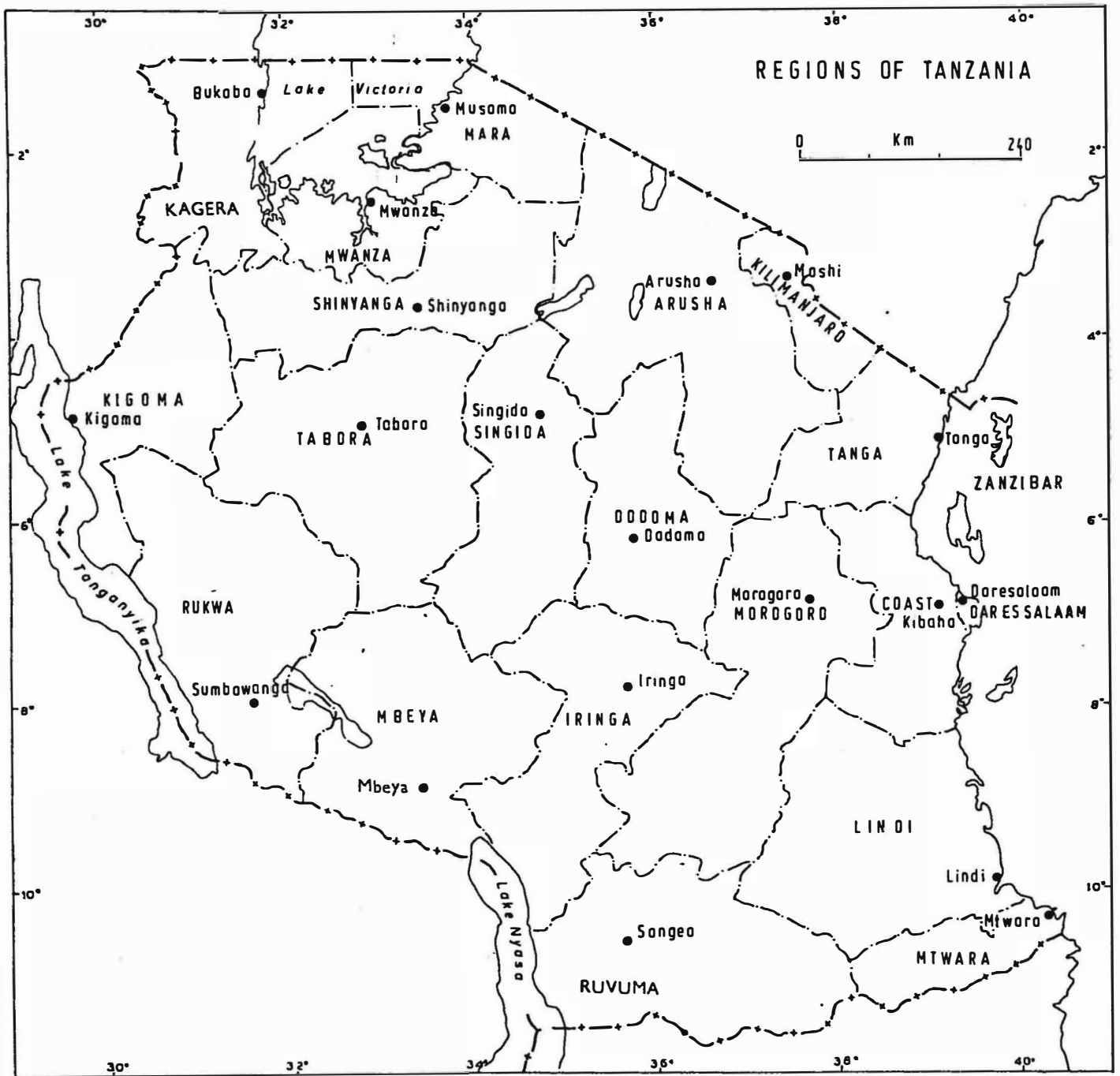
REGIONS AND DISTRICTS IN NORTH-EAST TANZANIA



THE TEAM VISITED THE FOLLOWING FOREST RESERVES AND PROJECTS

Catchment Forest Project Tanga, Moshi, Arusha and Morogoro

- | | | | |
|---|---|---|--|
| 1 | Longuzu/Kwamkoro Forest Project
Kwamkoro Forest Reserve
Amani Sigi Forest Reserve | 4 | Kilimanjaro Forest Reserve
Rau Forest Reserve |
| 2 | Lutundi Forest Reserve | 5 | West Kilimanjaro Forest St. |
| 3 | Magamba Forest Project, Lushoto
Mkusu Forest Reserve
Balangai Forest Reserve
Ndelemai Forest Reserve
Shume - Magamba Forest Reserve
TIRDEP/SECAP | 6 | Usa Forest Project
Meru Forest Reserve |
| | | 7 | Marang Forest Reserve |
| | | 8 | HADO-project, Kondoia |



