



**Ministry of Natural Resources and Tourism
Forestry and Beekeeping Division**

**Conservation and Management of the Eastern Arc Mountain
Forests Project**

**Eastern Arc Mountains Strategy
Thematic Strategy: Sustainable Forest Use**

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April, 2007



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Executive Summary

In recent years sustainability in forest resource utilization has become a major concern worldwide. There is an expectation that forests are healthy and sustainable when biotic and abiotic influences do not threaten the attainment of conservation objectives at present or in the future. The Eastern Arc Mountain Forests (EAMFs) and Grasslands provide a number of resources for the people. The value of these resources, and the poverty of the people living in the Mountains, creates an unsustainable use of many forest products. However, the exact nature of the unsustainable use and the species that are targeted is not synthesized. Moreover, strategies for addressing the unsustainable use have not been proposed. Therefore, the objectives of this study were to identify types of unsustainable resource uses, assess the extent and severity of problems caused by invasive species and propose strategies that would address the unsustainable use of forest products and any invasive species found in the study area.

Information was collected through review of policies, laws and available scholarly information on the intended issues with minimal field visits supported by interviews and participant observations. A purposive sampling design was used to select samples of forest blocks for ground truthing after a literature screening exercise, which helped to identify information gaps with regard to major themes of the study (i.e., forest uses and invasive species). In each sampled forest, groups of villagers and individual key informants were selected on the basis of availability and willingness to talk with researchers during field visits. Both primary and secondary data were collected to address the specific study objectives. These were intended to cover three major dimensions namely social, economic and ecological. Social and economic dimensions focused on the forest resource users whereas the ecological dimension focused on the forest land and resources therein. The study was guided by a conceptual framework.

The review of policies and laws related to forest conservation indicates that there are some distinct deficiencies, which make them fail to comply with sustainable use of forest products. There is a relatively big disparity between the statements and directives in policies and laws and the actual situation on the ground. Responsibilities and answerabilities of Government officials in the field have a lot to be desired. Where the degree of forest use is specified, the mechanism for follow-up or implementation is not clearly stated. These flaws in policy directives and laws jeopardize the attainment of sustainable forest use in the EAMFs.

The major types of unsustainable forest uses include illegal logging, illegal hunting or poaching, tree cutting for commercial firewood, medicinal plants, and encroachment for farming. Using a set of sustainability indicators, it was found that the current logging practices in the EAMFs were illegal and unsustainable. Several incidences of illegal logging were observed particularly in the forests of East Usambara, South Pare, Nguru, Ukaguru and Mahenge. Trees in upper and sensitive catchment areas were harvested for timber, as was noted in river valleys in East Usambara. It was reported that among the incidences of poaching offences committed for a period of ten years, illegal logging (48%) was more commonly committed in the Udzungwa Mountain forest block. Major timber species that are targeted (with location in brackets) include *Ocotea usambarensis*, *Podocarpus usambarensis*, *Ficalhoa laurifolia* (South Pare), *Ocotea usambarensis*, *Fagaropsis angolensis*, *Entandophragma excelsum* (West Usambara), *Cephalosphaera usambarensis*, *Milicia excelsa*, *Beilschmedia kweo*, *Brachylaena huillensis* (East Usambara and Nguru), *Cordia africana*, *Olea capensis*, *Brachylaena huillensis*, *Rapanea melanophloeos*, *Prunus africana*, *Allanblackia stuhlmannii* (North Pare), *Brachystegia* spp., *Milicia excelsa*, *Ocotea* spp. *Cordia africana*, *Podocarpus* spp. (Udzungwa, Uluguru, Nguru, Rubeho, Ukaguru). Species targeted for house construction and tool handles include *Juniperus procera*, *Manilkara discolor*, *Greenwayodendron* spp. and *Uvariadendron usambarensis*.

In order to ensure sustainable logging the following strategies are proposed: introduction of cost / benefit sharing schemes in areas under Participatory Forest Management (PFM) (Joint Forest Management (JFM) and Community Based Forest Management (CBFM)); to motivate local communities to enforce the set by-laws; create awareness and make efforts to bring about alternative income-generating activities in areas where illegal logging is severe such as East Usambara, South Pare, Nguru, Ukaguru and Mahenge. Others include promotion of domestication and use of lesser used or lesser known species for both timber and construction purposes to meet local demand particularly through demand-driven tree planting campaigns. Furthermore, there is a need to conduct forest inventory for EAMFs, which is a requirement for the development of forest management plans for the forests. Communities, especially those under JFM, should be provided with training on sustainable timber harvesting techniques, harvesting code and the need to enforce the code. Also there is urgent need to gazette sensitive areas including, upper catchment areas.

Although firewood collection in areas that have been regulated through JFM contracts appeared sustainable, other studies have revealed serious ecological damages caused by firewood collection. Such damages include removal of dead wood, which provides food and shelter to a wide range of animal and fungal species. The removal of dead wood not only causes habitat alteration but also reduces species diversity. Moreover, in the course of firewood collection, people tend to create tracks and footpaths, a process that changes the micro-environment by increasing openness of the forest, thus increasing the amount of sunlight reaching the forest floor and causing soil erosion.

The following wood species were noted to be commonly used for firewood and charcoal making in the EAMFs: *Stereospermum kunthianum*, *Allanblackia stuhmannii*, *Piliostigma thonningii*, *Dombeya shupangae*, *Annona senegalensis*, *Brachylaena huillensis*, *Prunus africana* and *Catha edulis*. The last three species are scarce, valuable and are in high demand for both subsistence and commercial purposes.

In order to have a sustainable supply of firewood and to reduce pressure on the EAMFs, the following strategies are proposed: encourage tree planting for commercial firewood production by private farmers or local farmers' associations particularly in South Pare and East Usambara, disseminate cost-effective, fuel efficient stoves to end users; and promote agroforestry and reforestation practices.

Although the Wildlife Conservation Act No. 12 of 1974 does not allow hunting without licences, illegal hunting was observed in the study area, particularly in Udzungwa, North Pare and East Usambaras. Notwithstanding, hunting is conducted in a very unsustainable manner. Poor hunting methods such as through the use of snares, noose traps, pit fall traps, log-fall traps, spike traps, spears and dogs are used. Studies on animal census and hunting intensity have shown that hunting reduces populations of wild animals. For example, bush pig and Abbot's duiker in New Dabaga / Ulangambi Forest Reserve (NDUFR) appear to be severely depleted.

The most hunted animals include bush hyrax (*Heterohyrax* spp), tree hyrax (*Dendrohyrax validus*), rock hyrax (*Proavia* spp) and elephant shrews (*Macroscelidea*). Other hunted animals include bush pigs, warhogs, antelopes, buffaloes, elephants, primates (such as the Iringa red colobus, Angolan black and white colobus and Sykes monkeys), giant pouched rat, bushbuck, blue duiker, Livingstone's suni, red duiker, Abbott's duiker and other small animals.

The following strategies are proposed to ensure sustainable hunting: Create awareness among local communities, improve enforcement of laws and by-laws through the involvement of local communities, and introduce incentive systems to enhance communities' involvement and commitment. In addition, facilitation of improved animal husbandry through

enhancement of domestic sources of meat and eggs, e.g. by increasing the number of domestic animals to the poorest part of the population could provide a better alternative to wild meat. Projects such as poultry keeping, which has relatively rapid turnover compared to other livestock, require less capital and running costs, and can be easily managed by poor households should be introduced. Cane rats (*Thryonomys swinderianus*) probably hold high potential too; not only do they breed quickly but are likely to be culturally acceptable. Other species that have been farmed for their meat in Africa include the brush-tailed porcupine (*Atherurus africanus*), giant rat (*Cricetomys emini*), red river hog (*Potamochoerus porcus*), duikers (*Cephalophus* spp.), giant African snail (*Archachatina marginata*), helmeted guinea fowl (*Numida meleagris*), double-spurred francolin (*Francolinus bicalcaratus*) and scaly francolin (*Francolinus squamatus*). Only some of these are found in the Eastern Arc region.

There is a need to strengthen vermin control units to protect crops grown by communities around Forest Reserves and National Parks. Furthermore, there is need to carry out animal census and determine sustainable harvesting levels.

Regardless of the high potential of wildlife trade, little is known about species involved, distribution and harvestable / cropping levels. Notwithstanding, there is evidence of people being involved in the business, e.g. the collection of animals for pet trade which was observed in the Udzungwa Mountain block.

The following strategies are proposed to improve and sustain wildlife trade: encouraging surrounding villages to form production groups and farming of wild animal species (insects, reptiles, birds, mammals etc.) in an ecologically sustainable way for trade. In addition, promotion of community-based eco-tourism could serve as another source of income for the communities.

Collection of medicinal plants in the Eastern Arc Mountain forests is reported to be very high. For example, a report by Udzungwa Mountain National Park (UMNP, 2005) indicates that more than one ton of medicinal plants are collected from the area annually. In some cases, extraction of medicinal plants is destructive to the plants. Such destructive extraction techniques include uprooting plants, roots cutting, and tree ring debarking. Such extraction techniques prevent regeneration and lead to the death of the plants. Since there is no replacement, it is likely that some of the plant species may become locally extinct.

The most targeted medicinal plants include *Artemisia afra*, *Deinbollia borbonica*, *Tabernaemontana pachysiphon*, *Zanthoxylum chalybeum*, *Microglossa oblongifolia*, *Trema orientalis*, *Warburgia salutaris*, *Prunus Africana* and *Allanblackia stuhlmannii*.

In order to address the problems associated with unsustainable use of medicinal plants in the EAMFs, the following strategies are proposed: Adhere to indigenous knowledge and useful traditional rules and ways of harvesting traditional medicine; and promoting and supporting domestication of medicinal plants in collaboration with local herbalists and traditional healers. Examples of domesticated plants on the Uluguru Mountains include *Maesa lanceolata* (Mingutinguti), *Myrica salicifolia* (Migeremamondo), *Senna petersiana* (Mikundekunde), *Piper capense* (Ludaha), and *Khaya anthotheca* (Mkangazi). However, availability of seeds is reported to be the major constraint. Other strategies include improving rural health services and the use of para-medics to reduce impacts on the forests. Also, there is a need to conduct forest inventories so as to establish the stocking and harvesting levels.

The study also revealed that East Usambara Mountain forests and especially Amani Nature Reserve are the most threatened by invasive species. Identified invasive species include *Maesopsis eminnii*, *Cedrela mexicana* and *Lantana camara*. Other lesser-known invasive species include *Castila elastica*, *Pyrostegia venusta*, *Selaginella* spp., *Arenga pinnata*, *Clidemia hirta* and bamboo species. Problems caused by invasive species are mainly with

regard to biodiversity loss, which is more serious in the East Usambara Mountain forests than in other Eastern Arc Mountain forests.

Strategies to address problems associated with invasive species include: proper management of the established botanical gardens to control escape of invasive species from the boundaries of the gardens; developing monitoring and evaluation programmes with a database which will provide knowledge of the local vegetation; and promotion of exploitation of timber invasive species (*Cedrela*, *Acacia*, *Eucalyptus*). Other strategies include provision of education / awareness / extension services on invasive species management to farmers and incorporating exploitation of invasive species into JFM guidelines.

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Acronyms

CBC	Community-Based Conservation
CBFM	Community-Based Forest Management
CMEAMF	Conservation and Management of Eastern Arc Mountain Forests
Dbh	Diameter at breast height
DCFM	District Catchment Forest Manager
DFO	District Forest Officer
DNRO	District Natural Resources Officer
EAM	Eastern Arc Mountains
EAMFs	Eastern Arc Mountain Forests
FBD	Forestry and Bee-keeping Division
FRs	Forest Reserves
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GPS	Geographical Positioning System
ICRAF	International Centre for Research in Agro-Forestry
IGAs	Income-Generating Activities
JFM	Joint Forest Management
MAFS	Ministry of Agriculture and Food security
MEM	Ministry of Energy and Minerals
MLHSD	Ministry of Land and Human Settlement Development
MNRT	Ministry of Natural Resources and Tourism
MWLD	Ministry of Water and Livestock Development
MW	Ministry of Water
NA	Not Assessed / Applicable
NDUFR	New Dabaga / Ulangambi Forest Reserve
NEP	National Environmental Policy
NFP	National Forest Programme
NLP	National Land Policy
NSGRP	National Strategy for Growth and Reduction of Poverty
NWP	National Water Policy
PFM	Participatory Forest Management
PRA	Participatory Rural Appraisal
SACCOS	Savings and Credit Co-operative Societies
SUA	Sokoine University of Agriculture
TAFORI	Tanzania Forestry Research Institute
TBA	Tropical Biology Association
TEV	Total Economic Value
ToR	Terms of Reference
TShs	Tanzanian Shillings
UMNP	Udzungwa Mountains National Park
UMFR	Udzungwa Mountain Forest Reserve
UNDP	United Nations Development Programme
URT	United Republic of Tanzania
US\$	United States Dollar
VPO	Vice President's Office
WCA	Wildlife Conservation Act
WD	Wildlife Division
WIMS	Weed Information Management Systems
WPT	Wildlife Policy of Tanzania
WTO	World Trade Organization
WWF TPO	World Wide Fund for Nature Tanzania Programme Office

1.0 Introduction

1.1 Background

In Tanzania, the Eastern Arc Mountain forests are spread across twelve mountain blocks and represent one of the oldest and most stable terrestrial ecosystems on the continent (Burgess and Kilahama, 2005; Newmark, 1998; Pòcs, 1988). The mountain blocks include North and South Pare, West and East Usambara, Nguru, Nguu, Uluguru, Ukaguru, Udzungwa ranges, Mahenge, Rubeho and Malundwe hill (NFP, 2001; Burgess and Kilahama, 2005). The total area of the natural forest and closed patches are estimated to be over 533,400 ha and 150,000 ha respectively. The Udzungwa Mountains contain the largest area of natural forest followed by Nguru and Nguu combined, Uluguru, Rubeho and East Usambara (Newmark, 1998). Table 1 shows the Eastern Arc Mountain blocks and their forest cover sizes.

Table 1 Description of the forest cover in the Eastern Arc Mountains

Eastern Arc Mountain	Natural Forest (x 100 ha)	Number of forest patches*	Closed forest (x 100 ha)	Loss of original cover (%)
Udzungwa	1,960.0	26	389	76
Nguru and Nguu	647.0	8	120	82
Uluguru	528.0	5	120	65
Rubeho	499.0	6	100	37
East Usambara	413.0	8	221	57
South Pare	333.0	5	120	73
West Usambara	328.0	17	245	84
Mahenge	291.0	3	<50	89
Ukaguru	184.0	1	100	90
North Pare	151.0	2	28	50
Malundwe Hill	> 4.5	NA	NA	NA
Total	5,334	81	< 1,493	-

Source: Newmark (1998).

* Current number of forest patches in the Eastern Arc Mountains is estimated to be about 150

NA = Not Assessed

The Eastern Arc Mountain forests are extremely important both nationally and internationally due to their recognized biodiversity and livelihood values. Locally they support the livelihoods of millions of people in and around the mountains. Also, the mountains provide fertile agricultural lands that supply the urban centres (Lulandala, 1998). These forests are important water catchment areas for numerous rivers and streams that supply water for domestic use, agriculture and industries (Lovett and Pocs, 1993; Svendsen *et al.*, 1995). Similarly, they have been dependable sources of timber for various sawmills supporting the construction and lumber industries and contributing to the regional timber trade. However, timber production in these forests has been banned since 1990. Globally, besides offering some products, the significance of the Eastern Arc Mountain forests is for their high species richness, endemism and a large number of restricted-range species and genera (Newmark, 1998). However, these forests are among the most critically threatened (Fjeldså *et al.*, 1995). Furthermore, Lulandala (1998) points out that the Eastern Arc Mountain forests' biodiversity is increasingly being subjected to tremendous resource use pressure, which seriously threatens its existence.

1.2 Problem Statement and Justification

There is an expectation that forests are healthy when biotic and abiotic influences do not threaten the attainment of current and future conservation objectives. The Eastern Arc Mountain forests and grasslands provide a number of resources for people. Sustainable management of the Eastern Arc Mountain forests is a major concern due to the fact that currently these forests are under severe pressure due to commercial and subsistence agriculture, commercial and subsistence timber extraction, intentional fires, extraction of other products for household use and spread of invasive species in some of the forests (GEF, 2002). Consequently, the values of these resources and poverty of the people living in the mountains are assumed to cause unsustainable uses of many forest products. However, the exact nature of the unsustainable uses and the species that are targeted are not synthesized and well documented. Moreover, strategies for addressing these unsustainable uses and severity of the problems caused by invasive species have not been developed. Therefore, the CMEAMF project needs the best available advice on how sustainable use of forest resources and management of invasive species can be built into its integrated strategy. Results of the current work will form core elements of the implementation of an integrated strategy for biodiversity conservation and water supply in the Eastern Arc Mountains.

1.3 Objectives

1.3.1 Overall objective

The overall objective of this study was to propose sustainable forest use strategies for the implementation of an integrated strategy for biodiversity conservation and water supply in the Eastern Arc Mountains. This objective was derived from the Terms of Reference (ToR) attached herein as Annex 1.

1.3.2 Specific objectives

The proposed work was organised into the following tasks and specific objectives in respect of the Terms of Reference (ToRs):

Task 1: To briefly review the policies and laws relating to the forests of the Eastern Arc Mountains

Specific objective (i):

- To identify and define the degree to which sustainable uses are allowed in the various categories of forests, which are found on the Eastern Arc Mountains.
- To identify flaws in governing policies and laws towards sustainable uses of forest resources.

Task 2: To synthesize available knowledge (primarily through a desk study) on the types of unsustainable uses which are occurring in the Eastern Arc Mountains

Specific objective (ii):

- To assess types of uses (logging, firewood collection, medicinal plants collection and hunting), which are going on in the Eastern Arc Mountains (species involved, value of the use, number of people involved in the activity, how long it has been going on etc.).

Task 3: To assess the extent and severity of the problems caused by invasive species in the Eastern Arc Mountains, primarily plants

Specific objectives (iii):

- To prepare a list of invasive species showing their locations and types of problems they cause.
- To assess the extent and severity of problems caused by invasive species in the Eastern Arc Mountains.

Task 4: To suggest strategies that would address the unsustainable uses of forest products and problems caused by invasive species within the context of the policies and laws that apply to the forests and grasslands of the Eastern Arc Mountains

Specific objective (iv):

- To develop a matrix of strategies to address unsustainable uses of resources of the Eastern Arc Mountains.

1.4 Research Questions

The following research questions were formulated to guide the study:

To what degree is sustainable use allowed in the various categories of forests found in the Eastern Arc Mountains?

