Evaluation Department

Norad

Environmental and Socio-Economic Baseline Study – Tanzania

Study 4/2009

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Environmental and Socio-economic Baseline Study – Tanzania

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The baseline studies related to Norwegian assistance in Tanzania, Malawi and Papua, Indonesia were carried out in the context of Norway's Environmental Action Plan. Norad's Evaluation Department decided in April 2008 to carry out baseline studies in order to enable a better measurements of the results of the specific development efforts supported. It contracted Scanteam to implement the studies.

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Scanteam is responsible for the scope and contents of this report. The views and conclusions do not necessarily correspond with those of Norad or its Evaluation Department.

Contents

Acronyms and Abbreviations

ASDS	Agricultural Sector Development Strategy
CBFM	community-based forest management
CHAPOSA	Charcoal Potential in Southern Africa
DDSEC	District Development Sustainable Energy Cluster
EIA	Environmental Impact Assessment
FAO	UN Food and Agriculture Organization
FR	forest reserve
HBS	Household Budget Survey
ILFS	Integrated Labour Force Survey
ILUA	integrated land use assessments
IMES-PORE	Integrated Modern Energy Services for Sustainable Development and Poverty Reduction
JFM	joint forest management
MAIR	Annual Implementation Report of MKUKUTA
MASL	metres above sea level
MDGs	Millennium Development Goals
MFPs	Multifunctional Platforms
MKUKUTA	National Strategy for Growth and Reduction of Poverty
NAFOBEDA	National Forest and Beekeeping Database
NAFORMA	National Forest Resources Monitoring and Assessment
NAPA	National Adaptation Programme of Action
NBS	National Bureau of Statistics
NFI	National Forest Inventory
NFMA	National Forest Monitoring and Assessment
NSGRP	National Strategy for Growth (and Reduction of Poverty)
PFM	Participatory Forest Management
PRSP	Poverty Reduction Strategy Paper
SMEs	Small and Medium-size Enterprises
TaTEDO	Tanzania Traditional Energy Development and Environment Organization
TFCG	Tanzania Forest Conservation Group
TSED	Tanzania Socio-Economic Database
VLFR	village land forest reserve

1. Executive Summary

The Norwegian Environmental Action Plan for environmental support in development cooperation includes an evaluation of the results when the implementation period ends around 2015. In order to facilitate a quality impact evaluation, Norad's Evaluation Department decided to carry out a Baseline Study related to the Action Plan in three case countries—Indonesia, Malawi and Tanzania. The purpose of these studies is to establish the current status in some Norad supported sites/ districts in terms of (i) socio-economic situation, (ii) the state of the environment and (iii) driving forces of environmental destruction, with the aim of using the information as benchmark to evaluate impacts of Norwegian Government support.

The Tanzania case study addresses particularly the activities of the Tanzania Traditional Energy Development and Environment Organization (TaTEDO), an NGO focused on promoting energy-efficient and renewable-energy technologies in the rural areas of the country. The impact study address the effects of improved energy stoves, efficient charcoal production techniques using improved kilns, tree planting and use of alternative energy sources around Ruvu South Forest Reserve in Kibaha and Kisarawe districts on deforestation and sustainable livelihoods. In order to be able to better measure the impacts of its interventions around Ruvu South, the Namakutwa-Namuete forested areas in Rufiji districts were chosen as a "comparison" area, since they were the areas in the Coast Region of Tanzania that were most similar to Ruvu South concerning the issues researched, and that there are no current programmes on energy efficiency there.

Five types of data sets were collected and used to describe and analyze the socio-economic and environmental situation in the targeted, as well as the "comparison" villages. These included i) a structured questionnaire to TaTEDO, which is implementing the scaling–up project; ii) village-level questionnaires for all the targeted villages, answered by key informants in the villages; iii), household questionnaires administered to the household head (or in his absence the wife of the household); iv) a natural resources and environmental transects for environmental auditing and forest inventory along established transects and v) national and district statistics and research reports prepared by other institutions / researchers.

For the household level questionnaire survey a total of 300 households from five villages in Ruvu South and Rufiji were interviewed.

1.1 Socio-economic Baseline Status

Gender distribution

In the target area about 61% of those who responded to the questionnaire were males, while about 39% were females. About 20% of the female respondents gave responses on behalf of their husbands, who were not present at the time of the interviews. About 78% of respondents were married. In the comparison area (Rufiji) 80 percent of the respondents were married.

Age structure

The dominant age class of household heads was the 20-40 year group, constituting about 45% and 40% of respondents in the target and comparison areas, respectively. The second most numerous age class was the 40 – 60 age category.

Educational status

The majority (64%) of household heads around Ruvu South had finished their primary education and another 14 % had started, but did not complete primary school. About 21% did not have any formal education. In the comparison area, the educational situation was slightly better.

Household size and composition

The average household size for the three villages around Ruvu South was 4.85, while it was 5.61 in the comparison area. The population for both Ruvu South and Rufiji villages was dominated by young people under twenty years of age. In both areas, about 10% were more than sixty years of age.

Main economic activities

Respondents in both areas had more than one economic activity as a coping strategy against income failures. Farming was the major activity practiced by all respondents. In Ruvu South charcoal making was also an important economic activity.