APPENDIX 3**OFFICERS CONTACTED**

1. Ministry of Lands, Natural Resources and Tourism, Division of Forestry, Dar es Salaam

Mr. P.E. Kimariyo	Ass. Director
Mr. B. Kessy	Head, Sec. for Training and Research
Mr. S.B. Mbwana	Head, Sec. for Development and Management
Mr. Ahlback	Forestry Planning
	Coordinator - " -
Mr. Dallu	Ass. Forest Officer - " -
Mr. R. Tutzauer	Forest Measurantonist, Sec. for Survey and Inventory
Mr. L. Okello	Chief Photogrammetrist, Sec. for Survey and Inventory
Mr. G.M. Sampa	Cartographer, Sec. for Survey and Inventory

2. Ministry of Lands, Natural Resources and Tourism, Regional Offices

Mr. Rajabu	Regional Officer, Tanga
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3. Ministry of Lands, Natural Resources and Tourism, Division of Forestry Catchment Forest Project
 - A. Catchment Forest Project - Tanga Region

Mr. O.R. Mndambi	Catchment Forest Officer, Tanga
Mr. R. Kajuna	Ass. Catchment Forest Officer, Tanga
Mr. S.K. Mswalla	Ass. Forest Officer, Project Manager, Longuza
Mr. Maulid	Ass. Forest Project Officer, Longuza
Mr. Mburi	Ass. Forest Project Officer, Longuza
Mr. Lyimo	Ass. Forest Project Officer, Longuza
Mr. S. Rumbeli	Forest Project Office, Magamba
	Forest Project, Lushoto

 - B. Catchment Forest Project - Kilimanjaro Region

Mr. S.W.N. Malingilla	Catchment Forest Officer, Moshi
Mr. R.I. Luganyuma	Ass. Catchment Forest Officer, Moshi
Mr. J.G. Mwakasonda	Ass. Forest Project Officer, West Kilimanjaro

 - C. Catchment Forest Project - Arusha Region

Mr. S.S. Kashenge	Forest Project Manager - Catchment Arusha
Mr. Mtipula	Ass. Forest Project Officer, Arusha
Mr. A.L. Mrema	Forest Project Officer, Usa Forest Project, Usa

 - D. Catchment Forest Project - Morogoro Region

Mr. S.M. Mkwiza	Catchment Forest Officer, Morogoro
Mr. Mosha	Ass. Catchment Forest Officer, Morogoro

4. Soil erosion control and agroforestry project

Mr. Woytek	TIRDEP/SECAP, Lushoto
Mr. Goebel	- " -
Mr. Mbegu	HADO-Project, Kondoa
Mr. Mlenge	- " -

5. Research and education

Prof. Msangi	UTAFITI, Dar es Salaam
Prof. A. Mascarenhas	Director, Institute of Resource Assessment (IRA/BRALUP), Dar es Salaam
Mr. O. Ngama	Hydrologist, - " -
Mr. Shishira	Geomorphologist, - " -
Mr. R. Mwalyosi	Ecologist - " -
Mr. G.A. Kitambi	Director General, Tanzania Forest Research Institute, Dar es Salaam
Mr. L. Nshubemuri	Senior Forest Research Officer, - " -
Mr. A.G. Kalaghe	Head, Silviculture Research Station, Lushoto
Mr. H. Msangi	Forest Research Officer, Natural Forest Subsection, Silviculture Research Station Lushoto
Mr. M.E. Shoo	Ass. Forest Officer, Silviculture Research Station, Lushoto
Dr. A.B. Temu	Dean, Faculty of Forestry, Sokoine University of Agriculture, Morogoro

6. District and Village authorities

Mrs. I.A. Mmari	District Executive Director, Moshi District Council, Moshi
Mr. D.L. Molleu	District Planning Officer, Moshi District Council, Moshi
Mr. T.A. Sikawa	Chairman, Sakila Village, Arusha District
Mr. S.M. Mafie	Secretary, - " -
Mr. E. Mshanga	Village Manager, - " -

7. Miscellaneous

Dr. V.A.O. Odenyo	Director, Regional Center for Services in Surveying, Mapping and Remote Sensing, Nairobi
Mr. S.N. Kalyango	Application Specialist, - " -
Mr. J.E. Sørli	Resident Manager, NORCONSULT, Nairobi
Mr. B. Engen	NORCONSULT, Nairobi
Mr. J. Holmes	Training Manager, TWICO, Dar es Salaam
Dr. L. Lundgren	Regional Soil Conservation Adviser, SIDA, Nairobi
Mr. C.A. Gerden	Senior Programme Officer, SIDA, Dar es Salaam
Prof. H. Skjelmerud	Norwegian Institute of Wood Working and Wood Technology, Oslo
Prof. J. Kielland-Lund	Institutt for Skogskjøtsel, Norges Landbrukshøgskole, Ås
Mr. Ø. Dick	Chief Engineer, Fjellanger Widerøe, Oslo
Mrs. Åse Seim	Ass. Resident Representative, NORAD, Dar es Salaam

APPENDIX 4

CATCHMENT FOREST PROJECT RESERVES

On the following pages we have compared the list of Protective Forest Reserves from Forest Division (1984) and the list in Lundgren's report (1984) with the information we got from the Catchment Forest Officers, which is here called "Adjusted Dec.84"

From Arusha and Kilimanjaro Catchment Forest Project we got written information and for Tanga and Morogoro we got verbal information. For Morogoro we have also referred to the list in the Management Plan for Morogoro Forestry Project (1981?) because this list's grand total (255 732 ha) was much lower than that in the adjusted list (384 618 ha).