1. What types of forest uses are there in the different blocks of the Eastern Arc?
2. How long have the forests been in use (legally and illegally) in the different mountain blocks?
3. What are the relative values for the different uses?
4. Are these uses sustainable or unsustainable in the forests where they occur?
5. What is the exact nature of the unsustainable use of the Eastern Arc Mountain forests?
6. Which species (flora and fauna) are most targeted for such unsustainable uses?
7. What is the relative abundance of such targeted species?
8. How many people are involved in the different uses of the forests?
9. What are the invasive plant and animal species found in the Eastern Arc Mountains?
10. Where are the origins of the identified invasive species?
11. Where do the invasive species occur within the Eastern Arc Mountains?
12. What kind of problems do they cause in places where they occur?
13. Where are the invasive species (flora and fauna) most prominent?
14. What are the major threatening invasive species (flora and fauna) in the Eastern Arc Mountains?
15. What is the scale or magnitude of the invasive species problem?

2.0 Methodology

2.1 Study Sites and Location

Literary, the study covered all the Eastern Arc Mountains of Tanzania, which are distributed in 14 Districts in five Regions. These are Mwanga and Same in Kilimanjaro Region, Lushoto, Korogwe, Muheza and Kilindi in Tanga Region, Mvomero, Morogoro, Kilosa, Kilombero and Mahenge in Morogoro Region, Mpwapwa in Dodoma Region, Mufindi and Kililo in Iringa Region. The relative locations of these Eastern Arc Mountain blocks are shown in Figure 1.

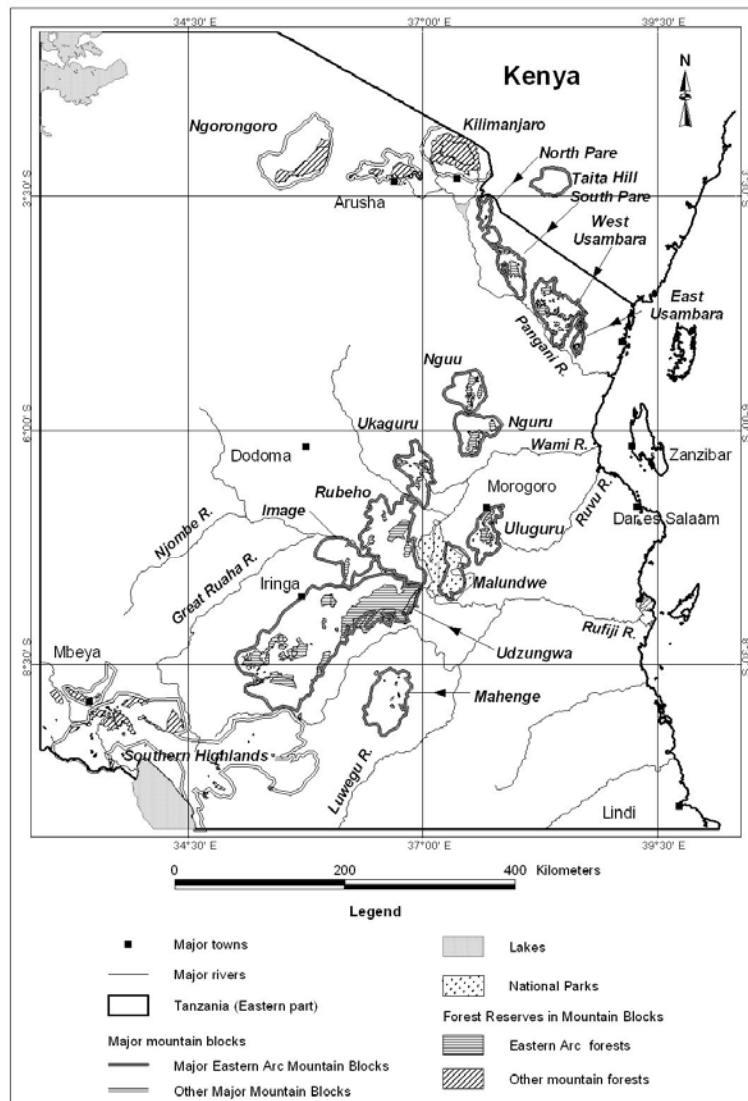


Figure 1: Relative location of Eastern Arc Mountain blocks

2.2 Conceptual Framework

This work was guided by a conceptual framework (Figure 2) which related the natural resource base (forests and wildlife) which provides the used resources and the community with people who are pursuing different livelihood activities. Furthermore, the governance through such tools as policies, legislation and norms link the resource base and the community. Due to scarcity of resources, overdependence of community needs on the limited resources as influenced by the prevailing socio-economic factors and inefficient use of legal instruments, leads to unsustainable use of resources. Furthermore, the forest resource base is affected by invasive species to varying degrees.

This report proposes strategies for sustainable use of resources in the Eastern Arc Mountains as means to address the unsustainable uses, flaws in legal natural resources management instruments and problems caused by invasive species to be implemented by relevant actors / institutions (Figure 2).

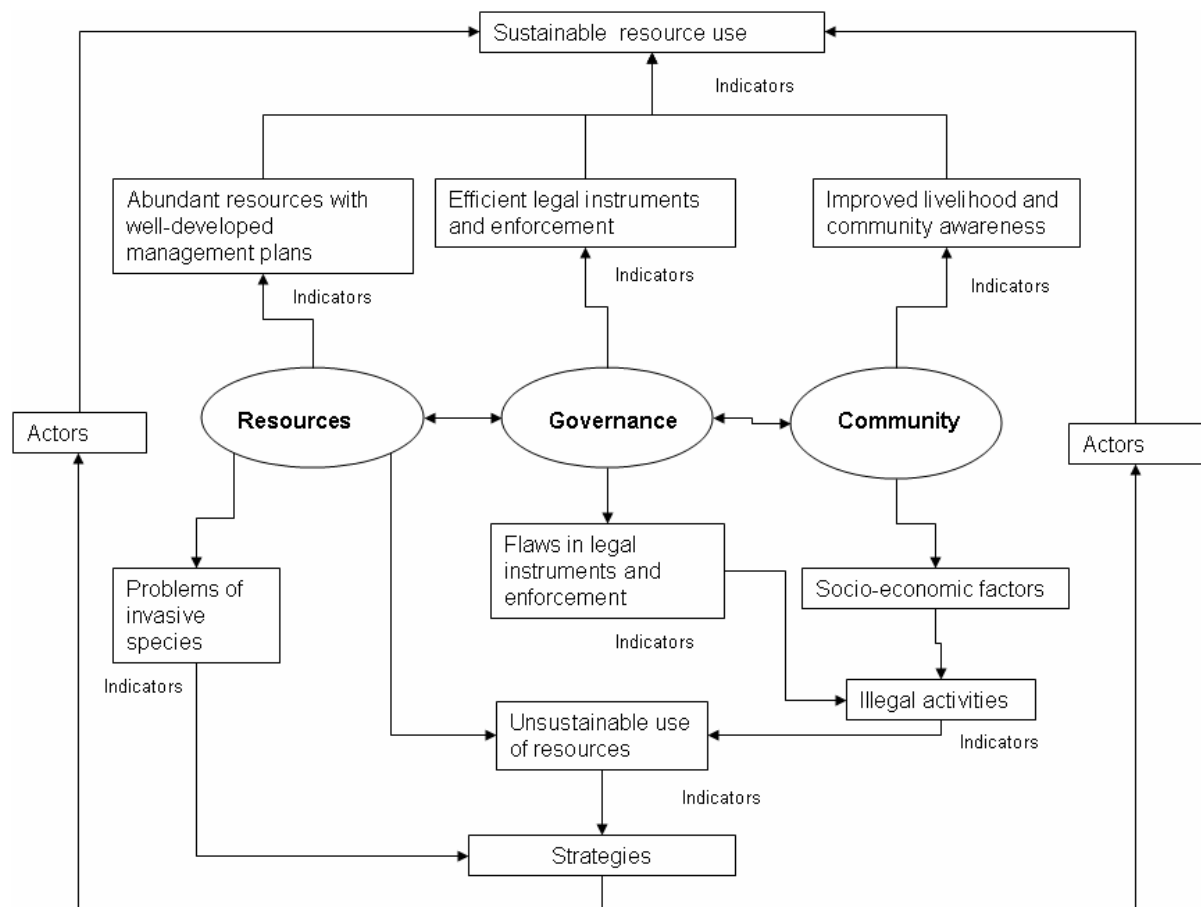


Figure 2: Conceptual framework

2.3 Sampling Design

A purposive sampling design was used to select samples of forest blocks for ground truthing after a literature screening exercise, which helped to identify information gaps with regard to major themes of the study (i.e., forest uses and invasive species). In each sampled forest, groups of villagers and individual key informants were selected on the basis of availability and willingness to talk with researchers. Respondents were interviewed in groups and individually to ascertain the use of forest products and services.

2.4 Data collection

2.4.1 Types of data

Both primary and secondary data were collected to address the specific study objectives. These were intended to cover three major dimensions namely social, economic and ecological. Social and economic dimensions focused on the forest resource users whereas the ecological dimension focused on the forest land and resources therein. The primary sources included key informants (individuals and groups). Secondary sources included research reports, journals, policy documents, laws and manuscripts on the Eastern Arc Mountains. The major sources included CMEAMF, Sokoine University of Agriculture (SUA), Tanzania Forest Research Institute (TAFORI), and the MNRT. The summary of the types of data, methods used and major sources are presented in Annex 2.

2.4.2 Data collection techniques

Three major data collection techniques were used. These include (i) review of scholarly literature, and relevant public policies and laws that apply to the Eastern Arc Mountain forests, (ii) rapid field surveys for ground truthing using group and individual interviews and (iii) participant observation.

Review of literature, relevant public policies and laws

This involved collection of a broad range of information from existing reports and journal articles, and review of relevant natural resource-related policies and laws and strategically identifying sections and clauses relevant to the study objectives. A summary matrix of literature reviewed with regard to EAMFs is attached as Annex 3.

Key informant interviews

These involved both formal and informal interviews in groups and individually with key informants who are well acquainted with the study areas. Local people (individuals and groups) and Government officials were used as key informants. This helped to reveal illegal activities taking place in and around the Eastern Arc Mountain forests, most of which are protected for water and biodiversity conservation purposes.

Participant observations

This included actual observations made by the researchers during field visits, documented by use of visual aids such as digital camera that helped to include pictures as indicators or evidence of illegal happenings in the EAMFs visited.

2.5 Data Analysis

2.5.1 Primary data

Data obtained through the review of policies, laws and verbal discussions with key informants and focused groups were subjected to content analysis whereby meaningful information was filtered to address the specific objectives of the study.

2.5.2 Secondary ecological data

These were summarized into tables and sentences to reflect the issues under study.

2.6 Work Plan

The work plan matrices are attached as Annexes 4 and 5.

3.0 Findings

3.1 Review of Policies and Laws Regulating Forest Uses in the EAMFs

This sub-section presents a review of the policies and laws, which regulate the use of the Eastern Arc Mountain forests; identifying and defining the degree to which sustainable uses are allowed in the various forest categories. Annexes 6 and 7 summarize the flaws and recommended remedial strategies for attaining sustainable uses of the resources.

3.1.1 National Forest Policy

National Forest Policy of 1998

The National Forest Policy allows use of Forest Reserves under participatory management arrangements as a means to motivate local communities to participate in forest management. The FBD can sign concessions with forest enterprises. In productive forests, commercial use can be conducted through concession arrangements. A concession is defined as “a long-term agreement between the Government and a forest enterprise, entrusting the latter to manage a Forest Reserve.... mainly for timber production” (URT, 1998a). However, there must be an approved management plan for the Forest Reserve and the concession holder is responsible for all harvesting and silvicultural activities. Although Catchment Forest Reserves are mainly categorized as protected forests the National Forest Policy acknowledges that they are of economic, scientific and aesthetic value and lists down potentials for non-wood products such as forest-based eco-tourism, game (and game meat), bee products (honey, beeswax, royal jelly and propolis), medicinal plants, genetic resources, tannins, gum arabic, resins, bark, aromatics, latex, natural dyes, fruits and nuts, fibre, spices and naval stores (MNRT, 1998a:10, 28, 33), but without any mention of the water originating from the forests.

Flaws in the National Forest Policy

Flaws in the National Forest Policy include public ownership that creates "open access" areas, insecure land tenure and weak or absent definition of property rights. These have contributed to excessive harvesting through illegal felling and lack of investment incentives on forest activities. Also, there is unregulated and uncontrolled trade in wood and non-wood forest products, which can instigate uncontrolled exploitation of such products. This has a potential to accelerate forest destruction and degradation (MNRT, 1998a:29).

3.1.2 The Forest Act No. 14 of 2002

Section 26(a) – (s) of the Forest Act prohibits the following activities inside Forest Reserves, except by people with legal concessions, licenses or permits (URT, 2002:1198-99):

- Cutting down, felling, digging up or removing any tree;
- Digging up or removing any protected wild plant;
- Harvesting, taking or removing any other forest product, subject to the provisions of the Beekeeping Act, 2002;
- Entering, perambulating for purposes of tourism or camping within a Forest Reserve;
- Taking and removing any rock, stones, sand, shells or soil;
- Undertaking any mining activities;
- Occupying or residing on any land;
- Clearing, cultivating or breaking up for cultivation or any other purpose, any land;
- Cutting, burning, uprooting, damaging or destroying any vegetation;

- Sowing or planting any crops, trees or other vegetation;
- Cutting or re-opening any saw-pit or work place;
- Erecting any buildings or other structures;
- Allowing any livestock to enter or graze or de-pasture within National Forest Reserves;
- Hunting, fishing, using or being in possession of any trap, snare, net, bow and arrow, gun, poison or explosive substance used or capable of being used for the purposes of hunting or fishing;
- Carrying out any research for which a research permit is required; and
- Collecting any honey barrel, hive or other receptacle for the purpose of collecting honey or beeswax.

But, the question is, who is there in the field to enforce all these regulations? There is lack of monitoring capability.

Stated economic uses

Section 49 (1) of the Forest Act, 2002 allows permits / licenses to be granted for the following activities inside Forest Reserves (URT, 2002:1198-99, 1229-30):

- Felling or extracting timber for domestic, commercial or export purposes, or for mining purposes or for prospecting and exploration of mineral resources;
- Gathering and taking away specified forest produce;
- Plucking, picking, taking parts or extracts of any protected plant for purposes of research or production or manufacture of any medicine or other product;
- Erecting buildings or other structures;
- Operating sawmills and other such industrial processes and machinery as may be prescribed;
- Constructing roads, bridges, paths, waterways, railways or runways;
- Camping, operating tourist facilities and undertaking activities connected with tourism, such as photographic tourism (*Sic.*);
- Exporting other such forest produce as may be prescribed;
- Sowing, planting or cultivating trees, crops or other vegetative matter;
- Entering Forest Reserves to hunt or fish;
- Allowing domestic animals to enter and graze;
- Any other activity for which the granting of a permit is specifically required by regulations.

Permits for all these activities are in accordance with the provisions of the Forest Management Plan for a particular Forest Reserve.

Degree of allowable economic uses

The Forest Act states that permits for the activities listed above shall specify:

- the name and address of the person or organization to whom the permit has been granted;

- the activity or activities authorized by the permit;
- the date of issue of the permit;
- the date of expiry of the permit;
- the date by which any activity authorized by the permit must be commenced;
- the Forest Reserve or part thereof or other place where the authorized activities may be undertaken;
- the conditions subject to which the permit is granted; and
- the fees, royalties and other charges that must be paid in connection with the granting of a permit or the undertaking of any activities authorized by the said permit; and such other matters as may be prescribed.

Flaws in the Forest Act

The Forest Act does not set limits of bags for consumptive uses or limits of acceptable use for non-consumptive uses. Perhaps these will be set out in Management Plans for the individual Forest Reserves. Regarding hunting, the Forest Act gives powers to the Director responsible for Forest Reserves to issue permits to enter a Forest Reserve only. Hunting permits must be previously sought and obtained from the Director of Wildlife (§49(1) (j) and §68 of the Forest Act).

Regarding compounding and prosecution of offences, §95 and 96 of the Forest Act give powers only to the Director or an Officer specifically authorized by the Director by notice published in the Government Gazette. This law seems not to devolve powers to the lower cadre of Forest Officers or lower offices, experience from the field shows that there is only one authorized Forest Officer each in Tanga and Arusha Regions who have such powers.

3.1.3 Wildlife Policy of 1998

The Wildlife Policy of Tanzania (WPT) defines wildlife as “those species of wild and indigenous animals and plants, and their constituent habitats and ecosystems, found in Tanzania, as well as those exotic species that have been introduced to Tanzania, and that are temporarily maintained in captivity or have become established in the wild” (MNRT, 1998b:38).

Stated economic uses

WPT lists game viewing (photographic tourism), tourist hunting (trophy or sport), resident hunting (licensed hunting for meat by residents), ranching, farming and live animal trade as the recognized forms of wildlife utilization allowed in mainland Tanzania. The Wildlife Division is responsible for issuing hunting and capturing permits for wildlife occurring in Forest Reserves (MNRT, 1998b:5). Before holders of such permits can legally hunt or capture wild animals in Forest Reserves they must seek and obtain entry permits from the Director of Forestry and Beekeeping (URT, 2002:1251). The Forestry and Beekeeping Division (FBD) and not the Wildlife Division (WD) can introduce and conduct game viewing in Forest Reserves.

Also, WPT permits small-scale animal cropping by rural communities practising community-based conservation (CBC). Generally, it is understood that CBC is supposed to be practised on village lands and where possible, on general lands. It is not known, therefore, if this could be extended to neighbouring Forest Reserves.

Degree of allowable economic uses

No specific bag limits are set by WPT for consumptive use of wild animals in Forest Reserves or anywhere. However, the policy promotes sustainable utilization quotas on a

scientific basis and monitoring of wildlife populations that are consumptively utilized (MNRT, 1998b:22). Also, it exercises control of wildlife utilization activities (p.23). The quotas are set annually per species per specified area (hunting block).

3.1.4 Wildlife Conservation Act No. 12 of 1974

The main focus of the Wildlife Conservation Act No. 12 of 1974 (WCA) is on creation, protection and management of Game Reserves, Game Controlled Areas and Partial Game Reserves and control of use of wildlife and other natural resources therein (URT, 1974). Forest Reserves are not part of these. However, §17 gives powers to the Minister responsible for wildlife, by order in the Government Gazette, to prohibit, restrict or regulate hunting, killing or capture of any animal or class of animals in any area of Tanganyika (mainland Tanzania) in certain periods of the year. Such a period is termed as closed season. Currently the closed season runs from January 01 to June 30 and the open (hunting) season is from July 01 to December 31 each year. Also, the Director of Wildlife is given powers to kill or authorise the killing of any animal in any place outside of National Parks and the Ngorongoro Conservation Area (§52).