Access to land

The amount of land cultivated was limited, primarily due to population pressure and the limitations intrinsic in working tools and manpower. Farmers from both study areas depended only on hand hoes, which limit agricultural production. More than 40% of farmers had inherited land while the cultivation by at least 5% had encroached into the forests. The same features occurred in Rufiji, except that borrowing land for cultivation was quite common and the average farmer cultivated more land than he or she owns.

Access to sources of energy

In both Ruvu South and Rufiji, over 90% of households depended solely on firewood as their source of energy for cooking. Kerosene was the main source of energy for lighting in both study areas. The use of electricity was almost non-existent.

Access to water

Nearly 100% of the households in Ruvu South depended on unprotected wells as their main sources. More than 90% stated that the available water was inadequate.

The situation found in Rufiji was very similar, although about 10% of households were getting water from "protected sources". The high dependence on unprotected water sources suggests that the households in both areas are vulnerable to water–borne diseases.

Soil fertility and tilling methods

Only 15% of farmers in Ruvu South considered their land to be of high fertility, 60% of those in Rufiji felt that their land is highly fertile. Other reported impediments to agricultural productivity were vermin (46%), drought (38%) and pests (17%).

In Ruvu South, crops cultivated included cassava (46%), maize (27%), cowpea (25%) and rice (2%). The farmers in Rufiji reported that they mainly cultivated maize (39%), cassava (29%) and rice (21%). Their land, although more fertile, was also susceptible to flooding in addition to the other impediments found in Ruvu South.

Agricultural production

In both areas, but particularly in Ruvu South, agricultural production was very low – well below subsistence level. The average maize production in Ruvu South was 2.3 bags, compared to about 7 bags in Rufiji. Only about 2.6% of households in Ruvu South reported selling maize, while about 7.3% reported selling cassava. In Rufiji, about 7% of households reported selling maize; but only 1-3 bags. Incomes of crop-selling families in Rufiji were double those in Ruvu South.

Livestock production

In both study areas, livestock-keeping within the overall production system was poorly developed. In the Ruvu South sample, only one percent of households had cattle while 80% have chickens. In Rufiji, two percent had cattle. Farmyard manure was therefore hardly available in either area, which has contributed greatly to low production and food insecurity.

Human capital

About 21% and 13% of household heads in Ruvu South and Rufiji, respectively, have had no formal education. Only (about 4% of households in Rufiji, and none from Ruvu South) have attended secondary school. The low level of formal education hinders the livelihood development and environmental conservation.

Food security and coping strategies

The majority of households in both study areas perceived that they were food insecure. The main reasons reported were drought, poor agricultural implements and vermin. The most critical food shortage period for both areas was reported between the months of September and December, just before the short rains. The main harvest usually sustains the households for a period of only three months (June – September). Selling of forest products, particularly charcoal and firewood, was reported as one of the coping strategies, particularly in Ruvu South. Other such strategies included working as casual labourers, selling of livestock (particularly chicken) and petty business, such as sale of fruits like mangoes and pineapples.

Access to almost all input and extension services was poor in both areas. Very few (10%) have hired tractors; while about 20% have access to planting materials; and only 5% have access to pesticides. None have access to fertilizers. Access to traditional farming tools, including hoes, machetes, axes and forks, was reported to be good.

Common diseases and access to health services

Malaria is the leading cause of out-patient medical attendances in both areas. The disease occurs throughout the year, but becomes more prevalent during the rainy seasons. Other diseases commonly affecting both under five and above five year olds are pneumonia, ARI, diarrhea, intestinal worms and anemia. Although some of these diseases are known to be related to smoky cooking environments, most villages did not associate the two. There is a dispensary in one of the Ruvu South villages, but none in any of the villages of Rufiji. About 40% of the respondents travelled up to 2 km to access health services.

Access to credit facilities

Access to credit facilities was generally poor in both study areas. Around Ruvu South, only one village (Kipangenge) had a farmer's credit facility (SACCOS), which was operational though with limited capital. There were no farmer credit facilities in Rufiji. Neither were formal credits from banks and other financial institutions available in the study areas. The villagers complained about low capital availability for all of their economic activities.

Forest product utilization

All households reported utilizing forest products. The forest products used, in order of importance, were charcoal, firewood, building poles, timber, withies and ropes. During village interviews it was admitted that about 70% of forest products collected around Ruvu South forest reserve was illegal. The forest products collected in Rufiji in order of importance were firewood, poles, withies, timber, vegetables, thatch grass, medicines and charcoal. Illegal collection of forest products was lower (10%) in Mbwara village in Rufiji, owing to the successful community-based forest management (CBFM) arrangements in that village.

Housing

About 90% of the households around Ruvu South own living houses. About 60% use corrugated iron sheets as roofing materials. This percentage is lower in Rufiji (33%), where a high proportion (39%) have dilapidated thatch grass roofs. In both areas the walls are made of poles and mud, and floors have no cement. The high dependence on poles and withies for house construction purposes implies substantial pressure on existing forests for these materials.