It is important to distinguish between the formal size (according to the boundaries) and the actual size of the forest.

In some cases the reserve has increased in size. The forest by itself has not increased. It is only the boundaries that have been enlarged.

Transfer of Forest Project land to District Councils is indicated as "To D.C."

ARUSHA CATCHMENT FOREST PROJECT

Forest Reserve Area in ha	For.Div.84. Protective Forest Res.	Lundgren 84 Catchment Forest Proj.	Adjusted Dec. 84	
Lake Duluti	18.6	34.4	34	
Burko	579.5	838.7	839	
Loliondo	2 331.0	10 011.3	7 409	1) 2602 to D.C.
Njogi	466.2	466.2	466	Managed from Dodoma
Northern Highlands	89 151.9	-----	-----	
Bereku	9 955.3	1 215.0	2) 1 215	
Essimingor	6 070.3	6 118.8	6 119	Esmangori
Hassama Hill	4 856.1	4 860.0	4 860	
Marang	35 399.2	23 328.4	23 328	Pitsawing, 6-licenses. Bot.cons.value
Meru	26 443.5	26 443.5	26 433	
Monduli	6 057.4	8 483.8	8 971	
Nou	31 256.5	29 121.0	29 121	Small scale pit- sawing
Ufiome	4 847.8	5 564.4	5 564	
Kitumbeine	12 990.5	12 910.5	-----	To D.C.
Gelai	2 448.3	8 025.0	-----	To D.C.
Longido	2 815.4	2 015.4	2 015	
Hanang	5 698.1	5 702.4	5 702	
Haraa	-----	628.0	628	
	241 386	145 767	122 704	

1) Consists of Kingarane (2964), Olosho (2261), Kisolidare (1921) and Kisamasi (263)

2) One part in Kondoa is not included.

KILIMANJARO CATCHMENT FOREST PROJECT

Forest Reserve Area in ha	For.Div.84. Protective Forest Res.	Lundgren 84 Catchment Forest Proj.	Adjusted Dec. 84	
Kilimanjaro	75 575.0	107 709.0	107 828	Softwood included
Kindoroko	885.0	885.0	884	
Minja	520.0	520.0	520	
Chome	14 282.0	14 282.0	14 282	
Kahe 1	884.2	----	----	
Chambogo	5 466.5	5 466.5	5 466	
Chongweni	92.3	92.3	----	To D.C.
Maganda	12.1	12.1	----	To D.C.
Mramba	3 354.9	3 354.9	3 354	
Vumari	1 820.2	1 770.0	----	1)
Kirangahengai	-----	322.0	----	To D.C.
Rau	-----	566.4	620	Bot.cons.value; Encroachment of forest, grass
Kiswani	-----	70.4	----	To D.C.
Kankoma	-----	74.5	----	To D.C.
Koho Hill	-----	78.1	----	1)
Gonja	-----	88.6	----	To D.C.
	102 892	135 292	132 954	

1) Probably Forest Reserve but not included in Catchment Forest Project.

TANGA CATCHMENT FOREST PROJECT

Forest Reserve Area in ha	For.Div.84. Protective Forest Res.	Lundgren 84 Catchment Forest Proj.	Adjusted Dec. 84	
Amani Estate	98.7	98.7	99	
Kwadiboma	268.0	268.0	268	
Mbegere	368.0	368.0	----	Not existing
Mkuli	2 931.0	2 931.0	----	- " -
Mkongo	985.0	985.0	----	- " -
Mkoro	91.0	91.0	----	- " -
Msingeho Hill	115.0	115.0	----	- " -
Mtunguru	2 305.0	2 305.0	----	- " -
Pumula	1 062.0	1 062.0	----	- " -
Rudewa	556.0	556.0	556	
Baga	3 049.0	3 049.0	3 059	Under Magamba For.Proj.
Mzinga	255.0	255.0	255	
Kitara Ridge	564.0	564.0	----	Not existing
Mkusu	7 360.0	7 360.0	3 674	Under Magamba For.Proj.
Mtumbi	304.0	304.0	----	To D.C.
Bumba Mavumbi	1 056.0	1 056.0	1 056	
Lukoka Hill	170.3	170.4	----	Not existing
Mahenzangulu	326.0	326.0	326	
Amani Sigi	1 141.2	1 141.2	1 141	
Balangai	1 003.0	1 003.0	988	Under Magamba For.Proj.
Derema	3 926.4	3 926.4	3 926	
Handeni Hill	544.0	544.0	544	
Kilanga	431.0	431.0	431	Large scale encroachment

Kilindi	5 128.0	5 128.0	5 128	
Kisima Gonja	1 440.0	1 440.0	1 440	
Kwamkoro	2 210.0	2 210.0	2 210	
Kwamsambia	1 416.0	1 416.0	1 416	
Lutindi	2 176.0	2 176.0	2 176	
Mafi Hill	2 671.0	4 475.0	4 475	
Mnyisi Scrap	674.0	674.0	674	
Mtai	6 071.0	6 071.0	6 071	Large scale encroachment Under Magamba For.Proj.
Ndelemai	1 437.4	1 437.4	1 422	
Amani West	144.9	144.9	145	
North Nguru	14 051.9	14 051.9	14 052	
Nkombola	191.9	191.9	192	
Shagayu	7 928.3	7 928.3	7 830	Under Magamba For.Proj. - " -
Shume Magamba	12 429.5	12 429.5	12 276	
Vugiri	40.0	40.0	40	
	86 920	88 724	75 870	