Stated economic uses

Section 20 of the WCA prevents the Director of Wildlife from granting permissions for hunting, killing, capturing or wounding wild animals in National Parks and the Ngorongoro Conservation Area. Since Forest Reserves are not mentioned, implicitly it means the Director has legal powers to issue permits / licenses for hunting, killing and capturing wild animals in those Reserves (§38; see also §68 of the Forest Act). §29(e) of the WCA states that the Minister responsible for wildlife may, through regulations (subsidiary legislation) provide that no one person shall be granted license to hunt more than the specified number of any species of animal in any specified area. Every hunting or capture permit or license must specify the species and number of animals, which may lawfully be hunted or captured by the holder of the permit or license and the permit / license is valid for a prescribed period of time (§§30 and 34). The permit / license holder must record in the spaces provided on the permit / license all relevant details of all the animals shot (even if not killed) or captured by him or her and, at the expiry of such permit / license, surrender it to the licensing officer (§44(1)).

3.1.5 Other relevant policies, laws, acts, and national strategy

National Land Policy of 1999

The National Land Policy (NLP) is, perhaps, only remotely related to this assignment. However, it has two objectives, which are relevant: ensuring that land is put to its most productive use to promote rapid social and economic development of the country, and protecting land resources from degradation for sustainable development (MLHUD, 1995:5). Also, NLP aims at protecting so-called sensitive areas, which include water catchment areas, mountains, forests and seasonal migration routes of wildlife, to mention just a few (p.13). These areas shall not be allocated to individuals. Also, development of hazardous lands, which include areas of steep slopes, is prevented (p.39).

Furthermore, NLP states that Certificates of Occupancy¹ shall be issued to all Government and public properties, including Forest Reserves (p.19) and that shifting cultivation is prohibited (p.36). NLP states in relation to these that before user rights for mining, timber harvesting, hunting etc. are considered, existing land tenure rights should be recognized (p.34). No stated uses and hence any degree allowable.

¹ Certificate of Occupancy means a certificate issued under §29 of the Land Act, 1999 by the Commissioner for Lands granting a right of occupancy to a 'person'.

The National Land Act of 1999

The National Land Act interprets land to include “the surface of the earth and the earth below the surface and all substances other than minerals and petroleum forming part of or below the surface, things naturally growing on the land, buildings and other structures permanently affixed to land” (URT, 1999:26). Land is divided into three categories: General Land, Village Land and Reserved Lands (p.42). According to this classification, National Forest Reserves are Reserved Lands (§6(1)).

Stated economic uses

Apart from being Reserved Lands, which may be used in accordance to the Forest Act, 2002, many parts of the Eastern Arc Mountain forests are hazardous lands because they have steep slopes. The Land Act states that, “hazardous land is land the development of which is likely to pose danger to life or lead to the degradation of or environmental destruction on that or contiguous land” and includes, among others, “land on slopes with a gradient exceeding any angle which the Minister [for the time being responsible for lands] shall, after taking account of proper scientific advice, specify” (URT, 1999:52). Being hazardous they cannot be put to any economic use except, perhaps for eco-tourism, including mountain or rock climbing, but this is not stated in the Act. No stated uses and hence no degree allowable.

National Water Policy of 2002

The National Water Policy (NWP) identifies water resources as rivers, lakes, wetlands, springs, reservoirs and groundwater aquifers (MWLD, 2002:9) and acknowledges that water is critical to ecological systems and to the maintenance of the environment (p.33).

Stated economic uses

NWP lists types of water use as domestic and for supplying livestock, agriculture, industry, mining and energy production, fisheries, sustenance of the environment / ecosystem, wildlife and tourism, forestry and beekeeping and navigation. Water uses are prioritized. First priority goes to basic human needs. “Water for the environment to protect the ecosystems that underpin our water sources, now and in the future” is given second priority. Other uses following after these two are subject to social and economic criteria. Based on the water resources listed above, in most cases water is accessed by users when it is already outside the Eastern Arc Mountain forests except for hydropower generation like in the case of Kidatu and Kihansi.

Degree of allowable economic uses

As far as NWP is concerned, there are no procedures and guidelines to ensure sustainability of ecological systems (MWLD, 2002:33). Therefore, no exact degree of allowable use of water is stated. The policy states only that “Water allocations and use shall be carried out considering the principles of sustainability so that the resources remain viable for the use of the present and future generations” (p.30).

National Environmental Policy of 1997

The National Environmental Policy (NEP) interprets the term *environment* to include, among others, plant and animal life (VPO, 1997:1). This gives it a stake in the affairs of the Eastern Arc Mountain forests. The policy aims at, among others, ensuring sustainable and equitable use of resources for meeting the basic needs of the present and future generations without degrading the environment or risking health or safety:

- Preventing and controlling degradation of land, water, vegetation and air, and
- Conserving and enhancing our natural and man-made heritage, including the biological diversity of the unique ecosystems.

The policy also states that the Government views a number of sectors, including tourism as the main impetus to the country's economic growth (p.8). But, it lists a number of problems, including land degradation, lack of good quality water for people, loss of wildlife habitats and biodiversity and deforestation (p.6) all of which are relevant to the Eastern Arc Mountain forests. NEP outlines sectoral objectives some of which are:

- *Agriculture*: Extensive agriculture is a threat to biodiversity conservation. Therefore, some of NEP's objectives are to minimize encroachment into forests, woodlands, wetlands and pastures and intensify wild and domesticated plant genetic conservation programmes (p.19).
- *Water and sanitation*: One of NEP's objectives is to protect water catchment areas and their vegetation cover (p.20).
- *Energy*: To minimize woodfuel consumption through the development of alternative energy sources and woodfuel energy efficiency.
- *Tourism*: To promote tourism based on careful assessment of the carrying capacity and prior environmental impact assessment applications and to allow and enable local communities to benefit from tourism as a way of motivating them to conserve tourist attractions and natural resources in general.
- *Wildlife*: To protect and utilize wildlife resources in a sustainable manner, but with participation of, and benefits to, local communities.
- *Forestry*: To promote rational exploitation of forest resources, intensify law enforcement in Forest Reserves, and conserve natural forests with biological diversity value and genetic resources.

Stated economic uses

NEP has a two-pronged focus: it intends to satisfy basic needs of the poor but at the same time protect the environment. It states that natural resource conservation should contribute to reduction of vulnerability of the poor (VPO, 1997:10) and that the country's rich biodiversity should be exploited in sustainable ways. Related to this is NEP's objective of promoting eco-tourism, which is believed to be environmentally friendly. The degree of use allowed is not stated.

The National Strategy for Growth and Reduction of Poverty (NSGRP)

Pg 1:

NSGRP will strive to widen the space for ... effective participation of civil society, private sector development and fruitful local and external partnerships in development.

Pg 2:

NSGRP adopts the "outcomes-approach" which counts on the contribution of all sectors towards specific outcomes on growth, improved quality of life, good governance and equity. The approach encourages inter-sector collaboration in devising more efficient ways of achieving these outcomes.

The strategy seeks to:

- Deepen ownership and inclusion in policy making processes by recognizing a need to make participation more institutionalized rather than a one-off event. Public debate on growth, equity and governance issues will continue throughout the five years of the strategy along with arrangements for monitoring and evaluation;

- Pay greater attention to mainstreaming cross-cutting issues – HIV, AIDS, gender, environment, employment, governance, children, youth, elderly, disabled and settlements; and
- Address discriminatory laws, customs and practices that retard socio-economic development or negatively affect vulnerable social groups.

The challenge is how to make sectors, in their unique ways and in collaborative settings, contribute to poverty reduction (URT, 2005).

Pg 6:

Constraints to rural growth are largely related to those related to the agricultural sector, broadly defined to include livestock and beekeeping. The constraints include, [among others], low productivity of land, ... infestations and outbreaks of crop and animal pests and diseases, erosion of natural resource base and environmental degradation.

Pgs 6-7:

The natural resource sectors have contributed on average 5.7 percent of GDP, with fisheries showing the highest growth rate and substantial increases in export earnings. This does not include contributions of natural resources in providing energy and water and as the basis for tourism. However, the present use of natural resources is unsustainable (e.g. wanton tree-felling for charcoal production, bad farming methods that precipitate soil erosion and bad fishing methods). This precipitates poverty by eroding sources of livelihoods and destroying the environment. The challenge is for policies in respective sectors to enforce sustainable exploitation of natural resources. There has not been adequate encouragement of community participation in identifying, planning and implementing steps to protect natural resources and environment or effective enforcement of existing regulations and by-laws.

Pg 7:

Tourism has developed rapidly since the mid-eighties. It is now an economically significant sector (12 percent GDP) that has grown at an average of 6.7 percent over the last four years. Tanzania is ranked as the 5th top tourism income earner in Africa with annual receipts of US\$ 739 million (WTO, 2001). However, apart from the indirect impact of increased revenue to Government, growth in tourism has not led to direct reduction of income poverty. Barriers to communities gaining increased benefits from natural resources (e.g. wildlife) need to be removed.

Pg 12:

As for nutrition, Tanzania has identified four nutritional disorders as being of public health significance, including protein energy malnutrition and nutritional anemia.

Pg 14:

Regarding income and non-income poverty and vulnerability, these are forces which lead to impoverishment. They include but are not limited to economic, environmental (e.g. stresses from gradual degrading of forest and soils), governance (e.g. extortion, corruption, unsatisfactory taxation and political exclusion) and socio-cultural (cultural norms or traditional beliefs) factors. Misguided or wrong policies and effects on environment and bad governance contribute significantly to vulnerability.

Pg 15:

Environmental concerns arise not only in the productive sectors but also in the provision and utilization of economic services (e.g. energy) and human settlements. Poor communities and households usually do not carry out "environmental impact assessments". As a result, poverty increases as environment and natural resources get destroyed. Interventions are required to halt such trends over land and water-based resources.

Pg 33:

Continued attention will be paid to equitable allocation of public resources. Capacity building needs at the level of Central and Local Governments will be pursued and good governance, accountability and human rights adhered to with a focus on the impact on the poor.

The strategy's goals include:

- Improved access to clean, affordable and safe water, sanitation, decent shelter and a safe and sustainable environment and thereby reduced vulnerability from environmental risk;
- Equitable allocation of public resources with corruption effectively addressed;
- Reduced vulnerability to environmental disasters;
- Soil, forest and aquatic ecosystems that people depend upon for production and reproduction conserved; and
- Reduction in land degradation and loss of biodiversity.

3.2 Types of Forest / Wildlife Uses and Current Status (Sustainability)

This sub-section and the summaries in Annexes 6 and 7 outline type of resources, use and current status (sustainability / unsustainability of the use). The last serves as a base for laying strategies for sustainable forest use under the context of policies and laws that apply.

3.2.1 Logging: current status and indicators

The current status of logging practices is considered unsustainable. Indicators that were used to evaluate the forest use through logging included: illegal harvesting; harvesting on steep slopes and catchment areas; presence / absence of Management Plans; the number and type of confiscations; number of court cases related to products from EAMFs; number / presence of sawpits in an area; poor harvesting practices (e.g. high stump heights, damage to remaining plants, and harvesting of under-size logs); high extraction rates; and low material utilization.

All logging activities in EAMFs were banned since 1990s. However, evidences of serious illegal logging were witnessed as indicated (Figures 3, 4, and 5). In addition, values in Tables 2 and 3 show how widespread illegal harvesting is in the EAMFs. Areas visited such as South Pare (Chome FR), East Usambara, Udzungwa and Rubeho Mountain blocks show high levels of illegal harvesting (www.easternarc.or.tz , 2006; and MNRT 2005).



Figure 3 Evidence of illegal timber business. Same District Catchment Forest Office (left) and District Forest Office (right) (Field photo, 2006)

Figure 3 shows confiscated timber and timber products at Same District Forest Office. The door frames were made from *Olea capensis*, which is a rare species found in the Eastern Arc Mountains. The species is heavily and illegally exploited from Kwizu Forest Reserve, which is under the Local Authority. It was reported that about 22 frames were confiscated at one time and that many others are smuggled out. The illegal harvesting makes the species locally threatened. It was further observed that illegal tree felling in the Forest Reserves is continuing despite the Joint Forest Management Agreements between FBD and villages. This is reflected in the volumes of timber confiscated as observed at Same District Catchment Forest Office (Figure 3 left) and Amani Nature Reserve Office (Figures 3 right). In Same District, between May 2005 and May 2006, a total of 967 pieces of hardwood timber were confiscated as indicated in Table 2.

Table 2 Number of confiscated pieces of timber per species illegally harvested in Same District (May 2005 – May 2006)

Species	No. of pcs	Average length (ft / pc)	Price / ft (TSh)	Value (TShs)
<i>O. usambarensis</i>	302	10	417	1,259,340
<i>Podocarpus</i> sp.	243	10	417	1,013,310
Others (mixed)	422	10	250	1,055,000
TOTAL	967	10	-	3,327,650

Source: DCFM, Same (May, 2006).

A field visit to Udzungwa Mountains revealed that there is serious illegal logging going on outside the National Park boundaries as shown in Figure 4.



Figure 4 Evidence of illegal logging for timber in Udzungwa Mountains (Field photo, 2006)

In May 2006 a total of 92 pieces were confiscated by Udzungwa Mountains National Park staff (Table 3).

Table 3 Number of confiscated timber pieces illegally harvested in Udzungwa Mountains Forest Reserves in May 2006

Date	Pieces of timber
03 May 2006	30
05 May 2006	30
30 May 2006	32
Total	92

Source: Udzungwa Mountains National Park (2006)

Figure 5 shows the incidence of poaching offences during a period of ten years. The poaching offence that is more commonly committed is illegal logging (48%).

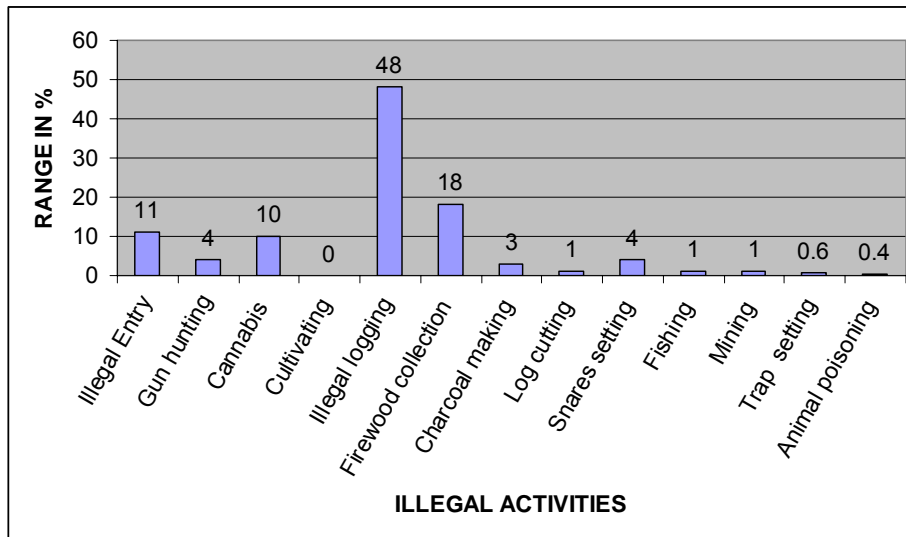


Figure 5 Number of poaching offences committed for ten years (from 1995/96 - 2004/05)

Source: UMNP 2005

According to the Morogoro Regional Catchment Forest Manager, there is also alarming illegal timber harvesting in Nguru Mountains where about 2000 pieces of timber were confiscated in just three months (Mialla, personal communication, 2006).

The significant amount of confiscated materials as shown in the preceding paragraphs calls for an immediate need to have a consolidated database on confiscated timber in the country. Currently, each project or District keeps data on confiscated timber, but these data are not aggregated into a national-wide database (Nashanda, Personal communication, 2006). The national data base could reflect the seriousness of the problem in the country and act as a scoreboard to evaluate success or failure of efforts to curb illegal logging.

Regarding extraction rates of poles and timber, in Mahenge Scarp FR for example, a report by Frontier (2004) shows extraction rates of 26 poles and 19 timbers per hectare (Table 4). These figures represent 7 percent and 10 percent of harvestable poles and timber, respectively. On the other hand, in Nawenge FR, the extraction rates were reported to be about 17 and 13 for poles and timber cut per hectare, respectively (Frontier 2004). Also, in the same report, it is indicated that most tree cuttings were old with only 2.7 percent and 3.7 percent of poles and timbers respectively being new. These findings may convince one to conclude that currently the extraction rates are on the lower side. However, in the absence of inventory reports, by species, and the guiding Management Plans for Forest Reserves, it is difficult to agree with such a conclusion. After all, there may be few new cuts because the area is highly depleted and hence there are no good trees any more.

Table 4 Summary results of poles and timber cutting survey in Mahenge Scarp FR

	Total transect length (m)	Total area of transect (m ²)	Total no. sampled	Live (% of total)	Average live per ha ²	Dead (% of total)	Average dead per ha ²	Cut (% of total)	Average cut per ha ²
Poles	8,650	86,500	3,355	2,819 (84)	325.8	312 (9)	36.1	224 (7)	25.9
Timbers	8,650	86,500	1,658	1,356 (82)	156.7	139 (8)	16.1	163 (10)	18.8

Source: Frontier, 2004

The consultancy work by Malimbwi et al. (2005) indicated that there is potential for timber harvesting in a number of forests in the EAMF blocks. However, the authors recommend the need to develop management / harvesting plans before the blocks are harvested.

For sustainable logging in the EAMFs, there is a need to conduct an inventory so as to establish harvesting levels, which are sustainable. Figure 6 is a histogram that determines how many trees (of different species and size classes) can be sustainably harvested per hectare. However, this histogram was developed for miombo woodland species and thus a much similar histogram could be developed for EAMFs to determine the levels and trees' utilization rules.

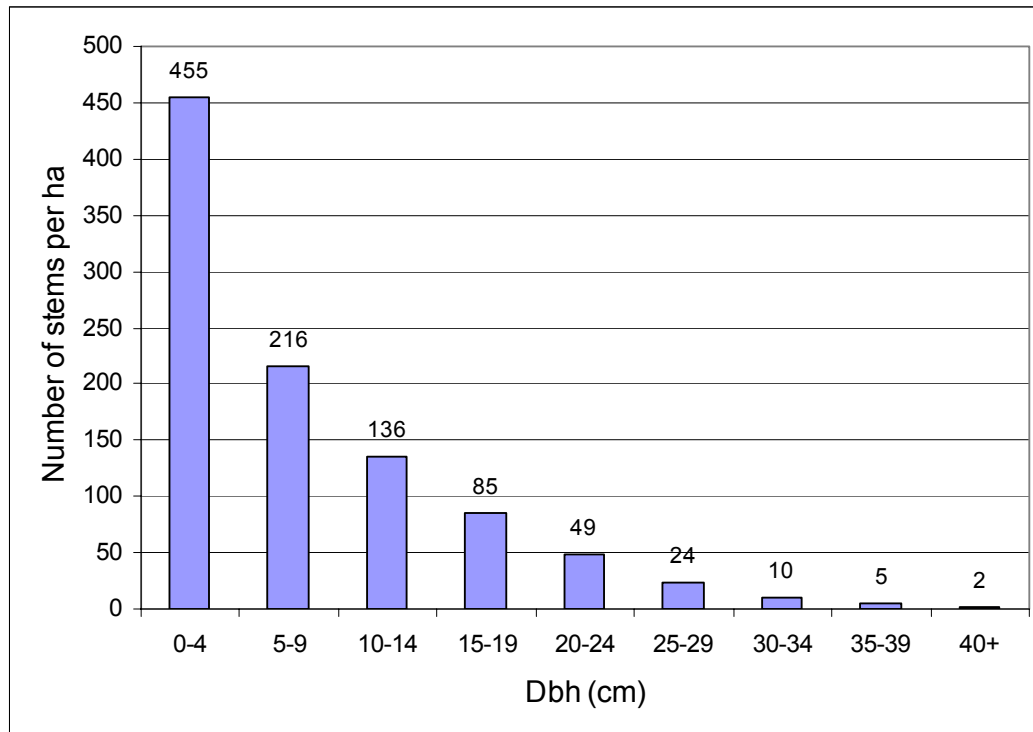


Figure 6 Recommended number of stems per hectare in a sustainably managed forest

Source: MNRT (2005).