Other household assets owned

These were generally few, but included radios, chairs, tables, watches, mobile phones, beds, kitchen utensils, some mosquito nets, charcoal iron and bicycles.

Awareness of existence of improved stoves and cooking habits

In Ruvu South 78% of respondents from Kipangege Village confirmed that they were aware of improved stoves. This is likely because TaTEDO had already initiated some awareness visits to this village, but not to Bokomnemela, where the awareness rate was only 35%. In the two study sites in Rufiji villages were unaware of improved stoves (93% in Nambunju and 60% for Mbwara were unaware of the stoves). About 60% of households do their cooking outside the living house. This is partly because most of the living houses are small in size. However, during the rainy season most of the cooking is done indoors. More than 80% of households in both sites use traditional three stone stoves for cooking.

1.2 Environmental Baseline Status

Altitude, forest type and climate

Coastal forests are found from 0 to 600 metres above sea level (MASL) and up to 200 km. inland from the coast. For this study, transects for environmental audit were established in three distinct areas: i) Ruvu South Forest Reserve, ii) Kipangege village land forest reserve and iii) Namakutwa-Namuete Forest Reserve. The mean altitude was 189 MASL in Ruvu South, and about 248 MASL in Rufiji.

Forest disturbance

The forests in both study areas were disturbed by human activities: charcoal making, firewood collection, as well as some encroachment and hunting of wild animals and fires. The forest reserve in Ruvu South was much more severely disturbed than Rufiji, presumably, due to both: (i) poor forest management and control systems and (ii) proximity to the main charcoal market in Dar es Salaam. Of the two, the most relevant was the fact that there was no functioning Joint Forest Management (JFM) system in Ruvu South, to stipulate government and local community rights and responsibilities.

Ownership and utilization of forests

Most forested areas of Tanzania are State Forest Reserves. The land tenure system recognizes village forest: land is owned and administered by village-level governments in consultation with village councils and general village assemblies. In Kipangege village land forest reserve (Kimpange VLFR), where about 9% of the survey plots were located, considerable registered environmental destruction was noted in the majority of study plots located in state forest reserves.

Canopy closure

Canopy closure often serves as an indicator of the level of disturbance that a forest type has experienced, other factors being constant. Undisturbed forests especially montane forests have a dense canopy closure. In the studied areas, Ruvu South had an average of 18% canopy closure, while the mean for Kipangege VLFR was about 38% and for Rufiji about 54%. The Ruvu South Forest Reserve has many openings resulting from illegal activities in the forests. Villagers in Kipangege have instituted strict rules and penalties against forest destruction in the VLFR, which is regenerating rapidly.

Estimates of stocking parameters

Stocking parameters, including tree density, basal area, tree volume and seedling density, were measured. These measurements observed a higher stem density per hectare in the regenerating VLFR than in the state forest reserve. However, since the stem sizes were small (diameter at breast height), the resulting stand volume for Kipangege was low (3.15m3/ha), compared to the Rufiji area, where the stems were few but the volume was high (5.8m3/ha). Volume and basal area parameters for Ruvu South forest reserve were not very different from those in the regenerating VLFR.

Magnitude and types of human disturbances

The forest audits revealed that many plots in the surveyed sites had either high or average levels of disturbance. Only a few plots in Rufiji and Ruvu South, in the innermost cores of the forests, had no disturbance. Charcoal making and forest fires were the two main types of disturbances found. Charcoal making was found to be a serious threat in Ruvu South and Kipangege, but less so in Rufiji. Regarding soil erosion, minor sheet erosion was observed in about 30% of the plots in Ruvu South.

Signs and evidence of wild animals

There were signs of wildlife in about 42% of the plots in Ruvu South, 87% of the plots in Rufiji and in all the three plots in the Kipangege VLFR. The main evidence of wild animals were animal footsteps, droppings and sighting in Rufiji, while in Ruvu South and Kipangege it was mostly droppings.

1.3 Mainstreaming Environment in Overall Portfolio

The study team was tasked with assessing whether environmental concerns were reflected in the non-specific environmental programmes. The team found ample evidence that the Norwegian aid administration had raised the issues in annual meetings and portfolio planning sessions with their Tanzanian counterparts. However, it is the view of the team that the environmental policy concerns are only reflected in a minority of cases in guiding documents like formal agreements, contracts, agreed minutes and activity planning.

2. Introduction

2.1 The Norwegian Environmental Action Plan

The Norwegian Environmental Action Plan for its development assistance will be evaluated when the implementation period ends around 2015. In order to facilitate a quality impact evaluation, the Norad's Evaluation Department decided to carry out a Baseline Study related to the Norwegian Action Plan in three case countries– Indonesia, Malawi and Tanzania.

According to the Terms of Reference for the Baseline Study, the consultants were to:

- Assess the relevance of existing data and reporting systems on national level and for the selected programmes in the case countries.
- Supplement data that already exists with more primary data emphasizing case studies of socio-economic effects of environmental related assistance at local level.
- Clarify data and interpretation problems, and especially try to identify other factors in addition to those stated in the Norwegian action plan and programmes which are likely to influence developments in the targeted areas during the implementation period.