MOROGORO CATCHMENT FOREST PROJECT

Forest Reserve Area in ha	For.Div.84. Protective Forest Res.	Lundgren 84 Catchment Forest Proj.	Adjusted Dec. 84	
Disalasalala	6.1	6.1		To D.C.
Dindili	1 006.9	1 005.0	1 005	
Mindu	2 285.3	2 205.3	2 205	
Mkungwe	1 966.0	5 645.0	5 645	
Mvuha	569.0	569.0	569	
Pangawe West	184.1	184.1	----	To D.C.
Pangawe East	768.5	768.5	----	To D.C.
Rugles Brise	20.2	20.2	----	To D.C.
Shikurufuni	219.3	219.3	----	To D.C.
Kihiriri	208.0	208.0	208	Encroachment
Mamboya	203.0	455.0	455	
Pala Mountain	10 619.0	10 619.0	10 619	
Talagwe	1 085.4	1 005.4	1 005	
Iyondo	25 385.0	25 385.0	25 385	
Kwiro/Nawense	134.4	134.4	623	Nawense added
Kalunga	761.2	761.2	761	
Ligamba	15.8	15.8	16	
Mahenge Scarp	386.9	386.9	500	
Matundu	8 598.8	8 598.8	8 599	Selective logging No tending
Mahulu	609.9	609.9	610	
Mselezi	770.5	2 245.0	361.0	
Mwanihama	8 501.6	8 501.6	8 502	
Myee	93.1	93.1	----	To O.C.
Nyangaje	138 075.0	138 075.0	138 075	

Sali	983.0	983.0	1 890	
Ikwamba	888.7	888.7	889	
Iwonde	4 388.4	4 388.4	4 388	
Kanga	6 664.0	6 664.0	6 664	
Mamboto	183.3	183.3	137	
Milindo	4 544.6	4 544.6	4 545	Softwood
Mkindu	7 541.4	7 541.4	5 244	Encroachment
Mwanihana	18 130.0	18 130.0	18 130	
North Uluguru	18 356.4	18 356.4	18 356	
South Uluguru	17 292.7	17 292.7	17 293	
Tangeni River	231.5	231.5	----	Not existing
Uponera	291.8	360.0	360	
Ukwiva	54 632.4	54 632.4	54 632	Temporary encroachment
South Nguru	18 792.1	18 792.1	18 792	
North Mamiwa Kisara	7 896.7	7 896.7	7 897	
South Kisara	6 266.2	6 266.2	6 266	
Namsiga- Mabenge distr.	----	----	1 390	
Mosagatt Kilomsloro	----	----	6 475	
Kimsosa Morogow	----	----	405	
Ruvu	----	----	2 983	
Kitulangulo	----	----	2 637	
Bundute	----	----	101	
	369 556	374 868	384 618	

MOROGORO CATCHMENT FOREST PROJECT
 DATA FROM MANAGEMENT PLAN FOR MOROGORO FORESTRY PROJECT

Mwanihana	18 000
Nyanganje	19 000
Iyondo	28 000
Iwonde	15 000
Mosagati	6 500
Matundu	17 700
Sali	1 000
Nawange/Kwire	134
Nambiga	1 400
Mselezi	800
Mahenge-Scarpment	400
Ukwiva	55 000
North Mamiwa Kisara	7 900
South - " -	6 300
Mamboya	200
Ikwamba	900
Uponera	300
Talagwe	1 100
Memboto	180
Palaulanga	10 600
Ruvu	3 100
Dindili	107
Mindu	2 300
Kitulangalo	2 600
Bunduki	111
Kimboza	3 800
Mkungwe	2 000
South Uluguru	17 300
Nguru South	19 000
Kanga	7 000
Mkindo	8 000

255 732

Note: This total is ca. 34% lower than the Adjusted Dec. 84 total.
 Most of this difference is due to Nyanganje (138 000 versus 19 000).

APPENDIX 5

EAST AFRICAN CAMPHORWOOD REGENERATION

By S. Rumbeli, Magamba Forest Project, Lushoto.

Camphor Forest fall in the Forest type known as Mountane rain Forest. In Tanzania Ocotea usambarensis can be found in most West Usambara, South Kilimanjaro and East Pare, Nguru, Uluguru, Usagara, Mufindi and Dabaga.

In East Africa, Camphor occurs in exploitable quantities in three localities thus Mount Kenya, Mount Kilimanjaro and in West Usambara which you are now visiting. In Tanzania therefore we are interested with two areas that is South Kilimanjaro and West Usambara where there are our two camphors Regeneration Project in the country.

The objectives of the project:

1. To improve and maintain the economic value of the Forests through replacing those which have been felled by stimulating and tending young regeneration of camphor in accordance with principle of sustained yield.
2. To maintain a permanent stream flow through of Camphor Forest and to cover watershed areas
3. To carry out anti erosion measures in all felled areas so as to promote no 2 above.
4. To provide in perpetuity a sustained yield of timber of high financial return of agreeable above.