Targeted tree species for timber

Table 5 shows a list of tree species, which are most targeted in the EAMFs.

Table 5 Tree species targeted for timber in the EAMFs

Botanical Name	Major locality	Remarks
<i>Beilschmiedia kweo</i>	Amani Nature Reserve, East usambara	Threatened for timber and tool handles in E. Usambara.
<i>Cephalosphaera usambarensis</i>	East Usambara and Nguru	Almost extinct in these mountains.
<i>Brachylaena huillensis</i>	Nguu, West and East Usambara, North Pare. Kilindi, Bombo I and II and Kindoroko FRs. Mahenge Scarp Forests	Cross-border trade between Tanzania and Kenya.
<i>Ocotea usambarensis</i>	West Usambara, South Pare and Udzungwas	Over-harvesting and forest fires in Chome and Shume Magamba FRs.
<i>Fagaropsis angolensis</i>	West Usambara	Threatened.
<i>Entandophragma excelsum</i>	West Usambara	High incidences of illegal use in Shume-Magamba FR.
<i>Ficalhoa laurifolia</i>	South Pare and West Usambara	Harvested mainly in S. Pare.

Botanical Name	Major locality	Remarks
<i>Milicia excelsa</i>	East and West Usambara, Udzungwas, Nguru and Ukaguru, Mahenge Scarp	Threatened for timber in many Forest Reserves.
<i>Olea capensis</i>	South Pare, West Usambara, Nguru and Uluguru	Threatened at Kwizu FR, S. Pare Mountains
<i>Podocarpus sp.</i>	West Usambara and South Pare	Excessive harvesting as a substitute to <i>Cupressus lucitanica</i> in the urban markets
<i>Milicia excelsa</i>	All Eastern Arc forests in river valleys and valley bottoms.	Traditionally preferred and thus heavily logged in river valleys in East Usambara.
<i>Newtonia buchananii</i>	All EAMFs over 800 m a.s.l.	Mainly used in North Pare. Lesser known species.
<i>Rapanea melanophloeos</i>	North Pare, South Pare	Mainly used at subsistent level
<i>Parinari excelsa</i>	East Usambara, Uluguru, Udzungwa, South Pare	Rarely used due to its hardness.
<i>Albizia gummifera</i>	South Pare	
<i>Khaya anthotheca, Afzelia quanzensis, Milicia excelsa, Brachystergia sp, Sterculia sp, Pterocarpus angolensis, Combretum spp</i>	Mahenge Scarp FR	

Sources: Key informants; Woodcock (1995); Cunneyworth and Stubblefield (1996a); Frontier (2005); MNRT (2005) and www.easternarc.or.tz (2006).

Targeted tree species for construction poles and tool handles

Communities in East and West Usambara are highly dependent on trees for house construction (Fig 7). Species used for construction include *Juniperus procera* *Allanblackia stuhmannii*, *Manilkara discolor*. *Prunus africana* is another species, which is mainly used for house construction in the West Usambara; it is found in Magamba and Mazumbai FRs and on household farms in Bumbuli, Vuga and Baga. Other species used excessively in the West Usambara for house construction include *Juniperus procera* and *Manilkara discolor*.

Kilenga (Personal communication, 2006) indicates that there is unsustainable use of some of the endangered species such as *Greenwayodendron spp* and *Uvariadendron usambarensis* for commercial tool handles in Tanga city and nearby townships of Muheza and Korogwe. The supply of these handles come from Amani Nature Reserve.



Figure 7 Evidence of use of indigenous trees for construction poles (Field photo, 2006)

3.2.2 Strategies for addressing unsustainable uses of trees for timber

The following strategies are proposed to address unsustainable harvesting of trees for timber:

- Build internal control systems into the procedure of issuing transit passes for timber harvested from private (or farm) lands. There is a need to streamline the procedure for issuing harvesting licenses and transit permits;
 - i. People possessing secondary products originating from unauthorized primary forest products should be liable to compounding. This is not addressed by the Forest Act No. 14 of 2002 (*cf.* §82(2)-(6) of WCA No. 12 of 1974);
 - ii. Sections 95 and 96 of the Forest Act should be re-visited in order to broaden the capacity of compounding and prosecuting of offences by forest officers (*cf.* §81 of WCA No. 12 of 1974);
- Introduce cost / benefit sharing schemes to areas under PFM (JFM and CBFM) to motivate local communities to enforce set by-laws;
- Timber and other forest products checkpoints be strengthened;
- Create awareness and make efforts to bring about alternative income-generating activities in areas where illegal logging is severe such as East Usambara, South Pare, Nguru, Ukaguru and Mahenge) and engage communities to help in conducting feasibility assessments of IGAs;
- Promote domestication and use of lesser used or lesser known species for both timber and construction purposes to meet local demand particularly through demand-driven tree planting campaigns;
- There is need to conduct forest inventory for EAMFs, which is a requirement for development of Management Plans for the forests;
- Provide training for sustainable timber harvesting techniques and enforce harvesting code;
- Involve stakeholders in designing solutions to unsustainable harvesting;
- Educate businessmen in timber products on laws and procedures involved; and
- Gazette sensitive areas including upper catchment areas.

Proposed actors in the implementation of these strategies are indicated in Annex 9.

3.2.3 Firewood collection: current status and indicators

Extraction of firewood is done in almost all categories of forests. Current consumption of firewood (Fig. 8) in the country is estimated at about 32 million m³ (based on the assumption that fuel wood consumption is 1m³ / person / year). Firewood is used for cooking and heating during cold seasons especially in high altitude areas. A limited number of households use fuel wood in income-generating activities such as brick and pot making. The current status of firewood use in the EAMF could be considered unsustainable. The indicators that were used to evaluate sustainability included presence of dead wood materials, number of dung beetles, wood-dependent factories, presence of firewood woodlots, use of scarce and valuable firewood, presence of alternative energy sources, and use of fuel-efficient stoves. Other indicators included starving trees through ring-debarking so as to dry them and poor access or inability to access the interior part of the forest. Inability to access the interior part of forest created a perceived scarcity of firewood in a particular forest while indeed there is a lot of dead wood in the forest.

Dead wood (whether standing, dead or dying trees, fallen logs and branches) is an important component of ecosystems. It provides food and shelter to a wide range of animal and fungal species as well as act as an indicator of the naturalness of the forest (WWF, 2004). There is reliable evidence that dead wood directly correlates with invertebrate diversity and that the removal of dead wood can reduce species diversity (Masser *et al.*, 1979; Niemela, 1996; Oakland *et al.*, 1996). When the dead wood decomposes, its nutrients become available to other plants, thus being an important part of nutrient recycling. Finally, removal of dead wood can deprive the soil of its protective cover, leading to soil erosion.

A study conducted by WWF – TPO (2005) in UMNP indicates that due to the removal of dead wood, grass and medicinal plants there is also a problem of habitat alteration. Human beings tend to create tracks and footpaths, a process that changes the micro-environment by increasing openness of the forest, thus increasing the amount of sunlight reaching the forest floor. Soil erosion is increased by soil compaction, removal of vegetation cover and obstacles such as dead wood, which contributes further to habitat alteration. The combined effect is to allow invasive plant species to grow in the area in question, which in turn leads to the displacement of native animal species by new ones from surrounding areas. Further in the same report, it was found that subjective observation and non-quantitative collection of butterflies indicated a significantly higher abundance and species richness of butterflies at the non-utilized sites as compared to disturbed sites.

In evaluating the overall health (or lack of) of the ecosystem the WWF-TPO (2005) used dung-burying beetles (*Scarabaeoidea*) as indicators. Overall, the abundance of dung beetles decreased from primary forest where there is no human use of dead wood to moderately used forest, before climbing again in the most disturbed forest, which had the maximum abundance of dung beetles. Such a finding can be explained by the fact that dung beetles are saprophytic (scavengers) in their ecological position on the trophic pyramids, feeding on materials indirectly derived from animals and plants. As a result, they are not immediately affected by the loss of animal and plant species.

Although this study was conducted in UMNP, it serves as a good indicator of ecological destruction going on in all forest-dependent communities of the EAMFs (e.g. in Uluguru, East Usambara and West Usambara forests). The fact that there is ecological impact (habitat destruction and alteration, and fall of animal diversity) associated with the collection of firewood; there is a need to lay down strategies to conserve the biodiversity.



Figure 8 Collection of indigenous tree species for firewood (UMNP, 2006)

Targeted species for firewood and charcoal

The following wood species were noted to be commonly used for firewood and charcoal in the EAMFs: *Stereospermum kunthianum*, *Allanblackia stuhmannii*, *Piliostigma thonningii*, *Dombeya shupangae*, *Annona senegalensis*, *Brachylaena huillensis*, *Prunus africana* and *Catha edulis*. The last three species are scarce, valuable and in high demand for both subsistence and commercial purposes. *Brachylaena huillensis* is illegally harvested for charcoal, flooring and curving materials mainly in Nilo FR and smuggled to Malindi and Watamu in Kenya. Other forests where this species is harvested illegally are Handeni Hill, Kilindi and Tongwe.

Strategies for addressing unsustainable use of firewood

The following strategies are proposed to address unsustainable use of forest for firewood:

- i. Promote use of efficient bio-energy from wood wastes and husks as an alternative to charcoal and firewood. However, promotion of such bio-technologies should be backed by both technical and sociological studies;
- ii. Encourage tree planting for commercial firewood production by private farmers or local farmers' associations particularly in South Pare and East Usambara;
- iii. Disseminate cost-effective, improved stoves to end users;
- iv. Promote agroforestry and reforestation;
- v. Expand village land Forest Reserves on village lands; and
- vi. Build the capacity of agricultural extension officers to promote retention / planting of suitable species.

Proposed actors in the implementation of these strategies are indicated in Annex 9.

3.2.4 Hunting: current status and indicators

Hunting of wildlife for food (i.e. bush meat hunting) and for economic gains is considered a significant threat to biodiversity conservation, particularly in tropical forests where production is much lower than in the savannah type habitats (Robinson et al 1999; Milner-Gulland and Bennet, 2003). The hunting and trapping practices that prevail in some EAMFs are illegal (Hartley and Kaare, 2001; see also Burgess *et al.* (Undated₂) on the Ulugurus) and considered unsustainable. Frontier Tanzania (2004) reports that the habitats and species of Mahenge Scarp Forest Reserve are under threat from not only charcoal production, pit

sawing, grazing, agriculture and fire but also hunting. Although Doggart (2005) argues that there are no clear guidelines as to what rates of utilization are sustainable in EAMFs, livelihood dependency on forest resources is not sustainable because of over utilization of the resources (Hartley and Kaare, 2001; see also Anon (Undated) for the Ulugurus and Frontier Tanzania (2004) for Mahenge Scarp Forest Reserve). For instance, writing on Manga FR in East Usambara, Woodcock (1995) reports that one trapper in Kwatango village sets 50 traps every day, but he traps an average of two animals per week. Cunneyworth and Stubblefield (1996a) report on Magoroto forest also in East Usambara that wildlife populations have declined. Many hunters in the surrounding villages attributed the decline not only to decrease in forested areas but also to their own hunting efforts (see also Cunneyworth and Stubblefield (1996b) for Bamba Ridge FR). All these are indications that the wildlife has been over-utilized and that the practice is unsustainable.

The hunting and trapping practices are illegal (FBD, 2005). The Wildlife Conservation Act No. 12 of 1974 (in short WCA) classifies wild animals into two categories and puts restrictions on their hunting and capturing. The first category is the category of totally protected species. These, e.g. the national game, must not be hunted (§16). One good example is the giraffe. As far as sport hunting is concerned, the females of species that do not carry sporting trophies are also sometimes protected e.g. impala or kudu, especially when populations are low. The second category is that of partially protected species. These are to be hunted only under licence. The Act also protects immature animals of all species, obviously pregnant or lactating females and males in breeding herds or those that are accompanied by young ones (§39). Also, no hunting is allowed at all in the close season (Jan-June) (§18).

The WCA introduced a licensing system. One of the purposes of licensing is to apportion the allowable crop of game amongst would-be hunters in the fairest possible way. People who hunt in the Eastern Arc Mountain forests do not follow the quotas set by the relevant wildlife authorities.

Furthermore, the WCA (§54(1)(a)) prohibits the following hunting methods:

- The use of poison or poisoned bait;
- The use of traps, snares, pits, spears, bows and arrows;
- The use of fire to surround or drive an animal;
- Hunting an animal at night by means of a torch, spotlight or other artificial light;
- The use of dogs.

But, these are the methods that are mostly used by hunters and captors in the Eastern Arc Mountain forests.

As far as Forest Reserves are concerned, §26 of the Forest Act also forbids, among other activities, hunting, fishing, using or being in possession of any trap, snare, net, bow and arrow, gun, poison or explosive substance used or capable of being used for the purposes of hunting or fishing without a permit (URT, 2002:1198). Even where a person seeks and obtains a hunting licence or permit from the Director of Wildlife (§§49(5) and 68(b)) for the purpose of hunting in a Forest Reserve, he or she still must seek and obtain a permit to enter the specified Forest Reserve (§49(1) (j)) and §68(a) of the Forest Act, 2002).

Indicators that the consultant used to evaluate the status of the current hunting practices, on whether or not the hunting were sustainable included animal populations (from census), methods of hunting, hunting intensity (i.e. reported numbers of poaching cases) and size and quality of habitat. Hunting (which is illegal) is reported to be high in some forests such as those of the Udzungwa Mountains (Figure 9 and 10). Forests where hunting is serious

include New Dabaga / Ulang'ambi FR and West Kilombero FR and Manga FR in East Usambara. For instance, in May 2004, while conducting a herpetological study in the central part of the Uzungwa Scarp Catchment Forest Reserve, Moyer and Mulungu (Undated) stumbled on signs of poaching. The authors report having discovered a very high level of poaching. They report further that:

Groups of hunters were encountered on the main trail by our colleagues, Dr. Don Church and Dr. Wes Sechrest. In spite of the fact that they were armed and carrying sacks of meat, they were not in the least alarmed by our presence in the forest.



Figure 9 Illegal hunting in Udzungwa Mountains National Park (File photo)

Men responsible for the hunting use snares (Nielsen, 2005), noose traps, pit fall traps, log-fall traps, spike trap, guns, spears and dogs. Some examples of snares used are shown in Figure 10.



Figure 10 Snares for trapping wild animals in UMNP (File photo)

A number of studies have been conducted in New Dabaga / Ulangambi Forest Reserve (NDUFR) in the Udzungwa Mountain block. Marshall *et al.* (2004) found a high level of hunting. The population density of blue and Harvey's duikers in NDUFR was reduced by 10% when compared to their density in West Kilombero Scarp Forest Reserve, which is subject to only low hunting pressure. Further, bush pig and Abbott's duiker in NDUFR appear to be severely depleted and potentially extirpated (Nielsen, 2005). Nielsen also found that the

number of hunters positively correlated with village population. The reports indicate that previous researchers found that groups of red colobus (*Procolobus badius*) rarely have < 10 individuals and speculated that it was likely that the small groups observed were a result of the high hunting levels and degraded habitat. Frontier Tanzania (2001a) also report that, animals in the forest are subjected to a severe hunting level, with a minimum of 33 set traps per km². They are hunted using snare traps, noose traps, pit fall traps, log-fall traps and spike traps, and as a result many of the larger mammals are very low in numbers, some even threatened with extinction. Nielsen (2006) also found that most huntable wildlife populations in the Forest Reserve are severely depleted and hence sustainable harvesting is currently not possible.

Although Marshall *et al.* (2004) found it difficult to determine the relative effects of hunting and habitat degradation they concluded that low red colobus group sizes on Udzungwa Mountains appear to be related to human activity rather than elevation. Anon (Undated₁) reports on Kilombero West Scarp FR that buffalo, bush pig, elephant and duikers are hunted in the forest. The report also states that guns and spears and not traps and snares are the methods used for hunting. Writing on South Nguru Mountains, Doggart (2005) reports trapping of birds and collection of chameleons and insects (target species include beetles and butterflies) for international trade.

Even in the Ulugurus Burgess *et al.* (Undated₁) reported that, although the majority of the endemic and near-endemic species have been recorded, a few species remain to be relocated. Burgess *et al.* (Undated₂), also reporting on the Ulugurus' state that, the globally threatened Abbot's duiker is hunted and that, possibly due to that, the species is currently confined to the deep forest areas. Still in the Ulugurus Anon (Undated₂) reports that in Madola Village people make wooden dolls and use monkey's fur for the hair of the doll. They must kill the monkeys to get the hair.

In New Dabaga / Ulangambi Forest Reserve (Nielsen, 2006), possibly in the Usambaras (Shelutete, 1996; Munyuku, 1995) and in all other EAMFs, low dietary standards (or low protein intake) and poverty provide the incentives for hunting. Although livestock meat is available in most rural areas, it is not affordable. Wild meat is in many cases much cheaper and preferred. But Woodcock (1995) thinks this is not the case. She reports that, for villages surrounding Manga FR in East Usambara, bush meat is either perceived as an occasional luxury or by some as old fashioned and "poor mans food".

In Nambiga FR, Frontier Tanzania (2001c) reports that evidence of illegal hunting (poaching) was widespread, although at that time it was not thought to represent a major threat to biodiversity. Trapping activities were found in 11 separate locations distributed throughout the forest. The types of trapping found were pitfall traps (designed for antelopes and buffalo), snare wires (for duiker) and raised log traps (for cane rats). But, pitfall trapping presents the most serious threat because they can continue killing animals, including unintended species, up to several years after their construction. For instance, during their work the Frontier Tanzania (2005) research team found a young elephant dead in a poachers' pitfall trap. Table 6 shows species hunted and hunting methods used in various mountain blocks.

Table 6 A summary of hunting location, species hunted methods of hunting and sources of information.