One of the main tasks in the baseline study was to identify more closely the anthropogenic reasons and possible remedies for deforestation and environmental degradation. The study team especially focused on the following factors, which seem to be the major ones:

- Firewood and charcoal collection by the households, for local sale and for exports.
- Wood extraction used as building material, furniture, tools, fencing poles, etc. in homes or marketed.
- Land clearing by farmers for agricultural purposes (permanent or short term fallow).
- Commercial logging by national or foreign companies.
- Clearing for cash crop plantations, cattle ranching, etc.
- Wild fires.
- Construction of infrastructure: dams, roads, settlements and clearing for mines, etc.

2.2 Tanzanian Environmental and Social Reporting Systems

Tanzania has adopted several national policies and strategic frameworks, which integrate national environmental and poverty action programmes. The most critical

frameworks include the National Environment Management Act (2004), the Poverty Reduction Strategy Paper (PRSP) (2000), the National Strategy for Economic Growth and Reduction of Poverty (2004), the Tanzania Development Vision 2025 (2001), the draft Rural Development Strategy (2001) and the Agricultural Sector Development Strategy (ASDS) (2001).

In addition, sector-specific policies, strategies and laws address issues of deforestation, land degradation and poverty reduction, *e.g.,* in water resources management, rangeland management, energy resources, local government and mining. Prior to trade liberalization, the forest sector's contribution to total trade was 3 – -4% of total exports, but afterwards, that contribution has jumped to about 11% of the country's exports[1].

In addition, several initiatives seek to establish and improve public reporting and monitoring systems. The reporting system of the comprehensive National Strategy for Growth and Reduction of Poverty (commonly referred to as MKUKUTA) for the period 2005–2010, has been of particular interest to the study team. As part of the programme's monitoring strategy, the second Annual Implementation Report (MAIR) covering 2006/2007 provides an overview of the performance, challenges, lessons learned, and the next steps within each cluster of key public administration issues: (i) growth and reduction of poverty; (ii) improved quality of life and social wellbeing; and (iii) governance and accountability.

The production of the MAIR, as well as coordination of the MKUKUTA, represent collaboration with a wide range of stakeholders, including government ministries, departments, and agencies, local government authorities, research and academic institutions, and non-state actors. Information was gathered from a range of sources, including studies for the public expenditure review, the MKUKUTA Status Report (2006), the Bank of Tanzania's Economic Survey, sector reviews, and reports by the ministries and the 2006-07 Household Budget Survey.

The MAIR highlights major challenges ahead and identifies areas for improvements, including the needs to strengthen monitoring and evaluation systems, sustain efforts to tackle corruption, improve governance and accountability, and focus efforts on drivers of broad-based economic growth, especially in the agricultural and natural resources sectors.

2.3 Environmental and Socio-Economic Challenges

2.3.1 State of the Environment

According to Environment Statistics 2005, 46% of the total land area of Tanzania is covered by forest and woodland. The rate of deforestation is estimated at 500,000 hectares per annum. Protected areas cover a total of 17,449 square kilometres. National parks gazetted as forest reserves include fish spawning areas and inshore coastal mangrove areas. Tanzania has enacted an Environmental Management Act and adopted Environmental Impact Assessment (EIA) regulations and guidelines. Environmental concerns have also been mainstreamed in the MKUKUTA, and

1 In 2004, the Tanzanian government imposed a ban on the export of timber and seized 157 containers of logs, many of which were harvested illegally.

sectoral policies have been reviewed to incorporate management of biodiversity issues. Communities manage conservation activities in Wildlife Management Areas, Participatory Forest Management Areas and Beach Management Units.

Environmental challenges in Tanzania continue to grow, and now include: unsound disposal of plastic materials; increased deforestation promoting deterioration of the ecological system (negatively impacting on soil fertility, on water flow, on biodiversity) and unsustainable mining activities, especially by small scale miners. All of these have compounded the problem. Beyond them, the general level of poverty and low level of education, especially in rural areas, coupled with the lack of an efficient property rights structure, has led to unsustainable harvesting of environmental resources. Enforcement of existing conservation regulatory instruments is weak, as is baseline information data.

Environment and natural resources management have been mainstreamed in the Tanzanian National Strategy for Growth and Reduction of Poverty (NSGRP). Fourteen percent of the targets in the strategy relate to environment and natural resources management and there are a considerable number of environmental interventions under non-environment targets. The NSGRP in combination with the new Environmental Management Act provide a fairly well developed policy framework for environment and natural resources management. A key challenge is the lack of implementation, enforcement and monitoring of existing policies. The rate of natural resource degradation is alarming. Key environmental challenges include land degradation, deforestation, degradation of aquatic ecosystems, lack of clean drinking water and sanitation, and loss of wildlife habitats and biodiversity. Environmental degradation and loss of ecosystem services particularly affect the poorest people and are strongly linked to health problems, vulnerability and malnutrition.

In all natural-resource-based sectors, pervasive market and policy failures, as well as corruption lead to unsustainable extraction of resources (wildlife, forests, and fish), loss of much needed government revenues and opportunities for growth and poverty reduction. The many cases of mismanagement (*e.g.*, illegal logging, illegal hunting and destructive fisheries) seriously risk undermining the implementation of policies for sustainable development. The poor suffer the most from environmental degradation, while the benefits from natural resource extraction frequently accrue to national elites and/or foreign entrepreneurs.