Ecology:

Ocotea Usambarensis (East African camphor) Mikulo in local name occurs naturally in the moist montane rain forest. The most common associates of camphor at lower elevation are Macaranga spp., Syzygium spp., Rapanea spp., Chrysophyllum spp., and at upper elevation Podocarpus milanjanus and Podocarpus usambarensis, other associates spp are Pygeum africana, Fagaropsis angolensis, Fikalhoa laurifolia.

The altitudinal range of Camphor is between 1200 - 2100 m. a.s.l. but very few trees occur down at about 900 m.a.s.l. at Amani and above 2400 m. Soils - camphor occurs on deep or shallow forest soil of volcanic or igneous origin.

The rainfall of the Camphor zone is from 1100 mm and 2000 mm at Magamba project. Temperatures are never very high in this zone.

Camphor forests usually occur on steep slopes. Therefore we can say that camphor (Ocotea usambarensis) is a slope and ridge top species.

All dominant camphor tree species grow tall, straight and have narrow crowns and competition in a high Forest community.

As a whole it is a high demander rather than a shade tolerant although at the early stage Camphor is immersed by the associated app.

Heartrot occurs in over-mature stems.

Establishment:

Seed production of Camphor is negligible since it is not regenerating in these communities. Therefore the best method by which camphor is regenerated today is by coppice and root suckers the latter is the best. When a mature Camphor is felled coppice shoots are produced then root suckers. These root suckers can occur over a radius of about 3 - 9 m.

Generally the establishment of camphor begins from the time of felling a tree when what I have mentioned take place. Seeding of camphor is not usually prolific.

Tending:

The operations here are climber cutting, slashing and liberating of suckers, killing of unwanted trees and thinning.

- (a) Climber cutting after felling of mature camphor the area is open therefore young regenerants of camphor are colonised by climbers and brambles which strangle young Camphor. Therefore it is necessary to carry out sanitary clearing soon after exploitation thus 8 months to one year from the time of felling.
- (b) Slashing and liberating of suckers - this is almost the same operation as no. (a) above; remaining with two to three root suckers.
- (c) Killing of unwanted trees to give room to Camphor and other economical spp. Like Podocarpus etc.
- (d) Thinning - At the beginning for the first 15 years thinning is not necessary; for that period it helps to obtain clean, self-pruned boles. Therefore do 1st thinning 15 years after the year of felling here do heavy thinning to stimulate DBH growth.
2nd thinning after 20 years - 3rd thinning after 40 years and 4th thinning after 60 years. Final felling - at the age of 70 - 75 years.

Therefore all silvicultural operations can be summarised as follows:

Y E A R	O P E R A T I O N
F - 1	One year before felling <u>couping</u> , <u>demarcation</u> , <u>selection and enumeration</u> by numbering all utitizable trees take place.
F	Felling of marked trees - exploitation
F + 1	One year after felling - sanit ry cleaning, - thinning of camphors coppices and root suckers to two or three per stump.
F + 5	Assessment to determine the re-generation progress.
F + 10	Second sampling assessment if re-generation is sufficient.
F + 15	1st Thinning
F + 20	2nd Thinning
F + 40	3rd Thinning
F + 60	4th Thinning
F + 70 - 75	Final felling

Growth and yield:

The root suckers grow fast for the first or two years. The annual incremental height which has been recorded in West Usambara is 0.4 - 0.5 m; and the DBH is 0.8 cm per year.

Utilization:

Camphor timber is good for light construction and joinery work. Young trees would be acceptable to plywood industry provided no heart rot. It is easy to saw, but nailing properties are poor.

APPENDIX 6**SHORT OUTLINE OF
TIRDEP/SECAP**

(Written by TIRDEP/SECAP)

Soil Erosion Control/Agroforestry Project (P.W.77.2117.8-01.140)

1) Goal

The project shall contribute to an improvement of the living conditions of the population of the Western Usambaras through:

- halting of environmental destruction
- introduction of a sustainable and viable landuse concept.

2) Measures

Activities are carried out in the three sectors of agriculture, livestock and forestry.

Agriculture

Improvement of soil fertility through soil erosion control measures such as macro and microcontour planting, manuring, composting, green manuring crop rotation and tree integration (agroforestry).

Livestock

Erosion control through introduction of permanent stall keeping and feeding of productive animals and fodder planting. Improvement of genetic potential in village based breeding centres.

Forestry

Village based tree raising and planting of multi-purpose trees for firewood, timber, fruits or fodder.

The three sectors are being integrated on village level to farm a sustainable agrosilvopastoral landuse concept.

3) Approach

To achieve the goal, a change of the present landuse practice is required. Conventional methods applied up to date, do not provide any longer the basis to sustain the population of the West Usambaras sufficiently.

Emphasis has now to be laid on methods, such as those offered by the project, which preserve the environment and use the cycles on nature rather than those which simply exploit natural resources. This implies, of course, that a considerable behavioural change of the cultivators of the Western Usambaras is required.