Mountain block	Species hunted	Methods of hunting	Source of information
Udzungwa	primates, Eastern Tree Hyrax and small forest antelope		Moyer and Mulungu (Undated)
	Chequered Elephant Shrew and Giant Pouched Rat	Snaring	
	Blue Duiker, Livingstone's Suni, Red and Abbott's duiker's	Snaring and hunting with dogs	
	Iringa Red and Angolan Black & White Colobus and Sykes Monkeys	Treed and the trees cut down; killed by dogs, spears or guns	
	Eastern Tree Hyrax	smoked out of hollow trees, den trees cut down and the animals extracted with long poles	
Udzungwa (Kilombero West Scarp FR)	buffalo, bushpig, elephant and duikers	Guns and spears	Anon (Undated ₁)
Udzungwa (New Dabaga / Ulangambi FR)	<i>Cephalophus monticola</i> , <i>C. harveyi</i> , <i>C. spadix</i> , <i>Potamochoerus larvatus</i>		Nielsen (2006)
Udzungwa		Hunting and trapping	De Luca and Mpunga (Undated)
Nambinga FR	antelope and buffalo,	Pitfall traps, and	Frontier Tanzania (2001c)
	duiker	Snares	
	cane rats	Raised log traps	
Mahenge Scarp FR	Medium-sized and larger mammals, including bushbuck	Snares	Frontier Tanzania (2004)
	Cane rats	Trapping	
South Nguru	Birds (<i>Tauraco livingstonii</i> , <i>Bycanistes brevis</i> , <i>Bycanistes bucinator</i> and <i>Cyrtospiza reichenovii</i>)	Trapping	Doggart (2005)
	Chameleons and insects (beetles and butterflies)	Collection	
	Bush pig, duiker, blue monkeys, bush buck, colobus monkey, hyrax and larger rodents	Snares, traps, dogs and spears	
Ulugurus	Abbot's duiker	Hunting	Burgess <i>et al.</i> (Undated)
	Monkeys	Hunting	Anon (Undated ₂)

Table 6 Con't from previous page

Mountain block	Species hunted	Methods of hunting	Source of information
East Usambara (Magoroto Forest)	Bush pig (<i>Potamochoerus porcus</i>), blue monkey (<i>Cercopithecus mitis</i>), vervet monkey (<i>Cercopithecus aethiops</i>), colobus monkey (<i>Colobus angolensis</i>), baboon (<i>Papio cynocephalus</i>), red duiker (<i>Cephalophus natalensis</i>), bushbuck (<i>Tragelaphus scriptus</i>), African civet (<i>Viverra civetta</i>), banded mongoose (<i>Mungos mungo</i>), cane rat (<i>Thryonomys swynderianus</i>), genet, rock dassie	Snares, traps, pits, dogs, nets, bows and arrows, pangas and guns	Woodcock (1995)
East Usambara (Bamba Ridge FR)	wild pigs (<i>Potamochoerus porcus</i>) blue monkey (<i>Cercopithecus mitis</i>), Colobus monkey (<i>Colobus angolensis</i>) and duikers	Traps and hunting with guns	Cunneyworth and Stubblefield (1996b)

Targeted animal species

Species or groups of animals targeted include monkeys (Iringa red and Angolan black & white colobus and Sykes monkeys), small forest antelopes, shrews (elephant shrew (*Macroscelidea*)), giant pouched rat, blue duiker, red duiker, Abbott's duiker (*Cephalophus spadix*), Livingstone's suni, hyraxes (bush hyrax (*Heterohyrax* spp), Eastern tree hyrax (*Dendrohyrax validus* - IUCN status vulnerable), rock hyrax (*Proavia* spp) etc. Hyraxes (known in Kiswahili as Pimbi or Perere) are the most commonly hunted animals, particularly in the Udzungwa Mountains. They are mainly hunted for meat and sometimes for their soft fur. They are also threatened through habitat loss.

The second group of animals which are heavily hunted in the EAMFs especially in Udzungwa and Uluguru mountains are the elephant shrews (*Macroscelidea*), locally known as Njule. There are two species namely *Rhynchocyon petersi* (black and rufous) and *R. cimei* (chequered). The first two are endemic to the Eastern Arc Mountains (Perkin, undated). As for the hyraxes, these species are threatened by hunting and habitat loss.

Other hunted animals include bush pigs, warhogs, buffalo, elephants, hippo (Frontier Tanzania, 2001c), bushbuck, other antelopes and other small animals.

For bird trapping (for international trade) in South Nguru Mountains target species include *Tauraco livingstonii*, *Bycanistes brevis*, *Bycanistes bucinator* and *Cyrtospiza reichenovii*. Chameleons and insects are also collected for the same purpose and target species (for insects) include beetles and butterflies (Doggart, 2005).

In East Usambara, Woodcock (1995) reports that bush pig (*Potamochoerus porcus*), blue monkey (*Cercopithecus mitis*), vervet monkey (*Cercopithecus aethiops*), colobus monkey (*Colobus angolensis*), baboon (*Papio cynocephalus*), red duiker (*Cephalophus natalensis*), bushbuck (*Tragelaphus scriptus*), African civet (*Viverra civetta*), banded mongoose (*Mungos mungo*), cane rat (*Thryonomys swynderianus*), and rock dassie are hunted.

3.2.5 Strategies for addressing unsustainable hunting practices

As stated earlier in this report, poaching and bush meat trade in EAMFs are illegal activities. Usually poaching cases are referred to Wildlife Officers whose main reaction is to ensure

compliance with existing wildlife laws. Enforcement is, of course, required in many circumstances especially in and around the Eastern Arc Mountain Forest Reserves. As stated by TRAFFIC (Undated), enforcement-related interventions have their limitations and are not appropriate in all circumstances. Also, they are not fully protecting the remaining natural resources. A mixed bag of different strategies, including incentive-based approaches that are culturally acceptable and economically viable in addition to enforcement, could be much more effective in addressing this conservation and livelihoods issue. Therefore, suggested strategies include to:

1. Create awareness among local communities (who are the stakeholders) on the potential threats facing hyraxes, elephant shrews and other animal species in their areas;
2. Improve enforcement of laws and by-laws through the involvement of local people;
3. Introduce incentive systems to local people;
4. Streamline wildlife management and Forest Reserves;
5. Encourage local communities to form and join environmental Savings and Credit Co-operative Societies (SACCOS), which could borrow money from banks and raise tree nurseries. Seedlings could be sold to gap planting projects;
6. Reconnect forests to maintain wildlife migration routes since isolation of the forests prevents natural population reinforcement from elsewhere. This could be done through gap planting of indigenous species;
7. Facilitate improved animal husbandry through enhancement of domestic sources of meat and eggs e.g. by increasing the number of domestic animals in the poorest part of the population. Poultry keeping has a relatively rapid turnover compared to other livestock, has less capital and running costs, can be easily managed by households and inspires children;
8. Increase cash income in the areas (micro-credit schemes / income-generating activities). Whilst livestock meat is available in most rural areas, it is not affordable. Also, in many rural areas poaching creates employment, although the low price obtained suggests that bush meat is not a luxury commodity with high profit margins. Increased income may take them away from, or prevent them from thinking about poaching;
9. Carry out animal census and determine sustainable harvesting levels;
10. Educate and sensitise people to change their mindset. Some rural residents hunt or buy wild meat for cultural and habitual reasons in addition to food security pressures;
11. Strengthen vermin control units; and
12. Introduce and encourage wildlife farming to reduce pressure on wild population.

3.2.6 Strategies to improve and sustain wildlife trade

Regardless of the high potential of this trade, little is known about species involved, distribution and harvestable / cropping levels. Notwithstanding, there is evidence of people being involved in the business e.g. the collection of animals for the pet trade was observed in Udzungwa Mountain block.

The following strategies are proposed to improve and sustain wildlife trade:

1. Encourage surrounding villages to form production groups and farm wild animal species (insects, reptiles, birds, mammals etc.) in an ecologically sustainable way for subsistence and trade.
2. Promotion of community-based eco-tourism;
3. Carry out census and determine sustainable harvesting levels (situation analysis);
4. Build capacity of the communities in entrepreneurship skills (business plans, recording keeping, and networking) and marketing;
5. Train villagers on selective capture techniques; and
6. Conduct market surveys.

3.2.7 Medicinal plants: current status and indicators

Collection of medicinal plants in the Eastern Arc Mountain forests is reported to be very high. Collection of medicinal plants is carried out during the daytime. A study conducted by WWF-TPO (2005) in UMNP indicates that one healer may collect about five kilogram's of medicinal plants per visit to the forest. The residents usually don't collect medicinal plants in large quantities because the collection area is nearby and accessible. For non-residents and those with clinics in areas which are far from UMNP, collection is done in larger quantities to minimize travelling costs and time spent. The resident traditional healers believe that it is this group of non-resident traditional healers that over exploit and damage medicinal plant species. Basing on those estimates, more than one ton of medicinal plants are collected from the UMNP annually (WWF-TPO, 2005).

In some cases, extraction of medicinal plants is destructive to the plant. The damage prevents regeneration and leads to the death of the plants. Since there is no replacement, it is likely that some of the plant species may become locally extinct. Extraction by uprooting plants, cutting roots, and tree ring debarking may only sustain the supply of medicinal plants when the demand is low, however, in case of demand increase, such approaches are unsustainable.

Targeted medicinal species

A study by Schlage *et al.* (2000) indicated that *Myrica salicifolia* and *Toddalia asiatica* are the most popular species used mainly in West Usambara. A list of other species, which are heavily used in West Usambara is given in Table 7.

Table 7 List of heavily used medicinal tree species in West Usambara

Botanical name	Disease treated	Remarks
<i>Artemisia afra</i>	Malaria	Over exploited locally
<i>Deinbollia borbonica</i>	Chronic cough, stomach ache, swelling legs	Has got only one tap-root, which is the one needed
<i>Tabernaemontana pachysiphon</i>	Not mentioned	Exported to USA
<i>Zanthoxylum chalybeum</i>	Stomachache, <i>degedege</i>	Over exploited locally
<i>Microglossa oblongifolia</i>	Malaria, toothache	Excessive harvesting
<i>Trema orientalis</i>	Thought to treat cancer	Exported to USA for cancer treatment test
<i>Warburgia salutaris</i>	Hookworm	Exported to USA for AIDS treatment test
<i>Prunus africana</i>	Hernia, neckache	Exported to USA for unknown uses
<i>Allanblackia stuhlmannii</i>		Potential threat due its commercial seed collection in East Usambara.

Source: Msuya (1998)

At one time scientists predicted that *P. africana* may face extinction in five to ten years (Scientists, 7th April, 2000) because of intense worldwide demand. The plant has a natural

remedy found in its bark that can ease prostate disorders. Although the local Tanzanian market has not reached alarming rates, chances are that it is going to increase in the foreseeable future and enhance unsustainable harvesting.

Catha edulis is a threatened species found in the West Usambara Mountains. Leaves of this tree species are collected on a commercial scale. Leaves are shipped to Kilimanjaro, Arusha, Manyara, Singida, Tanga and Dar es Salaam. Figure 11 shows leafless tree trunks after complete removal of young leaves and small branches as observed at Kandlele Kamp'ala between Magamba and Lukozi villages along the Lushoto-Mlalo road. A detailed study by Msuya (1998) established that out of 350 trees, which were sampled for impact assessment, 308 were either dead or without leaves on their crowns and branches.



Figure 11 The visible impact of the illegal harvesting of *Catha edulis* in the West Usambaras – note the dead / bare branches

In the East Usambara, *Allanblackia shuhlmannii* apart from being used for firewood and as building materials, seeds from these plants are frequently collected and sold, at TSh 150 / Kg, to the local Unilever project for industrial oil processing. According to the data available by Unilever, in the past three seasons, a total of 40, 132 and 200 tonnes of seeds were collected in 2004, 2005 and 2006 respectively, making a total collection of 372 tonnes. This totals TSh 55,800,000 in income for local communities averaging TSh 18,600,000 per annum. Currently there is a high market for *Allanblackia* seeds in the country, which, if not properly evaluated of its potential negative impacts may lead to the species being threatened.

The history of *Osyris lanceolata* (African sandalwood) harvesting in Tanzania and its export for perfumery dates back to the German rule (Malimbwi *et al.*, 2006; Mwang'ingo, 2002). After independence, a small factory operating in Mombo, and later relocated to Tanga, was the major consumer of sandalwood mostly obtained from Lushoto, Same and Kilimanjaro. Due to overexploitation and unsustainable harvesting by uprooting the trees, the stocks in these traditional sources have dried up (*ibid*). Harvesting has since shifted to Babati, Kondoa, Handeni–Kiteto, Singida, Mbulu and to a lesser extent Iringa (Mwang'ingo *et al.*, 2003, Mbago, 2004). Although the stock is nearly extinct in the Eastern Arc Mountains, there are some remnants, which are currently mined, as reported in Lushoto and Mwangi Districts during this study. Baga, Mazumbai and Mkuzu FRs and the surrounding general lands are the key areas where *O. lanceolata* is found, and illegally mined in Lushoto District, while Mramba and Minja FRs are the key areas where remnants do exist hence illegally harvested (mined) there too. The problem of unsustainable use of *O. lanceolata* is rated as very serious, as measured from the rapid increase in demand by oil processing industries.

Malimbwi *et al.* (2006) reports the existence of six legally registered *O. lanceolata* processing industries in Tanzania with annual demand of about 6,000 tonnes, which seem to be too high compared to the existing stock or supply. Table 8 shows a list of industries and their monthly demands. It was reported also that the Tanga Sandalwood Factory extracts oils from *Brachylaena huillensis* as well. This is another threat to this species apart from the threat from timber and fuelwood use, as stated earlier in this report.

Table 8 Sandal wood processing factories in Tanzania

No.	Company	Location	Capacity (Tonnes / month)
New companies			
1	Indo-African Essential Oils	Dar es Salaam	60
2	Equator Natural Essential Oils	Dar es Salaam	50
3	SIERRA Limited and Variety	Babati	30
4	Rainbow Limited	Dar es Salaam	41
5	Promising Traders	Dar es Salaam	36
6	Bajwa Farmers and Traders	Babati	200
Old companies			
7	Coastal Consortium Mombo	Mombo	30
8	Tanga Sandalwood Factory	Tanga	40
Total per month			487

Source: Malimbwi *et al.* (2006)

3.2.8 Strategies for addressing unsustainable use of medicinal plants

The following strategies to address the problem of unsustainable use of medicinal plants in the EAMFs are proposed:

- i. Adhere to indigenous knowledge and traditional rules and ways of harvesting traditional medicine;
- ii. Conduct inventory to establish stocking levels;
- iii. Promote and support domestication of medicinal plants in collaboration with local herbalists and traditional healers. Examples of domesticated plants on the Ulugurus include *Maesa lanceolata* (Mingutinguti), *Myrica salicifolia* (Migeremamondo), *Senna petersiana* (Mikundekunde), *Piper capense* (Ludaha), and *Khaya anthothea* (Mkangazi). However, the availability of seeds is the major constraint;
- iv. Improve harvesting, processing and packaging techniques; and
- v. Improve rural health services and use of para-medics.

3.3 Type of resource use, value, number of people involved, and duration of occurrence

Since it was not possible to get actual figures on resource values, number of people involved, and how long activities have been occurring, value judgement and experience has been used to get the values as summarised in Table 9.

Table 9 Type of resource use, value, number of people involved, and duration of occurrence

	Type of use	Relative value	Relative number of people involved	How long it has been occurring
1	Illegal logging	High	Few	After the ban in 1993
2	Regulated Firewood collection	Low	High	Since the introduction and institutionalisation of JFM in 1994
3	Regulated Medicinal plants collection	High	Few	Since 1990s
4	Illegal hunting	High	Few	For a long time

3.4 Other Forest Related Activities / Uses Negatively Impacting on the EAMFs

Table 10 provides a summary of other forest related activities that have negative impacts on the EAMFs.

Table 10 Other forest-related activities / uses

Resource	Use	Major locality in the Eastern Arc Mountains	Remarks
Forest land	Forest land used for agriculture and settlements	Mang'aliza FR and Pala-Ulanga Forest in Rubeho, Mahenge scarp, Kiverenge, Uluguru, Nguru South, Mselezi, Nanginga, Maganda, Chongweni, Gonja, Vumari, North Mamiwa and Mamboya Forests in Ukaguru	The extent of the problem is yet to be quantified due to lack of detailed studies to estimate forest area change caused only by encroachment. Nevertheless, it appears to cause big destruction
Charcoal	Charcoaling	Prevalent in almost all blocks, but at small scale	Its impact on EAMFs needs to be quantified
Bee and bee products	Honey extraction	Prevalent in almost all blocks, but at small scale	Unsustainable due to use of fires and cutting trees which harbour bees which leads to habitat loss
Ropes	Extraction of ropes	This is exercised in almost all the Eastern Arc Mountain forests. It is, however, highly notable in Ukaguru and Rubeho forests	Its impact is relatively low
Animal fodder	Cattle grazing inside the forest	Pare and West Usambara	This enhances soil erosion and destruction of habitat
Tree barks	Debarking of <i>Ocotea usambarensis</i>	It is pronounced in Rubeho, Ukaguru and South Pare	Debarking is done during preparation of local beehives. In Ukaguru forests, debarking is also done to get food additives (the bark of camphor is a famous food additive - to add food scent)

Resource	Use	Major locality in the Eastern Arc Mountains	Remarks
Handcraft and furniture	Handcraft furniture making	The activities are notable in Ukaguru forests	This has relatively high destructive effects
Forest soils	Excavation of forest soils	This practice is notable in Ukaguru forests where people use coloured forest soils to decorate their houses	This has relatively low destructive effects
Wild plants	Trade in wild plants	It is notable in Rubeho (Mpingo, Mharaka, Msekeseke) and Ukaguru (Mpingo, sandalwood)	This activity has high destructive effects

Source: Field data (2006)

3.5 The Extent and Severity of Problems Caused by Invasive Species in the EAMFs

3.5.1 Invasive Species in the Eastern Arc Mountains

The term *invasive species* refers to a subset of those species defined as introduced or non-indigenous species (NIS). U.S. Executive Order No. 13112 (1999) defines *invasive species* as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health" (Council on Environmental Quality, 1999). Pysek *et al.* (2004) define invasive species as a subset of naturalized plants...that produce reproductive off-springs often in very large numbers at considerable distances from the parent plants and thus have potential to spread over a large area (100 m in < 50 years).

A species is regarded as *invasive* if it has been introduced by human (intentionally or accidentally) to a location or an area where it did not previously occur naturally (i.e., is not native), becomes capable of establishing a breeding population in the new location without further intervention by humans and spreads widely throughout the new location. However, the majority of introduced species do not cause significant ecological change or environmental harm because they exist primarily in habitats already subjected to intensive human alteration; such species may not be considered 'invasive'. Basically, therefore, to reach invasion, three stages are involved namely importation stage (species is introduced), facilitation stage (species is naturalized) and establishment stage (species spread and invade).