The country's National Adaptation Programme of Action (NAPA) published in 2007 points to alarming grounds for concern with regard to climate change. Of greatest significance is the assessment that a 2-degree rise in temperature could reduce yields of Tanzania's staple maize crop by as much as 33%. The necessary protective measure – diversification into new crop varieties – will test impoverished farmers to the limit.

Tanzania is home to one of the great symbols of climate change - the melting icecap of Mount Kilimanjaro - which is projected to lose its permanence entirely by 2020. Of greater significance, however, the Kilimanjaro region is seeing the impact of temperature change on its sensitive forest ecosystem and its role in the water

cycle. Indeed, water management dominates the NAPA list of recommended adaptation projects - irrigation, conservation, harvesting and hydropower - all vital in defending a rural economy, which the World Food Programme describes as “highly susceptible to climatic shocks”.

2.3.2 The NAFORMA Project

Realizing that traditional National Forest Inventories (NFIs) cannot provide answers to many of today’s central questions about sustainable forest management at national and international levels, FAO has designed a new approach to Forest Assessments and Monitoring: The FAO programme on National Forest Monitoring and Assessment (NFMA). In the NFMA, FAO has developed a new and broader data-collection protocol that allows for more policy-relevant information to be collected and analysed. This evolving FAO approach incorporates many of the traditional NFI forest and tree measurements, but also includes systematic data on trees outside forests, identification of forest products and services derived from sample areas, property rights and policies associated with such products and services, as well as the socioeconomic and institutional characteristics of forest use and users. Upon request, an FAO programme supports countries in their efforts to close this knowledge gap by implementing field inventories and establishing forest information services. This FAO programme has been active since 2000. What started as a series of pilot projects has now developed into full scale support programme for national forest monitoring and assessment (NFMA) and integrated land use assessments (ILUA). In the case of Tanzania, the National Forest Resources Monitoring and Assessment (NAFORMA) which was launched in 2009.

One of the advantages of this approach is that the inclusion of data on the human use of the forest resources surveyed allows national forest policy analysts and decision makers develop knowledge about the human factors that affect changing forest conditions in a country, something that traditional NFIs could not deliver. Such knowledge makes it possible to monitor the effects of previous policy efforts and to develop alternative policy instruments that are more effective in achieving the national forest policy goals.

2.4 Access to Socio-Economic Data

A wealth of socio-economic data is available from different sources in Tanzania. This information, however, is scattered in different ministries and organizations. It is often difficult to know which data exists and where to find it. Even where comprehensive data is collected (e.g., in the area of education and health) only a small portion is published in annual publications or otherwise.

Recently, the National Bureau of Statistics has attempted to collect such national level data using National Household budget survey. Unfortunately the information is aggregated at national level and from the survey’s sampling design, district and regional level data analysis does not meet the required level of representativeness to support the drawing of conclusions.

Another national-level data source is the NAFOBEDA (National Forest and Beekeeping Database) within Forest and Beekeeping Division of the Ministry of Natural

Resources and Tourism. Although most of the information needed for making policy decisions and regular reporting in the forestry sector could be obtained through the NAFOBEDA, the database faces numerous challenges including firstly irregular updating of information stored in the database and secondly over-emphasis on designated Participatory Forest Management (PFM) areas (where donor support is directed). Data from non-PFM areas are scant. Substantial capacity-building at district level is still very much needed in terms of data collection and analysis, in order for NAFOBEDA to serve its purpose. As a baseline, the scenarios narrated in this report demonstrate that substantial effort will be needed in getting the required data for monitoring the incremental changes for the studied parameters in the studied areas.

To access scattered socio-economic data, the *National Bureau of Statistics* (NBS), in collaboration with over 20 Ministries and Government Institutions in Tanzania and supported by UNDP and UNICEF, has established the Tanzania Socio-Economic Database (TSED). The main purpose of TSED is to allow an overall, up-to-date view of the socio-economic situation in Tanzania and to facilitate use of data for analysis by policy makers and other users. TSED is a web-enabled database, and provides a means of organizing, storing and displaying data in a uniform format, to facilitate sharing in Tanzania and outside of Tanzania. TSED has been adapted from the DevInfo database technology used globally to monitor the MDGs and has simple and user-friendly features that makes data accessible. The National Bureau of Statistics is responsible for the general administration including overseeing the day to day operations of TSED, data provision, management, quality control and release of data. NBS provides technical support to the participating institutions using the database, and facilitates the dissemination of results of national surveys such as Household Budget Survey (HBS), Integrated Labour Force Survey (ILFS), Population and Housing Census and other data collected through the routine data systems.

3. Methodology for the Tanzanian Study

3.1 Description of Study Sites

Over several years Norway has rendered support to Tanzania Traditional Energy Development and Environment Organization (TaTEDO), an NGO focused on promoting energy-efficient and renewable-energy technologies in rural areas. A recent review[2] of TaTEDO's activities indicates the achievement of good results. Norad's Evaluation Department has proposed that the study team should prepare a baseline for an area into which TaTEDO's programme is extended. A detailed description of TaTEDO's interventions is provided in section 2 of this report.