This change can not be imposed on them, however, it can only be achieved by a process. If this process shall be selfsustaining it has to be borne by the villagers themselves. Consequently

participation during the stages of planning, implementation and sharing of the benefits of the project activities is essential and in turn leads to a high degree of selfhelp.

Especially in the forestry sector activities, are carried out through selfhelp. The upgrading of the genetic potential of livestock is village based too. Seed multiplication by project farmers shall contribute to increased independence from the official suppliers which usually are in short supply of any seed.

To initiate such a process a high advisory input is required, hence a rather personnel intensive approach was chosen.

After having successfully tested this approach during phase I of the project (1980/81 - 1983/84) in 6 villages, activities will be extended in phase II (1984 - 88) in 20 villages, concentrating mainly on Mlalo and Lushoto Division, and on Mlola Division for forestry activities.

In each of these villages a Village Extension Worker (V.E.W.) will advise farmers and village government on all project relevant measures.

The V.E.W. are recruited from either of the three involved departments (veterinary, agriculture and forestry) and regularly trained by the project. In each village up to 20 farmers participate in livestock up to 50 in agriculture activities and the whole village is involved in forestry. This is considered as being sufficient to get enough examples which can be taken over by neighbouring farmers and villages and to initiate the desired process on village level.

4) Result of Phase I

400,000 trees were raised and planted of which approximately 60% survived in the field. 70 km of contours were planted corresponding to an area of approximately 220 ha cultivated land being under erosion control measures (280 farmers) and 15000 fruit trees were distributed and planted. 33 farmers produced in 2 lactations an average of 3000 kg of milk from one animal each.

5) Resources for Phase II

- Allocated funds for 84/86	Germany (DM)	Tanzanian Tsh (84/85 only)
	1 300 000	1 080 000
- Staff (up to 6/88) in m/m	Expatriates	Tanzanians
	Agriculture	48
	Livestock	48
	Forestry	18
	Date collection	24
	V.E.W.	960

APPENDIX 7**FOREST POLICY TODAY**

The following text describes the official present-day forest policy. This appendix is quoted from Mlowe: Forest Reserves and Forest Policy in Tanzania, Mainland, 1984 pp. 7-11.

Forests are one of the national assets safe-guarded by every country. The Arusha Declaration and 1981 CCM Guideline cites forests as one of the major production lines which must be controlled by the people through their government. Since the Government realises that forests have a major role to play in promoting the growth of the National Economy, there is therefore a need for the Government to state its policy in a manner that it is understood and accepted by the independent Tanzania hence the forest policy of the Government States:-

(a) The Forest Policy of the Government:-

- (i) The Government of the United Republic of Tanzania accepts that forests and associated lands have a vital role to play in the economic and social development of Tanzania because of the many product and value yields that are derived from them. These product and value yields include wood and wood products, water and soil conservation, wildlife conservation, recreation, aesthetics, conservation of rare vegetation and many invaluable forest influences.
- (ii) The Government of Tanzania therefore accepts the necessity of developing this sector of the land based economy in all its entity in order to maximise the production of the various product and value yields so that the people of Tanzania and their descendants can continue to increasingly enjoy them in perpetuity.
- (iii) The Government recognising that forestry development is a land based economy, accepts the principle of setting aside permanently certain areas of land as State Forests specifically for production of all forest products and value yields whether they are market products, indirect products or social values.
- (iv) The Government accepts that any State Forest that has been reserved specifically because of its catchment or watershed value, or is under active planned forest development for production or protective purposes or both, shall be held sacrosanct and that no alteration of the boundaries shall be permitted save with the express approval of the President of the United Republic of Tanzania under advice of the National Assembly.
- (v) The Government accepts utilising forest produce on lands outside the State Forests to the best advantage of the community while appreciating that such produce is a dwindling asset in face of the increasing opening up of such areas for agriculture, Ujamaa Villages, build-

ings, roads and other non-foresteing requirements.

(b) Interpretation (Implications):-

In order to achieve the objectives of this policy:-

- (1) The Government will demarcate and reserve in perpetuity, for the benefit of her people and future generations, only those forests/woodlands/grasslands which serve the following purposes either singly or jointly:-
 - (a) Watershed or Catchment protection.
 - (b) Stabilisation of land and flood control.
 - (c) Improvement of local climate.
 - (d) Production of wood products (lumber, timber, poles, fuelwood, etc.).
 - (e) Conservation of rare vegetation and wildlife habitat.
 - (f) Improvement of landscape appearance and recreation of the public.
 - (g) Protection of farmland and farm animals.
- (2) The Government accepts that her people needs in wood products and other forest benefits must receive precedence over all other considerations. In addition to satisfying the internal requirements, the management of the forest estate, in particular the production side of it, shall be directed towards achieving the greatest revenue compatible with a continuous yield and towards maintaining and improving the lucrative external trade in wood and other forest products now and in the future.
- (3) In order to maintain in perpetuity and adequate forest estate and to maximise the production of various product and value yields, the Government accepts to maintain a competent Forest Service, staffed and financed to the best standards compatible with the national resources and with the policy of self-reliance.
- (4) In order to assure that the taxpayers money that creates and maintains the forest asset is not only usefully utilised but profit accruing and its products are also enjoyed by the people, a more aggressive approach in implementation is required to ensure that the Government does not only create and tend the resource but it fully participates in harvesting, processing and marketing of her natural wealth.