There are a number of ways of introducing invasive species. These can include: accidental introduction through contaminated imports, (e.g. *Clidemia hirta* in horticultural soil); Accidental escape from discarded horticultural waste; Aquarium escape (e.g. *Salvinia molesta*); Garden escape e.g. *Mimosa pigra*; Accidental naturalisation from a managed agro-ecosystems such as crops (e.g. *Psidium cattleianum*, *Leucaena leucocephala*); Forestry e.g. *Myrica faya*; Deliberate planting in unmanaged natural ecosystems such as reforestation (e.g. *Melaleuca quinquenervia* and *Leucaena leucocephala*) and deliberately sowing from the air. Other means include erosion control (e.g. *Lantana camara*, *Pueraria lobata*) and landscaping (e.g. *Tamarix* spp). This study focused primarily on plant invasive alien species (IAS) in the Eastern Arc Mountain forests and recommends possible control measures for all involved stakeholders, aiming at maintaining the core values of the forests and human livelihoods. Table 11 show a list of major invasive species reported from different Eastern Arc Mountain forests, in Tanzania.

Table 11 Major invasive species found in the Eastern Arc Mountain forests, Tanzania

	Species	Native range	Location	Nature of the problem
1	<i>Acacia mearnsii</i>	Australia	South and North Pare	Not serious
2	<i>Arenga pinnata</i>	Asia	East Usambara	- Serious problem - High seed production
3	<i>Castilla elastica</i>	Neo-Tropics	East Usambara	Rapidly spreading in fragments, edges and disturbance gaps
4	<i>Cedrela odorata / mexicana</i>	Central and South America	East Usambara, Uluguru (lowlands)	The problem is serious in forest gaps
5	<i>Clidemia hirta</i>	Pan-tropical invader from Neotropics	East Usambara	Found in forest interior
6	<i>Cordia alliodora</i>	Neotropical pioneer	East Usambara	High seedling / sapling densities
7	<i>Elaeis guineensis</i>	Afrotropical regions	East Usambara	Dominant in teak planted areas of Longuza
8	<i>Eucalyptus sp.</i>	Australia	South and North Pare and West Usambara	Not serious problem
9	<i>Landolphia owariensis</i>	Congo and Central Africa	East Usambara	- Blankets the ground - smothers canopy
10	<i>Lantana camara</i>	Tropical America, Tropical, and Southern Africa	Most blocks	Colonize open areas
11	<i>Leucaena sp.</i>	Texas to Peru	West Usambara	
12	<i>Maesopsis eminii</i>	West Tanzania and Central Africa	East Usambara, Ukaguru	Big threat to biodiversity (will replace native forest)
13	<i>Phyllostachys bambusoides</i>	Asian	East Usambara	Dense thickets spread into forest rapidly
14	<i>Piper aduncum</i>	Neotropical	East Usambara	- Found in forest edges - Grow near rivers
15	<i>Psidium cattleianum</i>	South America	East Usambara	- Shade tolerant - Vegetative growth
16	<i>Pyrostegia venusta</i>	Tropical South America	East Usambara	Causes crown dieback of tree in the forest
17	<i>Selaginela sp.</i>	Tropical and Warm temperate Europe	East Usambara	Hinder all regeneration and mainly smothers small trees and shrubs
18	<i>Syzygium jambos</i>	South East Asia	East Usambara	- Shade tolerant - Grow near rivers
19	<i>Tectona grandis</i>	Asia	Udzungwa	Not serious
20	<i>Rubus sp.</i>		South and North Ukaguru, Uluguru, Udzungwa	

It is evident from the Table 11 that the East Usambara Mountain forests are severely threatened by invasive plant species in terms of numbers. There are about 15 species which have invaded the natural ecosystem, mainly inside Amani Nature Reserve and other adjacent natural forests and plantations (teak plantations have been affected by *Elaeis guineensis* and *Lantana camara*).

3.5.2 General problems caused to the forest ecosystem by invasive species

An overall assessment has revealed that there about 19 vascular invasive species in the Eastern Arc Mountains of which 79% are located in East Usambara Mountain. Generally, invasive species affect geomorphological processes, biogeochemical cycles, hydrological cycles and fire regimes as follows:

- *Geomorphological processes*: Soil erosion e.g. *Leucaena leucocephala*; soil stabilisation e.g. *Pueraria lobata*, *Tamarix* spp.;
- *Biogeochemical cycles*: Nitrogen enrichment e.g. *Myrica faya*, *Leucaena leucocephala*; salinisation e.g. *Tamarix* spp.;
- *Hydrological cycles*: Reduce stream flow e.g. *Salvinia molesta*, *Mimosa pigra*; Lower water table e.g. *Mimosa pigra*, *Tamarix* spp. and;
- *Fire regime*: Increase fire frequency e.g. *Melaleuca quinquenervia*; decrease fire frequency e.g. *Mimosa pigra*, *Lantana camara*.

The affects of invasive species are mainly agent specific, thus vulnerability for invasion is subject to the following factors:

- *Climate*: e.g. *Salvinia modesta* spreads following major floods;
- *Disturbance*: e.g. *Mimosa pigra* facilitated by overgrazing by water buffalo;
- *Species interactions*: e.g. *Psidium cattleianum* spread by introduced cattle;
- *Hybridisation*: e.g. *Lantana camara* hybrid plants more invasive; and
- *Land Management*: e.g. *Melaleuca quinquenervia* increased after change in fire regime.

Since most of the forests in the Eastern Arc Mountains are subject to some of these factors like disturbance (e.g. illegal logging, pole cutting, fire burning), species interaction (e.g. arboretum species interacting with native ones) and land use changes (e.g. plantation forests, experimental plots, road construction), the extent and severity of the problems are more or less linearly related to these factors. Where the factors are overlapping, the problems are more severe than where single factor or two prevails. This is substantiated by the severity of the problem in specific mountain block as presented in the following sub-section.

A recent survey that was carried out in Amani Nature Reserve with regard to the nature, extent and severity of the invasive species' problems have revealed that 91 species were reproducing; 53 had escaped; 23 have naturalised, 23 have spread; 25 species in forest edges and fragments; 16 species with unknown introductions have spread have spread in different parts of East Usambara.

Table 12 gives a summary type of invasive species, the problem it causes, extent and severity of the problems and its possible control measures as particularly observed in East Usambara Mountain Forests of the EAMFs.

Table 12 Invasive species; problems and their extent and severity

Invasive Species	Problem caused by the invasive species	Extent and severity of problem
<i>Arenga pinnata</i>	A recent invasive. Problems not evident, though it colonizes the forest	Not established
<i>Castila elastica</i>	Escape to natural habitat from the boundaries of botanical garden	May be large if not controlled
<i>Cedrela mexicana</i>	Sporadic regeneration, believed to be a serious problem	Large extent in relative terms
<i>Clidemia hirta</i>	<ul style="list-style-type: none"> • Less studied, but has been reported to displace most mosses and liverworts • It can drive some species to extinction 	Do not pose any major threat
<i>Elaeis guineensis</i>	Rapid growth in the plantation and natural vegetation/forest	No evidence
<i>Lantana camara</i>	<ul style="list-style-type: none"> • A noxious weed, which colonizes fire-stricken areas of forests • Prevents regeneration of other species thus limiting biodiversity richness 	The species has been poorly investigated. Yet, no major threats visually
<i>Maesopsis eminii</i>	<ul style="list-style-type: none"> • Rapid spread in forest gaps • May affect regeneration of native species but no research evidence 	Large extent in relative terms
<i>Phyllostachys bambusoides</i>	Escape from the boundaries of the botanical garden	Not established
<i>Psidium cattleianum</i>	Replaced native species	Un-quantified
<i>Pyrostegia venusta</i>	<ul style="list-style-type: none"> • In 1999 the species covered over 6,000 m² spreading over 10 m per year and smothers 30-40 m trees • It hinders human movement through the forest 	Large extent in the long-term
<i>Selanigella</i> spp.	<ul style="list-style-type: none"> • Estimated to cover $\approx 100 \text{ m}^2$ / year • Spreads vegetatively 2-3 m / year. Hinders all regeneration and mainly smothers small trees and shrubs 	Large extent and severe in the longer term

3.5.3 Reviewed methods to control invasive species

Since the problems of the invasive species are normally associated with introduction from elsewhere, their control and management should be guided by experience from a broad range of experiences in similar climatic regions such as tropical Africa. The following are some of the key control methods tried in South Africa:

- *Biological control*: has shown success in controlling *Salvinia modesta* but failed to combat *Lantana camara*;
- *Plant import restrictions*: proved to be functional for known invaders entering via trade and ineffective against “new” invaders and smuggled plants;
- *Mechanical removal*: proven to be labour intensive, expensive and not 100 percent efficient especially for herbaceous invasive species covering larger areas; and

- *Herbicides*: useful over large areas but only if the target species is not herbicide resistant. It is difficult to use non-specific herbicides in conservation areas.

3.5.4 Strategies to address problems caused by invasive species

Preventing the establishment of invasive species is always the best method of control (The Nature Conservancy, 2005). However, stopping harmful species at the stage of which some are established in parts of the EAMFs can be difficult, but it can also be invaluable in terms of both the diminishing cost of future control and the preservation of our natural systems. Proposed strategies to address problems caused by invasive species include:

- i. Properly manage the established botanical gardens to control escape of invasive species from the boundaries of the gardens;
- ii. Carry out physical and chemical removal of invasive species;
- iii. Prevent the introduction of new exotics, otherwise the rich indigenous biodiversity of the area will ultimately become a heaven of the gardens and trials plots' exotics;
- iv. Develop monitoring and evaluation programme with a database which will provide knowledge of the local vegetation;
- v. Promote the exploitation of timber from invasive species (*Cedrela*, *Acacia*, *Eucalyptus*);
- vi. Eradication of non-timber invasive species through pilot control (*Rubus*, *Lantana*);
- vii. Provide education / awareness / extension services on invasive species management to farmers;
- viii. JFM guidelines should incorporate exploitation of invasive species; and
- ix. Establish networking with other stakeholders in the African region such as Forest Invasive Species Network for Africa (FISNA).

3.5.5 Elements to be included in the legislation for smooth implementation

- Managers will have to learn to live with many alien plants and target control actions just to those that interfere with goals;
- Managers seeking to control invasive plants should consider developing an Invasive Species Management Plan. Such a Plan must include: site goals or management objectives; a list of the invasive plant species identified as interfering with goals or objectives; species life history information; the observed or potential impacts on the site; an assessment of control options; a monitoring plan; a detailed budget of projected costs; and other external factors;
- The cost of clearing must be spread equitably amongst all beneficiaries;
- Farmers of alien plants should help share the cost for clearing beyond their own land (the polluter pay principle). Responsibility must be clearly defined;
- Tanzania must learn from the experience gained in other countries;
- Biological control has a key role to play;
- Screening criteria and / or early invading alien plant identification criteria need to be developed;
- Management should ideally be done on a catchment basis;

- Local and Central Government must contribute towards the management of Catchment Forests as custodians of biodiversity in the environment and community welfare, and as landowners where applicable;
- Regional and international / trans-boundary partnerships and initiatives should be facilitated;
- The potential impact of alien clearing on communities has to be considered;
- Control authorities should be able to work on all land at the land owner's expense;
- Recognition that long-term follow up and commitment are indispensable;
- Clear guidelines for issuing of permits for cultivation or selling of commercial invading alien plants are needed;
- Heavy fines for contravention or non-compliance should be given;
- Recognition that landowners or research plot owners remain responsible for the management and control of invading alien plants on their land and beyond their boundaries and for the restoration actions arising from disturbance activities;
- Transparent and objective methods for prioritisation of areas needing clearing should be demanded;
- Effective systems of control should be developed as a management tool and guidelines for clearing, biological control, herbicide use and fire as a management tool;
- Where authorities clear alien state plants on private land they must be entitled to claim ownership of any produce and to use income from this to defray costs;
- The extent of alien plant invasions should be systematically surveyed, mapped and monitored and the present status should be "frozen", especially in areas that are considered "clean" or in a maintenance state; and
- Administrative / legal management has to be done geographically on a per property basis.

3.5.6 Role players in the control measures of invasive species

The problems of invasive species in the EAMFs can not easily be controlled if partnerships in the control interventions are not taken on board. Real partnerships between the Government, NGOs, and research institutions are highly encouraged. The Government of Tanzania as a signatory of the Convention on Biological Diversity, has a commitment "to strictly control the introduction of non-indigenous species". This can be made possible through the formation of a National Programme for the Control of Invasive Species in Tanzania.

It is important to note that it is very difficult to control *Maesopsis eminii* because it so easily re-colonises sites which are disturbed while simultaneously it is difficult and costly to attain an acceptable regeneration of primary forest species. Therefore, the most appropriate way is to control disturbance, which in any event is of primary importance for the conservation.

4.0 Conclusions and Recommendations

4.1 Conclusions

The review of policies and laws related to forest conservation indicates that there are some distinct deficiencies, which make them fail to comply with sustainable use of forest products. There is a relatively big disparity between the statements and directives in policies and laws and the actual situation on the ground. Responsibilities and answerabilities of Government officials in the field have a lot to be desired. Where the degree of forest use is specified, the mechanism for follow-up or implementation is not clearly stated. These flaws in policy directives and laws jeopardize the attainment of sustainable forest use in the EAMFs.

The major types of unsustainable forest uses include illegal logging, illegal hunting or poaching, tree cutting for commercial firewood, medicinal plants, and encroachment for farming. Using a set of sustainability indicators, it was found that the current logging practices in the EAMFs were illegal and unsustainable. Several incidences of illegal logging were observed particularly in East Usambara, South Pare, Nguru, Ukaguru and Mahenge. Trees in upper and sensitive catchment areas were harvested for timber, as was noted in river valleys of the East Usambara. It was reported that of the incidences among poaching offences committed for a period of ten years, illegal logging (48 %) was the more commonly committed in Udzungwa Mountain forest block. Major timber species that are targeted (with location in a bracket) include *Ocotea usambarensis*, *Podocarpus usambarensis*, *Ficalhoa laurifolia* (South Pare), *Ocotea usambarensis*, *Fagaropsis angolensis*, *Entandophragma excelsum* (West Usambara), *Cephalosphaera usambarensis*, *Milicia excelsa*, *Beilschmedia kweo*, *Brachylaena huillensis* (East Usambara and Nguru), *Cordia africana*, *Olea capensis*, *Brachylaena huillensis*, *Rapanea melanophloeos*, *Prunus africana*, *Allanblackia stuhlmannii* (North Pare), *Brachystegia* spp., *Milicia excelsa*, *Ocotea* spp. *Cordia africana*, *Podocarpus* spp. (Udzungwa, Uluguru, Nguru, Rubeho, Ukaguru). Species targeted for house construction and tool handles include *Juniperus procera*, *Manilkara discolor*, *Greenwayodendron* spp. and *Uvariadendron usambarensis*.

In order to ensure sustainable logging the following strategies are proposed: introduction of cost / benefit sharing schemes in areas under PFM (JFM and CBFM); motivation of local communities to enforce the set by-laws; create awareness and make efforts to bring about alternative income-generating activities in areas where illegal logging is severe such as East Usambara, South Pare, Nguru, Ukaguru and Mahenge. Others include promotion of domestication and use of lesser used or lesser known species for both timber and construction purposes to meet local demand particularly through demand-driven tree planting campaigns. Furthermore, there is need to conduct forest inventory for EAMFs, which is a requirement for development of Forest Management Plans for the forests. Communities especially those under JFM should be provided with training on sustainable timber harvesting techniques, harvesting code and the need to enforce the code. Also there is urgent need to gazette sensitive areas including, upper catchment areas.

Although firewood collection in areas that have been regulated through JFM contracts appeared sustainable. Other studies have revealed serious ecological damages caused by firewood collection. Such damages include removal of dead wood, which provides food and shelter to a wide range of animal and fungal species. The removal of dead wood not only does habitat alteration but also reduces species diversity. Moreover, in the course of firewood collection, people tend to create tracks and footpaths, a process that changes the micro-environment by increasing openness of the forest, thus increasing the amount of sunlight reaching the forest floor and causing soil erosion.

The following wood species were noted to be commonly used for firewood and charcoal making in the EAMFs: *Stereospermum kunthianum*, *Allanblackia stuhlmannii*, *Piliostigma*

thonningii, *Dombeya shupangae*, *Annona senegalensis*, *Brachylaena huillensis*, *Prunus africana* and *Catha edulis*. The last three species are scarce, valuable and are highly demanded for both subsistence and commercial purposes.

In order to have a sustainable supply of firewood and to reduce pressure on the EAMFs, the following strategies are proposed: encourage tree planting for commercial firewood production by private farmers or local farmers' associations particularly in South Pare and East Usambara; disseminate cost-effective, improved stoves to end users; and promote agroforestry and reforestation practices.

Although the Wildlife Conservation Act No. 12 of 1974 does not allow hunting without licences, illegal hunting was observed in the study area, particularly in the Udzungwa and North Pare mountain forests and the East Usambara. Notwithstanding, hunting is conducted in a very unsustainable manner. Poor hunting methods such as the use of snares, noose traps, pit fall traps, log-fall traps, spike trap, spears and dogs are used. Studies on animal census and hunting intensity have shown that hunting reduces populations of wild animals. For example, bush pig and Abbot's duiker in New Dabaga / Ulangambi Forest Reserve (NDUFR) appear to be severely depleted.

The most hunted animals include bush hyrax (*Heterohyrax spp*), tree hyrax (*Dendrohyrax validus*), rock hyrax (*Proavia spp*) and elephant shrews (*Macroscelidea*). Other hunted animals include bush pigs, warthogs, antelopes, buffaloes, elephants, primates (such as Iringa red colobus, Angolan black and white colobus and Sykes monkeys), giant pouched rat, bushbuck, blue duiker, Livingstone's suni, red duiker, Abbott's duiker and other small animals.

The following strategies are proposed for sustainable hunting: Create awareness among local communities; improve enforcement of laws and by-laws through the involvement of local communities (JFM); and introduce incentive systems to enhance communities' involvement and commitment. In addition, facilitation of improved animal husbandry through enhancement of domestic sources of meat and eggs, e.g. by increasing the number of domestic animals in the poorest part of the population could provide a better alternative to wild meat. Projects such as poultry keeping, which has relatively rapid turnover compared to other livestock, require less capital and running costs, and can be easily managed by poor households. Cane rats (*Thryonomys swinderianus*) may also hold high potential; not only do they breed quickly but are likely to be culturally acceptable. Other species that have been farmed for their meat in Africa include the Brush-tailed porcupine (*Atherurus africanus*), Giant rat (*Cricetomys emini*), Red river hog (*Potamochoerus porcus*), Duikers (*Cephalophus spp.*), Giant African snail (*Archachatina marginata*), Helmeted guinea fowl (*Numida meleagris*), Double-spurred francolin (*Francolinus bicalcaratus*) and Scaly francolin (*Francolinus squamatus*). Most of these are, however, not found in the Eastern Arc Mountain region.