Two areas were selected for the baseline study: an area h around Ruvu South Forest Reserve (here referred to as "Ruvu South") and a comparison area in Rufiji district around Namakutwa-Namuete Forest Reserve (here referred to as "Rufiji"). In the study area in Ruvu South, TaTEDO is scaling up its environmental and livelihood improvement initiatives through the Integrated Modern Energy Services for Sustainable Development and Poverty Reduction Program. In Rufiji, TaTEDO anticipates no such interventions in the near future. Thus, the team decided that Rufiji could serve as a comparison area. The two areas along with the locations of the environmental audit transects (shown on the map as environmental audit plots) are displayed in Figure 1 (a, b and c) below.

3.2 Location, Characteristics of Study Areas in Ruvu South and Rufiji

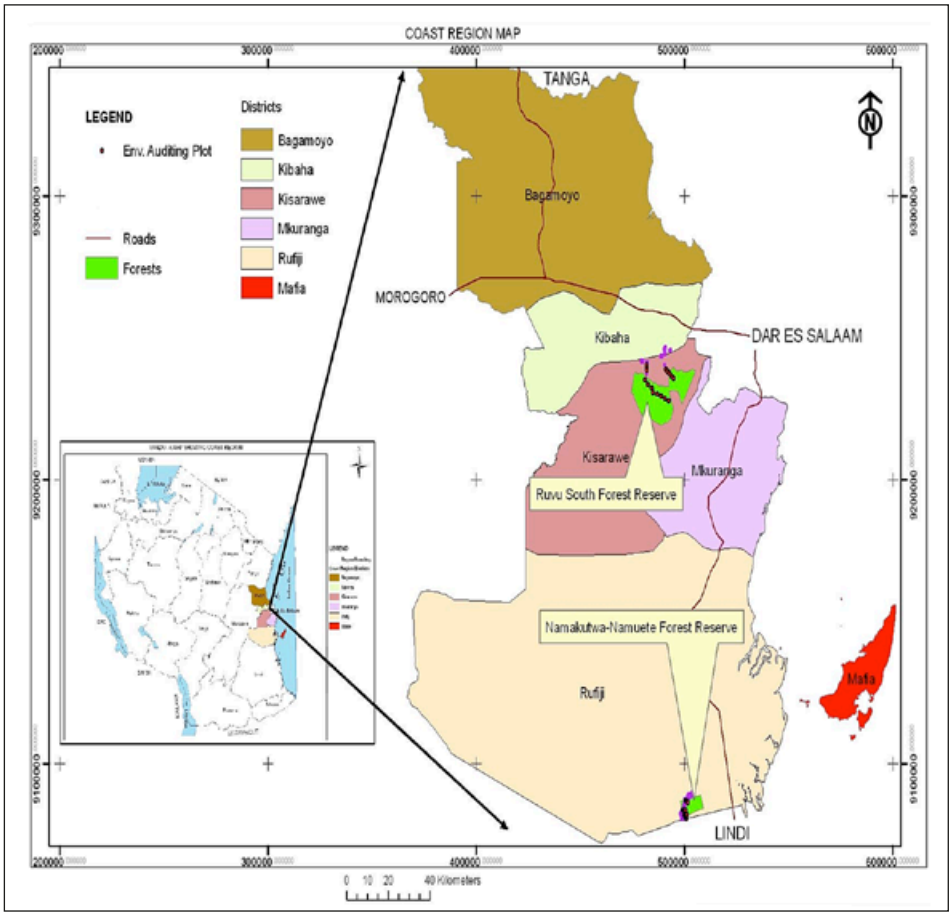
The Ruvu South Forest Reserve is located in the Coast Region falling within the two administrative districts of Kibaha and Kisarawe. The forest has an area of about 35,000 ha and boundary length of about 100 km. It is categorized as a protective forest reserve. According to Clarke & Dickinson (1995), the forest overlies gentle topography with no distinct features, with an altitudinal range of 120-260 MASL. The Ruvu South Forest Reserve is located about 30 km south-west of Dar es Salaam city.

Although Ruvu South is an old forest reserve, the level of effort expended in its protection and management work has declined over the years, so that in practice the reserve is now an open access area, within which local villagers and outsiders make a living out of charcoal burning and other extractive uses. Most of the reserve and the adjacent region are classified as deteriorated savannah woodland and thorn

2 See Norad Collected Reviews 30/2007: TaTEDO Integrated Sustainable Energy Services for Poverty Reduction and Environmental Conservation Program. TaTEDO's research shows that improved wood stoves are 2.5 times as effective as the traditional 3-stone fireplace and may reduce firewood consumption by 50-80% and also reduce toxic gases. Improved charcoal production kilns increase the conversion of wood to charcoal from 65 to up to 100%. Norway is seeking to scale up TaTEDO's activities mainly by assisting the organization to commercialize its services.