(c) Implementation Strategies of the Forest Policy:-

The Government therefore requires the Ministry/Department/Division invested with the planned development of the forest sector to ensure:-

- (i) Sufficient areas of forests and associated lands are set aside as State Forests for the sole purpose of producing the various products and value yields that can be derived from such forests and associated lands.
- (ii) All State Forests permanently reserved are managed in such a way that they can best contribute to the economic and social well being of the people of Tanzania.
- (iii) Efficient State and/or Co-operative harvesting, promotion and development of State/Parastatal wood processing and wood using industries keep pace with the growth of the raw material resource in order to ascertain full utilisation of the forest wealth in the interests of the public and not of individuals.
- (iv) Ujamaa villages, local authorities, institutions and private organisations play their full part in developing the forest sector throughout the country.
 - (i) The public is educated in forestry so that they can best understand and enjoy the many good things that abound in our forests.
 - (vi) Education and training is to be promoted in all aspects of forestry.
 - (vii) Applied research is undertaken and promoted with a view to obtaining the most useful forest crops; better utilisation of all forest products and value yields; establishing better management of water supplies, soils, fauna and flora conservation; making better use of secondary benefits of forests, and to re-establish trees in the treeless areas of the Republic.
- (viii) Certain areas of forests and associated lands are developed for recreation of the people of Tanzania as well as tourists from other countries.
- (ix) Rare vegetation types and forest types are preserved for the scientific and social education of the people of Tanzania, their descendants and other peoples of the world as a whole.

APPENDIX 8**BY- LAWS FOR RURAL AREAS (DISTRICTS) 1983
MOSHI DISTRICT**

This is an unofficial translation into English from Swahili.

Translator: Victoria Rweikiza
B0, Norway.

**SHERIA YA SERIKALI ZA MITAA
(MAMLAKA ZA WILAYA) 1983
(NA. 7 YA 1982)**

**SHERIA NDOGO ZA HIFADHI YA ARDHI
NA MAZINGIRA (ZIMETENGENEZWA CHINI
YA FUNGU LA 148)**

LAWS FOR RURAL AREAS (DISTRICTS) 1983
NO 7 OF 1982

THE PART OF LAWS FOR PROTECTION OF THE SOIL AND SURROUNDINGS.
FORMED UNDER PARAGRAPH 14B

These laws will be known as by-laws for District Council of Moshi, for protecting of soil, forests and unpreserved surroundings and immediate protection, planting of trees and increasing of forests.

A. The following are definitions that will be used:

1. MINISTER: This means the State Minister or another minister who is responsible with Regional rulers/governing.
2. DIRECTOR: The Operation District Director.
3. OFFICER MALIASILI: The regional and district officer of Maliasili.
4. FOREST OFFICER: Means any officer of forests from the Field Assistant.
5. CHAIRMAN: The Chairman of Regional, District of the Ujamaa Village, or Village.
6. THE OPERATION OFFICER OF THE VILLAGE: The officer of the government who advises and is in charge of village development.
7. VILLAGE OR UJAMAA VILLAGE: An area of land that is inside of boundaries of village or Ujamaa village.
8. COUNCIL: The District Council of Moshi.
9. DISTRICT: An area of land that is inside of district boundaries, including the areas of inhabited wilds and forests.
10. IMPORTANT AREAS: Mountains, hills, water sources, river and water sources, river and water channels (ravines)
11. MOUNTAIN: Elevated small hills.
12. ELEVATED OR RAISED AREAS: All parts with high and steep areas.
13. WATER SOURCES: Areas where there are water springs, small rivers, and water sources.
14. THE RIVER BANKS: The land around the edges of small and large rivers, water sources and water channels: Not less than 15 meters on each side of the

river even if the area is flat plains.

15. CUTTING TREES /FELLING TREES: Felling and removal of trees, bushes and grass.
16. SCHOOL: The primary schools, secondary schools, colleges and religious sector/schools.
17. TREE GARDEN: It is where seedlings/young plants are raised for planting.
18. LICENSE: It is the license that is given by forest department: Chapter 389/19/no. 3.
19. FOREST PRODUCTS INCLUDE: i) Trees, beams, cut timber, rods, bark of trees, roots, gum paste, leaves, fruits and seeds.
ii) From this law, products also include soil (earth) sand, small stones, honey, wax and all plants that are growing on the ground apart from agriculture products.
20. THE RESERVED PARTS OF UJAMAA VILLAGE: They are forests of the village, either natural or planted and spared for that purpose.
21. TREE FARM: A plantation of any kind of trees that are planted by the people privately or Ujamaa village or school and individuals.
22. LOG/TRUNK OF TREE WHEN FELLED: A trunk of the tree that is felled from a tree or from any part of branch after it has been felled.
23. BEAM/POST/POLE: A part of a tree that can be used as a beam or a pole for building, for electricity and telegraph poles, or for fish traps.
24. TREES: Includes the wild date palm, clumps of trees, seedlings, and natural or planted trees of any age.
25. FOREST: An area of naturally growing trees.
26. DOMESTIC ANIMALS: Includes cows, goats, sheep, horses, pigs and all domesticated animals.
27. PROTECTION AREAS: Includes hills, water edges, springs, water channels (ravines), farms, forests, and other areas spared for purposes of protection.
- B. LEGAL RESPONSIBILITY FOR THESE LAWS: District Operation Director, Officer Maliasili Distr., Forest District Officer or representative, Agriculture District Officer or representative, Parish Secretaries (Tarafa). Parishes are divided into small

parts (Kata) that have secretaries, and village secretaries and all Police Officers are responsible.