There is need to strengthen vermin control units to protect crops grown by communities around Forest Reserves or national parks. Furthermore, there is need to carry out animal census and determine sustainable harvesting levels.

Regardless of the high potential of wildlife trade, little is known about species involved, distribution and harvestable / cropping levels. Notwithstanding, there is evidence of people being involved in the business, e.g. the collection of animals for pet trade which was observed in Udzungwa Mountain block.

The following strategies are proposed to improve and sustain wildlife trade: encouraging surrounding villages to form production groups and farming of wild animal species (insects, reptiles, birds, mammals etc.) in an ecologically sustainable way for subsistence and trade. Community-based eco-tourism could serve as another source of income for the communities.

Collection of medicinal plants in the Eastern Arc Mountain forests is reported to be very high. For example, a report by Udzungwa Mountain National Park (UMNP, 2005) indicates that more than one tonne of medicinal plants are collected from the area annually. In some cases, extraction of medicinal plants is destructive to the plants. Such destructive extraction techniques include uprooting plants, roots cutting, and tree ring debarking. Such extraction techniques prevent regeneration and lead to the death of the plants. Since there is no replacement, it is likely that some of the plant species may become locally extinct.

The most targeted medicinal plants include *Artemisia afra*, *Deinbollia borbonica*, *Tabernaemontana pachysiphon*, *Zanthoxylum chalybeum*, *Microglossa oblongifolia*, *Trema orientalis*, *Warburgia salutaris*, *Prunus africana* and *Allanblackia stuhlmannii*.

In order to address the problems associated with unsustainable use of medicinal plants in EAMFs, the following strategies are proposed: Adhere to indigenous knowledge and useful traditional rules and ways of harvesting traditional medicine; and promoting and supporting domestication of medicinal plants in collaboration with local herbalists and traditional healers.

Examples of domesticated plants on the Ulugurus include *Maesa lanceolata* (Mingutinguti), *Myrica salicifolia* (Migeremamondo), *Senna petersiana* (Mikundekunde), *Piper capense* (Ludaha), and *Khaya anthotheca* (Mkangazi). However, availability of seeds is reported to be the major constraint. Other strategies include improving rural health services and use of Para-medics to reduce impact on the forests. Also, there is need to conduct forest inventory so as to establish the stocking and harvesting levels.

Also, this study revealed that East Usambara Mountain forests and especially Amani Nature Reserve are the most threatened by invasive species. Identified invasive species include *Maesopsis eminii*, *Cedrela mexicana* and *Lantana camara*. Other lesser-known invasive species include *Castila elastica*, *Pyrostegia venusta*, *Selaginella spp.*, *Arenga pinnata*, *Clidemia hirta* and bamboo species. Problems caused by invasive species are mainly in biodiversity loss, which is more serious in East Usambara than in other Eastern Arc Mountain forests.

Strategies to address problems associated with invasive species include: Proper management of the established botanical gardens to control escape of invasive species from the boundaries of the gardens; developing monitoring and evaluation programmes with a database which will provide knowledge of the local vegetation; and the promotion of exploitation of timber from invasive species (*Cedrela*, *Acacia*, *Eucalyptus*). Other strategies include provision of education / awareness / extension services on invasive species management to farmers and incorporating exploitation of invasive species in JFM guidelines.

4.2 Recommendations

Apart from the enlisted strategies, the following need further actions or research:

- i. The flaws in policies and laws related to sustainable resource use as reflected in annexes 6 and 7 should be addressed;
- ii. Firewood consumption and distribution patterns in areas around the EAMFs are not well documented and a detailed study on the same could provide useful information for strategy formulation;
- iii. A number of invasive species were noted in the EAMFs and potential control methods were reviewed. However, there is need to determine more appropriate control methods through research;

- iv. Regardless of the huge amount of confiscated timber in different locations / projects / districts, there is no national-wide database that consolidates these data to portray the actual situation in the country. Therefore, there is need to establish such a database;
- v. Training on land use planning and mapping should be provided to communities around the EAMFs;
- vi. There is need to observe animal movements especially in those areas which are close to National Parks. On occasion animals invade crops and generating a human wildlife conflict issue.
- vii. There is a need to conduct forest inventories and animal counts to serve as inputs for the development of Management Plans; and
- viii. There is a need to strengthen participatory resource management.

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Appendix 1 Terms of Reference



Conservation and Management of the Eastern Arc Mountain Forests: Eastern Arc Mountains Strategy (GEF/UNDP:URT/01/G32)

Development of Sustainable Forest Use Strategies

Introduction

The Eastern Arc Strategy is a component of the Project 'Conservation and Management of the Eastern Arc Forests' (GEF/UNDP: URT/01/G32). The project is implemented by the Forest and Beekeeping Division of the Ministry of Natural Resources and Tourism and it is funded by the Global Environment Facility through the United Nations Development Programme.

Objectives

The objective of the Eastern Arc strategy component is:

Conservation status of Eastern Arc Mountains improved through the development and implementation of an integrated conservation strategy for biodiversity conservation and water supply

Linkage to Project Outputs

One of the project Outputs of CMEAMF is 'A set of thematic strategies for biodiversity conservation are developed and implemented – through both macro frameworks and individual management plan processes'. CMEAMF has reviewed the major issues affecting conservation across the Eastern Arc Mountains, and has prioritised the most important for the development of detailed strategies to address the problem. The results of this work will form core elements of the larger Eastern Arc strategy document. This work is also closely linked to the forest disturbance and threat assessment work being currently undertaken for the project by Prof. Madoffe and Dr. Munishi at SUA.

Problem Statement

The Eastern Arc Mountain Forests and Grasslands provide a number of resources for people. The value of these resources, and the poverty of the people living in the Mountains, creates an unsustainable use of many forest products. However, the exact nature of the unsustainable use, and the species that are targeted is not synthesized. Moreover, strategies for addressing the unsustainable use have not been prepared. These are core elements of the proposed Eastern Arc strategy and CMEAMF needs the best available advice on how sustainable use can be built into its documentation.

Proposed work

The work proposed under this service contract will be to undertake the following tasks:

- To briefly review the policies and laws relating to the forests of the Eastern Arc Mountains to define the degree to which sustainable use is allowed in the various

categories of forest which are found in these mountains (Central Government Catchment Forest Reserves, Local Authority Forest Reserves, Village Land Forest Reserves, general and private lands).

- To synthesise available knowledge (primarily through a desk study) on the types of unsustainable uses that are occurring in the Eastern Arc Mountain Forests, including detailed descriptions of a) the types of use, b) the species involved, c) the values of this use, d) the number of people involved with the activity, e) how long it has been occurring.

Types of use already identified are as follows:

- Logging
 - Firewood collection
 - Medicinal plant collection
 - Hunting
-
- To assess the extent and severity of problems caused by invasive species in the Eastern Arc Mountain Forests, primarily plants, including preparing a list of the species involved, their location in the Arc (as known) and the types of problems they cause.
 - To suggest strategies that would address the unsustainable use of forest products (and any invasive species problems), set within the context of the policies and laws that apply to the Forests and Grasslands of the Eastern Arc Mountains.
 - To convene a workshop of relevant stakeholders to present the proposed sustainable use strategies and seek input to improve them.
 - To produce a final document that makes final proposals for sustainable use and recommendations for further work required.

Proposed Implementation Mechanism

Time-frame: Work is proposed to start in 2005 once all procedures have been completed. It is expected that the project will take eight months in total, with six months to complete the data gathering and limited field work, and two months to write the draft, hold a workshop and finalise the strategy. The final report is expected by the end of 2005.

Reporting: The consultant will prepare monthly progress reports on the work. These will include a financial element and the progress with the work and the quality of financial reports will form the basis for releasing further funds. The consultant is also expected to produce the following:

- Draft Sustainable Use Strategy for the Eastern Arc Mountain forests, containing sections on:
 - Short review of the policies and laws relating to the Eastern Arc forests, focusing on the types of permitted uses in Catchment Forest Reserves, Local Authority Forest Reserves, Village Land Forest Reserves and general forest lands.
 - Review of the unsustainable uses that are occurring in the Eastern Arc Mountain forests, including detailed descriptions of a) the types of use b) the species involved c) the values of this use d) the number of people involved in the activity, and e) how long it has been occurring. Different sections should cover logging, firewood collection, medicinal plant collection and hunting. This will primarily be a review of the existing literature, with some field verification and email contact with experts outside the country.

- Review of the invasive plant and animal species found in the Eastern Arc Mountain forests, where they are from in the world, where they occur within the Eastern Arc Mountain forests, and what kinds of problems they bring. This is primarily a review of existing literature, augmented by field visits to some problematic areas, and email contact with experts from outside the country.
- A detailed section that outlines, for each of the major unsustainable use, those strategies that can be employed to make the use sustainable. This has to be written within the context of the relevant policies and laws relating to the various categories of forest in the Eastern Arc Mountains. This is the core part of the work, and is primarily a desk exercise based on the expertise of the staff at Sokoine and elsewhere.
- A set of proposals for further work that needs to be undertaken to better understand the issue of unsustainable use of the Eastern Arc Mountain forests.
- Financial report of the use of funds to a standard acceptable to UNDP and the Government of Tanzania.

Budget: The budget will be agreed between the service provider and CMEAMF. UNDP will be involved with these discussions.

Funding disbursements: Funds will be disbursed according to a schedule agreed between the service provider and CMEAMF. UNDP will make the actual payments directly from Dar es Salaam.

Contracting: The contract will be prepared between UNDP Dar es Salaam and the service provider, with technical inputs from CMEAMF.

Staffing issues: The service provider will be responsible to UNDP for the delivery of this work, and to the CMEAMF Project Coordinator Dr. Felician Kilahama, with technical backup provided by Dr. Neil Burgess – the project Technical Advisor.

Appendix 2 Matrix table showing types of data / information collection methods and major source(s) for the Eastern Arc Mountains, Tanzania.

Key issue under ToRs	Specific information / data needed by the client	Method used	Source(s) of information
1. Policies and Laws	<ul style="list-style-type: none"> • Stated uses in different forest categories • Degree of allowable uses in different forest categories 	Review of relevant government documents, i.e Policies and Laws	<ul style="list-style-type: none"> • Forest and Wildlife, Policies • Forest and Wildlife Laws • Environmental Policy and Act • Land Policy and Land Acts • NSGRP (MKUKUTA)
2. Types of forest use	<ul style="list-style-type: none"> • Logging: <ul style="list-style-type: none"> - pitsawing and/or sawmilling - targeted species - legal or illegal • Fuelwood collection: <ul style="list-style-type: none"> - level of dependency - commercial or subsistence - how serious • Sandal wood: <ul style="list-style-type: none"> - where found - abundance - harvesting rate - dealers - current status • <i>Prunus africana</i>: <ul style="list-style-type: none"> - where found - abundance - harvesting rate - dealers - current status • <i>Catha edulis</i>: <ul style="list-style-type: none"> - where found - level of dependence - tree damage levels - dealers • Medicinal plants: <ul style="list-style-type: none"> - species used 	<ul style="list-style-type: none"> • Literature review • Ground verification • Minimal household and market surveys • Key informant interviews • Group discussion • Stakeholders' workshop 	<ul style="list-style-type: none"> • Forestry and Wildlife offices: <ul style="list-style-type: none"> - DCFM and DFO offices - Tanga Regional Catchment Office - Amani Nature Reserve - Udzungwa National Park • Non-government offices: <ul style="list-style-type: none"> - TFCG-Korogwe - TIP-Lushoto - SECAP-Lushoto - WWF - WCST - EAMFCP - CARE-Morogoro - Any other relevant source

Key issue under ToRs	Specific information / data needed by the client	Method used	Source(s) of information
	<ul style="list-style-type: none"> -commercial or subsistence -dealers •Hunting: <ul style="list-style-type: none"> -species' availability -factors influencing -who are involved? -hunting methods 		
3. Problem of invasive species	<ul style="list-style-type: none"> Where prominent? Which species involved? How serious is the problem? Major threats 	As above	TAFORI Catchment offices, FBD. Internet
4. Sustainability 4.1. Unsustainable uses 4.2 Sustainable uses	<ul style="list-style-type: none"> Which uses? How demanded? How supplied? Which uses? How demanded? How supplied? 	<ul style="list-style-type: none"> Compare results Compare results 	
5. Forest use strategies	<ul style="list-style-type: none"> Which strategies? How to be implemented? 	Experiences from elsewhere and emerging issues in global conservation needs ecological aspects , macro and micro-economics	Literature Researchers experience Workshop

Appendix 3 Eastern Arc Mountains: Information matrix from the screened literature and key informant interviews on forest uses

Mountain Block	Wood based uses			Non-wood based uses		Associated forest land uses			Remarks and the way forward
	Logging	Pole wood	Fuel wood	Medicinal	Other uses	Hunting	Minin g	Encroachment for farming	
East Usambara	xxx	xxx	xxx	xx	xx	x	xx	x	Sufficiently documented on major uses. Need for key informants interviews.
West Usambara	xxx	xxx	xxx	xxx	xx	x	xx	x	Sufficiently documented on major uses. Need for key informants interviews.
Udzungwa	xx	x	NI	xx	x	xxx	NI	NI	Sufficiently documented on the ecological side and little on socio-economic side.
Uluguru	xxx	xx	xxx	xx	x	xx	xx	x	Sufficiently documented on major uses. Need for key informants interviews.
South Pare	xxx	xx	xx	x	x	NI	NI	NI	Insufficiently documented on major uses. Need for field visit for interviews.
Mahenge	xxx	xx	xx	x	x	xx	xx	xx	Insufficiently documented on major uses. Need for field visit for interviews.
Nguru	xx	NI	NI	x	xx	x	NI	xx	Insufficiently documented on major uses. Need for field visit for interviews.
Nguu	NI	NI	NI	NI	NI	NI	NI	NI	Insufficiently documented on major uses. Need for field visit for interviews.
North Pare	x	NI	NI	NI	NI	NI	NI	NI	Insufficiently documented on major uses. Need for field visit for interviews.
Rubeho	NI	NI	NI	NI	NI	NI	NI	NI	Insufficiently documented on major uses. Need for field visit for interviews.
Ukaguru	NI	NI	NI	NI	NI	NI	NI	NI	Insufficiently documented on major uses. Need for field visit for interviews.
Malundwe Hills	NI	NI	NI	NI	NI	NI	NI	NI	No reliable scholarly information on major uses. Need for field visit.

Key: Relative levels of information available

x = low level
 xx = medium level
 xxx = high level
 NI = No Information

Notes: Literature indicates that in almost all forests, researches were biased on biodiversity leaving much to be desired on forest uses and invasive species. There is general lack of quantitative information of the uses and regeneration potential by species in almost all forests.

Appendix 4 Work / activity implementation time schedule (February - June)

Activity	Duration (months)					
	February	March	April	May	June	July
1. Revisiting of the proposal and contract	→					
2. Preparation of a work plan matrix		→				
3. Screening of relevant literature		→				
4. Review of relevant policies and laws		→				
5. Preliminary field work in W. Usambara		→				
6. Review of literature		→				
7. Presentation of the initial findings		→				
8. Field work			→			
9. Data processing				→		
10. Compilation				→		
11. submission of draft report						↓

Appendix 5 Work / activity implementation time schedule (June - October)

	Duration (months)				
	June	July	August	September	October
12. Report review by the client				↓	
13. Receiving client's comments				↓	
14. Incorporating client's comments				→	
15. Compilation of final report				→	
16. Submission of final report					↓

Appendix 6 National Policies, their flaws and proposed strategies

	Resource type	Use type	Policy	Flaws to sustainable resource use	Strategy	Responsible organ
1	Timber	Logging	Forest Policy 1998	1) Public ownership of general land that creates feelings to the public that this particular area is no-man's land 2) Unclear forest land tenure	1) The majority of forests in general land should be turned into Forest Reserves area and the remaining portion should be turned into Forest Reserves' buffer zones 2) Forest regulations should be reviewed to address forest land tenure that serves as incentives to investments	MNRT/FBD FBD
2	Non-Timber	- Medicinal plants - Building Poles - Fire wood - Charcoal		Unregulated and uncontrolled harvesting and trade in non-timber forest products	Review the policy so that to regulate and control harvesting and trade in non-timber forest products	FBD
3	Wildlife / wild animals	Hunting	Wildlife Policy of 1998	Ambiguity and bureaucracy in processing of hunting permits	Procedures and powers in issuing hunting permits be streamlined to make it a one station activity	MNRT
		Tourism		No specific number limits are set by WPT for consumptive use of wild animals in Forest Reserves or anywhere.	The Policy be reviewed to clearly set these limits and should <u>stress</u> the need to have animal counts before permits are issued	MNRT/FBD
		Wildlife trade				
4	Land	Forest land for agriculture and settlement	National Land Policy 1999	Un-harmonized to forest Policy	There is need to harmonise policies to ease their operationalization	MLHSD, MNRT, MW, MAFS, VPO
5	Water		National Water Policy 2002	The policy is silent on compensation to those who manage water sources, e.g. catchment areas	The multi-sectoral approach be utilized to review the policy so as to address the flaw	MNRT, MW, MAFS, VPO MEM

Appendix 7 National Acts their flaws and proposed strategies

	Resource type	Use type	Act	Flaws to sustainable resource use	Strategy	Responsible organ
1	Timber	Logging	Forest Act 2002	<p>1) Does not set limits of bags for consumptive uses or limits of acceptable use for non-consumptive uses</p> <p>2) Shortage of monitory capability</p>	<p>1) The Act be reviewed to clearly set these limits and should <u>stress</u> the need to have animal counts before permits are issued</p> <p>2) Introduction cost/benefit sharing schemes to areas under JFM to motivated local communities to enforce set by-laws.</p>	<p>FBD</p> <p>FBD, Project and district</p>
2	Non-Timber	- Medicinal plants - Building Poles - Fire wood - Charcoal		<p>1) Does not set limits of bags/number/bowls for consumptive uses or limits of acceptable use for non-consumptive uses</p> <p>2) Lack of monitory capability</p>	<p>1) Review the policy to regulate and control harvesting and trade in non-timber forest products</p> <p>2) Introduction cost/benefit sharing schemes to areas under JFM to motivated local communities to enforce set by-laws</p>	<p>FBD, WD, and project</p> <p>FBD, WD, and project</p>
		Non-timber product trade				
3	Wildlife	Hunting	Wildlife Conservation Act No 12 of 1974	No specific number limits are set by WPT for consumptive use of wild animals in Forest Reserves or anywhere.	<p>1) The Act be reviewed to clearly set these limits and should <u>stress</u> the need to have animal counts before permits are issued</p> <p>2) Introduction cost/benefit sharing schemes to areas under Community-Based Conservation or WMAs to motivated local communities to enforce set by-laws</p>	<p>FBD, WD, and project</p> <p>FBD, WD, and project</p>
		Wildlife trade		Unregulated and uncontrolled trade in harvesting scale wildlife trade	Review the policy to regulate and control harvesting and trade in wildlife	WD and project