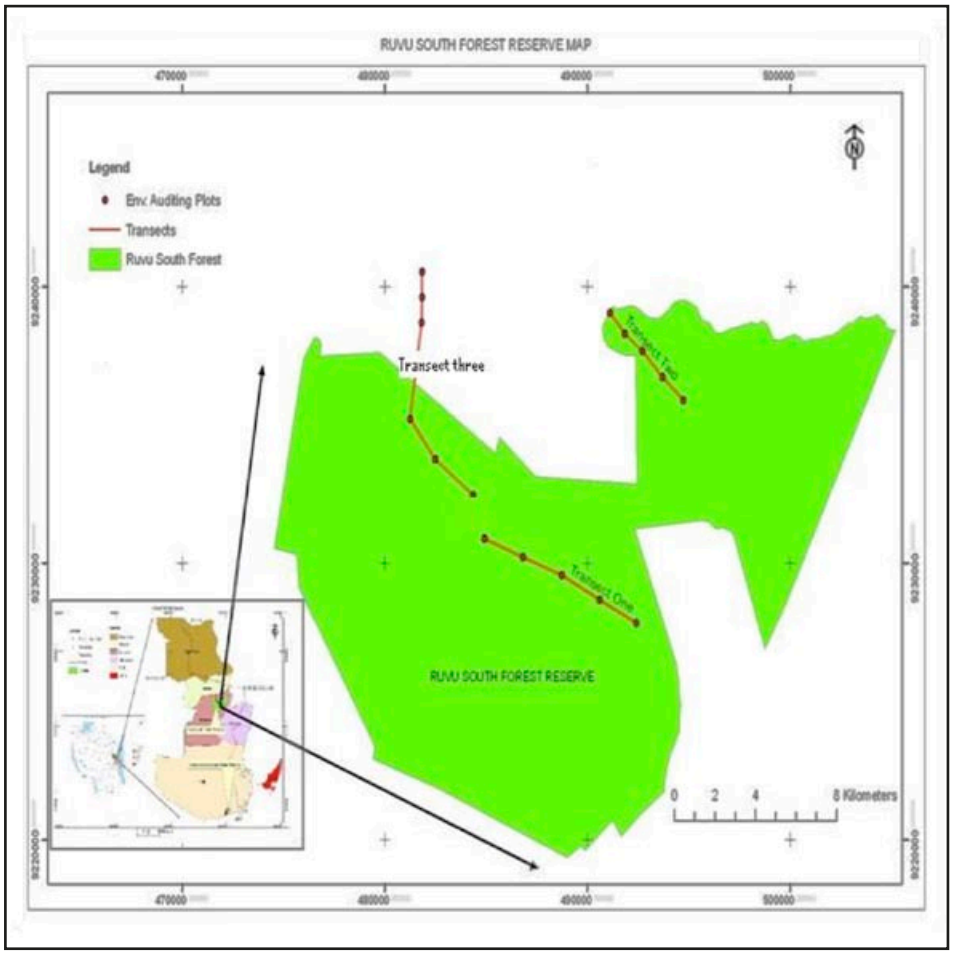
shrub on sandy soils (estimated 85% deterioration of the original vegetation), while the more remote parts consist of somewhat denser woodland and mixed forests.

Figure 1 (a): Location of study areas and environmental audit transects in the Coast Region



The Namakutwa-Namuete Forest Reserve has an area of about 4,605 ha. Its legal status is that of a productive Forest Reserve with definite boundaries, owned by the government. The forests are essentially described as deciduous woodland and forest lying between 150 and 380 MASL and located in Rufiji District. 8° 15' S - 8° 19' S; 39° 00' E - 39° 06' E. These forests consist of a fine plateau catenary sequence occurs on the hill tops with a thin (3-4 cm) humus layer. Soils on the hillside are coarser, shallower and better aerated, with varying depth of humus related to the level of anthropogenic disturbance. Valley bottoms contain deep loamy soils underlain by fine clays which retain water. Over about 15 years, soil degradation has been noticed, following land clearance from agriculture. (Clarke & Dickenson, 1995).

Figure 1 (b): Detailed location of environmental plots and transect in Ruvu South forests