C. THE ORDERS/
ARRANGEMENT
FOR USING
TREES:

- a) A written clearance will be given to those who want to fell trees for building houses, that will be under-signed by the Village Chairman, where the tree/trees are found, together with the forest officer of that place. The clearance will be announced to the public leaders of that village that has allowed the tree/trees to be cut at that certain place, and how long the clearance will last.
- b) The government leaders of the village will be responsible for protecting, tending, and improving trees and forests that are founded on that area of the village. Places that are outside of the village Maliasili officers and Districts Officers of forests will be responsible for. A fee will be paid for every tree burnt for making charcoal and for permission from the public authorities of that village. The village will plant 4 trees replacing one tree felled for making charcoal. Charcoal sellers will pay Shs. 4/= for every sack of charcoal to the District Council. This payment can be changed at any time the District Council of Moshi decides to. The Forest Officer will have authority over the areas that are outside the village.

D. ASSURING
TREE
PLANTING:

- 1) The Moshi District Council has the authority to establish areas of "Forest Reserves", and areas to protect the surroundings and to promote the trade of the council.
- 2) The village public authorities getting advice from the Forest Officer will make sure that trees are planted every year in that village and that special areas will be reserved for planting the different kinds of trees on soil protection areas, and the later involvement of the village.
- 3) Village authorities under the Forest Officer advisement will make sure that every village will plant fruit- and shade trees on their lands.
- 4) All primary schools with enough areas will be advised to reserve areas for planting fruit- and shade trees.

E. PREVENTION
OF FIRE:

- 1) There will be no permission to burn in the garden (shamba) of any person or owner without informing the Chairman or Operation Officer. The permission will be given after certain observations. This will be permitted by Forest Officer or Agriculture Officer to those areas that are outside the village.
- 2) It will be forbidden to throw cigarettes and burning matches on the roadsides or houses unless the person extinguishes the cigarettes, matches or charcoals. People throwing lighted objects will be punished under this law.
- 3) It will be forbidden to set on fire and burn grass or clumps of trees inside the village or any village inside the district. If one does that, he will be punished, unless he will burn the remaining products from that garden and piled them together for the purpose of killing the damaging parasites and diseases of plants.
- 4) Collecting grass and putting it under a tree and setting on fire for felling it, is illegal under this law. If one cuts trees to enlarge the cultivation area, he will have to contact the authorities and the Chairman of the village.
- 5) All people are responsible under this law to participate in helping put the fire out (except imprisoned and insane people) and to inform the Chairman, operationer of the village, and forest Officer/Maliasili about the burning fire.

F. FOREST
PROTECTION:

- 1) Any person who does any of the following things in this district without license or getting permission will be guilty:
 - i) Cutting or burning forest products (all parts of a tree, charcoal, leaves, gum, fruits and seeds)..
 - ii) Felling the forests or clumps of trees
 - iii) a) Grazing domestic animals on reserved tree areas.
b) Grazing domestic animals on farms or gardens (shambas) in the District.
 - iv) Cultivating on water sources, around the river edges, water channels, high areas.
 - v) Neglecting planting trees on the garden of the village or on water courses and reserved areas.

- vi) Cutting the trees on hills, mountains, water edges, and steep areas.
- vii) Changing or removing boundary signs of forests or tree plantations that are reserved by councils or public outside the village area. the village area.

2) (not translated)

3) (not translated)

4) The council has the power to:

- a) Remove people or villages from areas with hills, mountains, and along the rivers if the council decides to plant or protect them from damage.
- b) Order the planting of the following trees:

- i) Chlorophora excelsa (mvule)
- ii) Codyla africana - (mroma)
- iii) Podocarpus spp - (toghoso)
- iv) Dalbergia melanoxylon - (mpingo)
- v) Tamarindus indica - (mkwaju)
- vi) Newtonia b Buchananani - (mkurfi)
- vii) Ficus spp - (mikuyu, mitembo, etc.)

5) (not translated)

**G. PUNISHMENT
OF THOSE
WHO
BREAK THE
RULES:**

- 1) Any person who does not follow the given rules will be guilty and will be fined for breaking of the rules not more than Shs. 500/= or be jailed not more than three months or both.
- 2) If one breaks the rules again, he will be fined to pay not more than Shs. 1000/= or be jailed not more than six months or both.
- 3) If one is sentenced with destroying forest products, seeds, or burning, the Court will order that person to restore them; either by planting trees or taking care of that area until it is recovered.
- 4) If any person tries to cheat and uses forged documents to fell or burn the trees, he will be punished by a fine of shs. 2000/= or will be jailed for one year.
- 5) Forest Officer/Maliasili
 - i) Will be allowed to punish the person who has broken the rules, to pay not more than shs. 200/= for every offense, and a receipt will be offered.