Appendix 8 Information matrix of the documented forest uses in the Eastern Arc Mountains, Tanzania

Eastern Arc Mountain Blocks	Logging activities	Wood fuels	Medicinal plants extraction	Hunting activities and impact	Other forest uses	Invasive species and associated problems	Source of Information	Remarks
East Usambara	<p>Illegal logging is prevalent.</p> <p>Species used: <i>Belchmidia kweo</i>, <i>Milicia excelsa</i>, <i>Newtonia buchananii</i>, <i>Brachylaena hulchensii</i></p>	<p>Legally collected as per JFM agreement by taking dead woods.</p>	<p>Legal and illegal extraction of medicinal plant material for subsistence, research and commercial uses reported.</p>		<p>Illegal harvesting of building poles and raw material for making of tool handles.</p> <p>Species used: <i>Allanbackia stuhlmannii</i>, <i>Greenwayodendron suaviolense</i>, <i>Uvariadendron usambareense</i>, <i>Synsepalum msolo</i>.</p>	<p><i>Maesopsis eminii</i>, <i>Clidemia herta</i> (herb), <i>Lantana camara</i> (herb)-very serious problem all over E. Usambara.</p> <p>It is debatable whether <i>Maesopsis eminii</i> is problematic ecologically.</p>	<p>Frontier Tanzania (2001);</p>	<p>There is very serious illegal harvesting of endemic species (<i>Greenwayodendron suaviolense</i>, <i>Uvariadendron usambareense</i>, <i>Synsepalum msolo</i>) for timber and making of tool handles at commercial scale.</p>
West Usambara	<p>Illegal logging reported.</p> <p>Species used: <i>Newtonia buchananii</i>, <i>Ocotea usambarensis</i>, <i>Entandofragm a excelsum</i>, <i>Fagoropsis angolensis</i>, <i>Podocarpus sp.</i>, <i>Cordia africana</i>.</p>	<p>Except for Shagayu catchment FR, firewood collection is illegal in most forests. Preferred species are: <i>Prunus africana</i>, <i>Catha edulis</i> and <i>Trema orientalis</i>.</p> <p>Annual household consumption ranges between 1.8 to 2.0 m³ per capita.</p>		<p>Hunting is minimal. Species hunted: rock hyrax, and black monkeys.</p>	<p>Illegal harvesting of <i>Manilkara discolor</i> and <i>Juniperus procera</i> for house construction.</p> <p>Illegal harvesting of <i>Catha edulis</i> leaves is very serious for local and commercial uses as stimulant.</p> <p>Forest mining of <i>Osyris lanceolata</i> at Lushoto after many years of legal and illegal extraction.</p>	<p><i>Eucalyptus sp.</i>, <i>Acacia mearnsii</i> (black wattle) in fire burnt areas.</p>	<p>Madoffe and Munishi (2005); Msuya, T.S. (1998); Kaoneka, R.A.S. (1993); Mgonja (Personal communication, 2006).</p>	<p><i>Entandofragm a excelsum</i> and <i>Milicia excelsa</i> are threatened due to their relatively lower abundances and regeneration potential.</p> <p><i>Prunus</i>, <i>Catha</i> and <i>Trema</i> tree species are preferred because of their splitting and burning properties.</p>

Eastern Arc Mountain Blocks	Logging activities	Wood fuels	Medicinal plants extraction	Hunting activities and impact	Other forest uses	Invasive species and associated problems	Source of Information	Remarks
								Harvesting of <i>Catha edulis</i> leaves is unsustainable.
South Pare	Serious illegal harvesting of <i>Ocotea usambarensis</i> , <i>Ficalhoa laurifolia</i> , <i>Podocarpus latifolius</i> . Up to 30 smaller trees are cut at each pit saw site to create space.	Not a serious problem especially in the Western part. It is a problem in the eastern part due to few woodlots outside the reserve.		Exists to smaller extent. Species targeted are Bush pigs, bush back, duiker's black.		<i>Phillipia sp.</i> , Fern sp. <i>Eucalyptus sp.</i> , <i>A. mearnsii</i> .	Kingazi, S.P. (2002); Baker (2001); Persha (2003)	
Mahenge	illegal extraction in Nawenge, Mselezi and Mahenge scarp forests. Species used: <i>Pterocarpus angolensis</i> , <i>Milicia excelsa</i> , <i>Newtonia buchananii</i> .							
Udzungwa	Illegal pit sawing is prevalent.			Species hunted: Red and Angolan Black and White Colobus, Iringa and Sykes Monkeys, Eastern Tree Hyrax, Sall	Extraction of poles			

Eastern Arc Mountain Blocks	Logging activities	Wood fuels	Medicinal plants extraction	Hunting activities and impact	Other forest uses	Invasive species and associated problems	Source of Information	Remarks
				<p>forest antelopes, Elephant shrew, Giant Rat, Blue Duiker, Livingstone's Suni, Bush Pigs Red and Abbott's duiker's Monkeys.</p> <p>Methods used: Shooting, using dogs, snares and cutting of trees. (Minimum of 33 set traps per km² reported) (Zilihona <i>et al.</i>, 1998).</p> <p>Threatened species: Buffalos (<i>Syncerus caffer</i>) and Bushbuck</p>				

Appendix 9 Strategies for addressing unsustainable uses of resources

No	Resource	Type of use	Current status and indicators	Proposed action / strategy	Responsible Institution
1	Timber	Logging	<p>Not sustainable</p> <p>Indicators:</p> <ul style="list-style-type: none"> • Harvesting of endangered species • Type and number of confiscations • Tree stumps and fresh cuts • Number of saw pits • Number of court cases • Lack of management plans • High stump height > 15 cm • Damage to remaining plants • Harvesting on steep slopes and catchment areas • Poor participation of timber dealers • Number of harvested undersize logs • Low material utilization ratio • Extraction rate (allowable cut) 	<ol style="list-style-type: none"> 1) Build internal control systems in issuing of transit passes for timber harvested from private (or farm) lands. The current system has a lot of loop holes. There is need to streamline the procedure for issuing harvesting licenses and transit permits; 2) People possessing secondary products originating from unauthorized primary forest products should be liable to compounding. This is not addressed by the Forest Act No. 14 of 2002 (<i>cf.</i> §82(2)-(6) of WCA No. 12 of 1974); 3) Sections 95 and 96 of the Forest Act should be re-visited in order to broaden the capacity of compounding and prosecuting of offences by forest officers (<i>cf.</i> §81 of WCA No. 12 of 1974); 4) Introduce cost / benefit sharing schemes to areas under JFM to motivated local communities to enforce set by-laws. -Timber Checkpoints be strengthened; 5) Create awareness and make efforts to bring about alternative income generation activities in areas where illegal logging is severe such as East Usambara, South Pare, Nguru, 	<p>FBD, Project and District</p> <p>FBD</p> <p>FBD</p> <p>FBD</p> <p>FBD, Project and District</p>

No	Resource	Type of use	Current status and indicators	Proposed action / strategy	Responsible Institution
				<p>Ukaguru and Mahenge. And engage communities to help to conduct feasibility assessments of IGAs;</p> <p>6) Promote domestication and use of lesser used or lesser known species for both timber and construction purposes to meet local demand particularly through demand-driven tree planting campaigns;</p> <p>7) There is need to conduct forest inventory for EAMFs which is a requirement for development of management plans for the forests;</p> <p>8) Provide training for sustainable timber harvesting techniques and enforce harvesting code;</p> <p>9) Involve stakeholders in designing solutions to unsustainable harvesting;</p> <p>10) Educate business community in timber products on laws and procedures involved; and</p> <p>11) Gazette sensitive areas including upper catchment areas.</p>	<p>TAFORI, SUA, Project and District</p> <p>FBD, Project and District</p> <p>FBD, SUA, Project and District</p> <p>Project and District</p> <p>Project and District</p> <p>FBD, Project and District</p>
2	Firewood	Firewood collection	<p>Unsustainable.</p> <p>Indicators:</p> <ul style="list-style-type: none"> Lack of naturally dead plant material in the forest indicates that the harvesting of such wood 	<p>1) Promote use of efficient bio-energy from wood wastes and husks as an alternative to charcoal and firewood. However, promotion of such biotechnologies should be backed by both technical and sociological</p>	<p>Project and District</p>

No	Resource	Type of use	Current status and indicators	Proposed action / strategy	Responsible Institution
			<p>is no longer sustainable. And subsequent decrease in number of beetles</p> <ul style="list-style-type: none"> • Wood dependent factories • Type of species harvested • Firewood woodlots • Presence alternative energy sources • Use of fuel efficient stoves 	<p>studies;</p> <p>2) Encourage tree planting for commercial wood fuel production by private farmers or local farmers' associations particularly in South Pare and East Usambara;</p> <p>3) Disseminate cost-effective, improved stoves to end users;</p> <p>4) Promote agroforestry and reforestation;</p> <p>5) Expand village Forest Reserves on village land; and</p> <p>6) Build capacity of agricultural extension officers to promote retention/planting of suitable species.</p>	<p>Project and District</p> <p>FBD, Project District and COSTECH</p> <p>TAFORI, Project and District</p> <p>FBD and District</p> <p>Project and District</p>
3	Charcoal	Charcoal making	<p>Unsustainable.</p> <p>Indicators:</p> <ul style="list-style-type: none"> • Decrease in number of endangered species • Number of confiscation cases 	<p>1) Promote planting of woodlots on farms;</p> <p>2) Promote agroforestry and reforestation;</p> <p>3) Promote use of alternative energy sources such as biogas;</p> <p>4) Promote use of fuel-efficient stoves; and</p> <p>5) Use of efficient kilns</p>	<p>Project and District</p> <p>Project and District</p> <p>Project and District</p> <p>Project and District</p> <p>Project and District</p>

No	Resource	Type of use	Current status and indicators	Proposed action / strategy	Responsible Institution
4	Wild animals (wildlife)	<p>Hunting / trapping (for subsistence and trade)</p> <p>Snare traps, noose traps, pit fall traps, log-fall traps, spike trap, guns, spears and dogs are used.</p> <p>Buffalo, bushpig, elephant, primates such as Iringa red colobus, Angolan black and white colobus and Sykes monkeys, eastern tree hyrax, chequered elephant shrew, giant pouched rat, bushbuck, blue duiker, Livingstone's suni, red duiker, Abbott's duiker and other small forest antelopes)</p>	<p>Not sustainable</p> <p>Indicators:</p> <ul style="list-style-type: none"> • High hunting intensity (ref. reported number of poaching cases), • Method of hunting e.g. use of dogs, traps • Habitat reduction • Reduced populations of wild animals. 	<ol style="list-style-type: none"> 1) Create awareness among local communities (who are the stakeholders) on the potential threats facing hyraxes, elephant shrews and other animal species in their areas; 2) Improve enforcement of laws and by-laws through the involvement of local people (JFM); 3) Introduce of incentive systems to local people; 4) Integrate or streamline the management of wildlife management units and Forest Reserves; 5) Local communities should be encouraged to form and join environmental SACCOS which could borrow money from banks and raise tree nurseries. Seedlings could be sold to gap planting projects; 6) Reconnect forests to maintain wildlife migration routes since isolation of the forests prevents natural population reinforcement from elsewhere. This could be done through gap planting of indigenous species; 7) Facilitate improved animal husbandry through enhancement of domestic sources of meat and eggs 	<p>Project, District and WD</p> <p>WD, FBD, Project and District</p> <p>WD, FBD, Project and District</p> <p>WD, FBD, Project and District</p> <p>WD, FBD, Project and District</p> <p>WD, FBD, Project and District</p>

No	Resource	Type of use	Current status and indicators	Proposed action / strategy	Responsible Institution
				<p>e.g. by increasing the number of domestic animals in the poorest part of the population. Poultry keeping has a relatively rapid turnover compared to other livestock, has less capital and running costs, can be easily managed by households and inspires children. Cane rats (<i>Thryonomys swinderianus</i>) may also have potential; not only do they breed quickly but are likely to be culturally acceptable (Chardonnet <i>et al.</i>, 2002 and Anon., 2004d in TRAFFIC, Undated). Other species that have been farmed for their meat in Africa include the Brush-tailed porcupine <i>Atherurus africanus</i>, Giant rat (<i>Cricetomys emini</i>), Red river hog (<i>Potamochoerus porcus</i>), Duikers (<i>Cephalophus spp.</i>), Giant African snail (<i>Archachatina marginata</i>), Helmeted guinea fowl (<i>Numida meleagris</i>), Double-spurred francolin (<i>Francolinus bicalcaratus</i>) and Scaly francolin (<i>Francolinus squamatus</i>) (Anon., 2004d; Chardonnet <i>et al.</i>, 2002; Wilkie <i>et al.</i>, 1999 all in TRAFFIC, Undated).</p> <p>8) Increase cash income in the areas (micro-credit schemes/income-generating activities). Whilst livestock meat is available in most rural areas, it is not affordable. Also, in many rural areas poaching creates employment, although the</p>	<p>WD, FBD, Project and District</p> <p>WD, FBD, Project and District</p> <p>WD, FBD, Project and District</p> <p>WD, FBD, Project and District</p>

No	Resource	Type of use	Current status and indicators	Proposed action / strategy	Responsible Institution
				<p>low price obtained suggests that bush meat is not a luxury commodity with high profit margins. Increased income may take them away from or prevent them from thinking about going into poaching;</p> <p>9) Carry out census and determine sustainable harvesting levels;</p> <p>10) Educate and sensitive people to change their mindset. Some rural residents hunt or buy wild meat for cultural and habitual reasons in addition to food security pressures; and</p> <p>11) Strengthen vermin control units</p>	
5	Wildlife trade	Trapping and collection of : Insects(butterflies, scorpions, beetles), avians, reptiles (chameleons, snakes snails, amphibians (frogs, snails)	<p>Difficult to say about their use sustainability since there is no information on how much is available and how much is allowed to take.</p> <p>Indicators:</p> <ul style="list-style-type: none"> • Number of species trapped • Diversity indices 	<p>1) Encourage surrounding villages to form production groups and farm wild animal species (insects, reptiles, birds, mammals etc.) in an ecologically sustainable way for subsistence and trade.</p> <p>2) Promotion of community-based eco-tourism</p> <p>3) Carry out census and determine sustainable harvesting levels (situation analysis);</p> <p>4) Build capacity of the communities in entrepreneurship skills (business plans, recording keeping, and networking) and marketing;</p>	Project, FBD, WD and district

No	Resource	Type of use	Current status and indicators	Proposed action / strategy	Responsible Institution
			<ul style="list-style-type: none"> • De facto management. - Bushfires which prevent forest expansion and connectivity. 	<p>discuss human impacts on the forests;</p> <p>3) Enhance coordination with partners such as UMADEP to tailor them such that agricultural inputs in project areas complement and strengthen the conservation focus of CMEAMFP;</p> <p>4) Re-connect the forests -The demands for arable land and development have created barriers to wildlife dispersal by interrupting habitat patches;</p> <p>5) Relocate villages living near Forest Reserves;</p> <p>6) Prevent the annual, non-selective and harmful bushfires in surrounding areas;</p> <p>7) Mark boundaries of the Forest Reserves by planting quick-growing non-invasive tree species;</p> <p>8) Train foresters in land use planning;</p> <p>9) Facilitate and support land use planning at village level. Multisectoral approach to land use planning may work better;</p> <p>10) Introduce PFM (JFM and CBFM) model with maximum devolvement to community level for village land</p>	<p>Project</p> <p>Project, FBD, and District</p> <p>Project, FBD, and District</p> <p>Project and District</p> <p>Project, FBD, and District</p> <p>Project, FBD, and District</p> <p>Project</p> <p>Project / FBD / District</p>

No	Resource	Type of use	Current status and indicators	Proposed action / strategy	Responsible Institution
				<p>forest areas.(Strengthen village environmental committees- through capacity building);</p> <p>11) Promote private forests;</p> <p>12) Introduce micro-credit schemes and in-forest and off-forest income-generating activities; and</p> <p>13) Gazette upper catchment areas.</p>	<p>Project / FBD / District</p> <p>Project / District</p> <p>FBD</p>
7	Medicinal plants	<p>Collection / harvesting of medicinal plants to treat human-, domesticated animals' and crop diseases.</p> <p>Some communities do not have health facilities and/or drug shops. As a result, forest resources have been relied on to provide requisite medicines to the communities.</p>	<p>Unsustainable.</p> <p>Indicators:</p> <ul style="list-style-type: none"> Poor harvesting techniques e.g. ring (de)barking and root cutting are selective but harmful harvesting practices, which almost always kill the plants. Also, the amounts of bark, roots and leaves harvested suggest that many people harvest the plants. But, if kept at a level of local consumption, it could be sustainable. 	<p>1) Adhere to indigenous knowledge and useful traditional rules and ways of harvesting traditional medicine;</p> <p>2) Conduct inventory to establish stocking and harvesting levels;</p> <p>3) Promote and support domestication of medicinal plants in collaboration with local herbalists and traditional healers Examples of domesticated on farmlands on the Ulugurus include <i>Maesa lanceolata</i> (Mingutinguti), <i>Myrica salicifolia</i> (Migeremamondo), <i>Senna petersiana</i> (Mikundekunde), <i>Piper capense</i> (Ludaha), <i>Azadirachta indica</i> (Mwarobaini) and <i>Khaya anthotheca</i> (Mkangazi). However, the availability of seeds is the major constraint. Some species such as <i>Ocotea usambarensis</i> (Mvumba) do not produce seeds;</p> <p>4) Improve of harvesting, processing</p>	<p>Project, FBD, and District</p> <p>Project, FBD and District</p> <p>Project, TAFORI and District</p> <p>Project, FBD, SUA,</p>

No	Resource	Type of use	Current status and indicators	Proposed action / strategy	Responsible Institution
				and packaging techniques; and 5) Improve rural health services and use of Para-medics to reduce impact on the forests.	TAFORI and District District / Min of Health
8	Bee and bee products	Honey collection / gathering / extraction through modern beekeeping	-	1) Promote modern beekeeping using stinging and stingless bees in forest patches (apiaries) on village lands and along reserve boundaries; and 2) Enhance multilevel marketing.	Project, FBD, and District Project
		Honey collection / gathering / extraction through local beekeeping Indicators: • Felling of trees (destroying habitat) • Use of fire for bee extraction	Unsustainable due to use of fires and cutting down trees. But sustainable if fires and cutting of trees are avoided.	1) Promote modern beekeeping using stinging and stingless bees in forest patches (apiaries) on village lands and along reserve boundaries; and 2) Enhance multilevel marketing.	Project, FBD, and District Project
9	Animal fodder	Cattle grazing inside the forests (Pare and West Usambara)	Unsustainable Indicators: • Soil erosion, • Destruction of habitat -Number of cattle per household	1) Encourage zero-grazing 2) Encourage multiple land use	Project, FBD, and District Project, FBD, and District