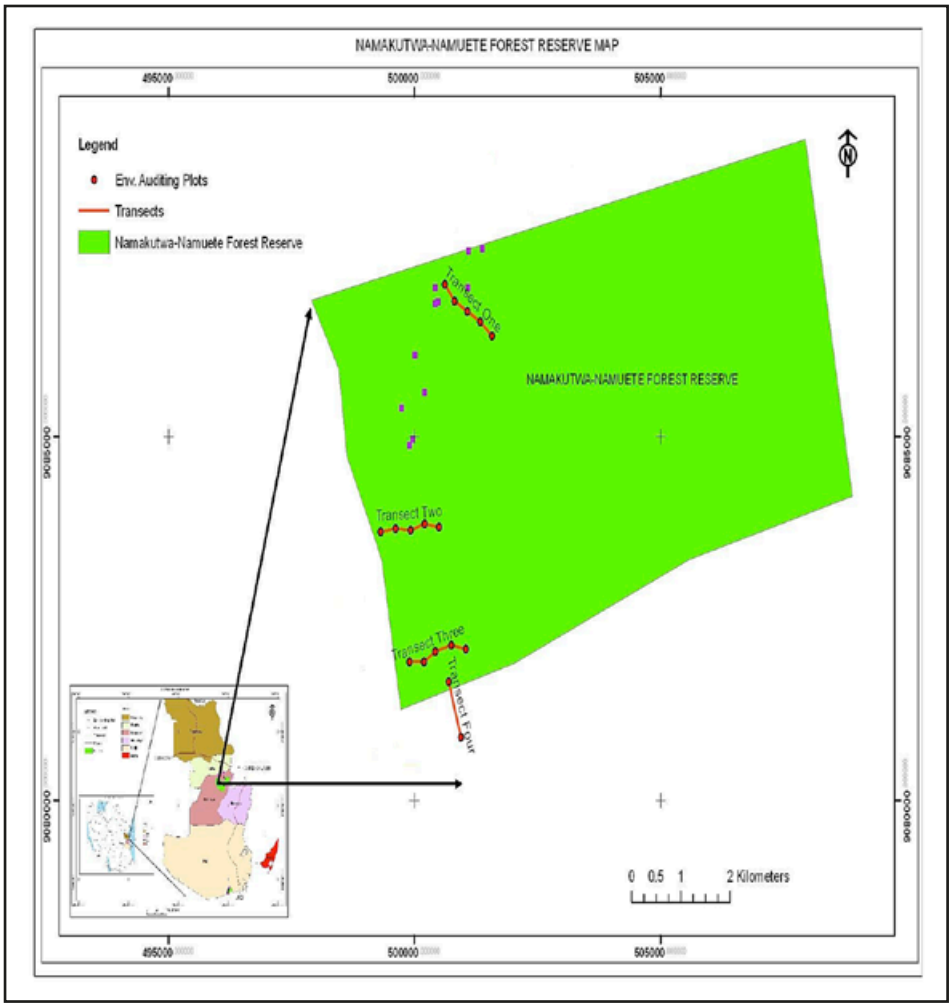
During the preliminary investigations, there was a problem in identifying a "control" area, because TaTEDO's activities encompass all villages around the reserve and the environmental and socio-economic situation in neighbouring reserves was too different to provide a basis for comparison. The team therefore agreed with Norad to establish a "comparison area" in Rufiji, whose characteristics are relatively similar to the Ruvu South Area. In addition, there had been minimal interventions in that area, in terms of improved energy.

Ruvu South and Rufiji are about 45 km and 190 km, respectively, from Dar es Salaam.

Coastal forests of Eastern Africa (including Ruvu South and Rufiji) are under severe threat. Due to encroachment and illegal cutting inside the reserve, the forests are becoming smaller and more fragmented over time. The team used a root-cause analysis to identify the factors underlying the forest degradation. A wide range of natural and man-made causes interacting at different levels and intensities have brought about degradation and loss of coastal forests and associated habitats and the species that they support. Over time, an estimated 60% of natural habitats have been converted to farmland and urban areas. Stakeholders have identified

three-quarters of the remaining coastal forest areas as highly or very highly threatened. The threats they perceive include expanding agriculture, charcoal burning, fuel wood collection, uncontrolled fires, unsustainable logging, unplanned settlement, destructive mining practices and a variety of "other" causes, including invasive species.

Figure 1 (c): Detailed location of environmental audit plots and transect in Namakutwa-Namuete forest



3.2.1 TaTEDO interventions around Ruvu South forests

A common characteristic in almost all the programmes and projects conducted by TaTEDO is their emphasis on improved wood fuel technologies to reduce fuel consumption while contributing to the process of reversing the current deforestation trends in Tanzania. The main philosophy behind TaTEDO's interventions on wood-fuel-saving stoves and ovens is summarised in the causal chain that is presented in Figure 2. The interventions are expected to bring about substantial effects in this chain, in terms of forest conservation, reduced drudgery for women, improved health conditions and income generation for local communities. In this, TaTEDO aims to contribute to achievement of various Millennium Development Goals (MDGs). However, TaTEDO is relatively unprepared to monitor such effects, as discussed in section 6 of this report.

Table 1: List of current interventions by TATEDO

S/N	PROGRAMMES	DONORS
1.	Up-scaling Access to Integrated Modern Energy Services for Poverty Reduction	EU and HIVOS Norwegian EU ands HIVOS
2.	Integrated Modern Energy Services for Sustainable Development and Poverty Reduction (IMES-PORE) (Phase II)	Embassy
3.	Integrated Sustainable Energy Services for Poverty Reduction and Environmental Conservation Programme (ISES-PRECP Phase II).	HIVOS
4.	Households Efficient Stone or Brick Made Woodstoves in Rombo and Hai Districts	SIDA and UNEP
5.	African Rural Energy Enterprise Development (AREED) Programme II	
	PROJECTS	
1.	Fredskorpset - Exchange Project	Norwegian Peace Corps
2.	Enabling Access to Sustainable Energy (EASE)	ETC and DGIS
3.	South-South North Climate Change Mitigation Project	DGIS
4.	Competence Platform on Energy Crops and Agro-forestry Systems for Arid and Semi-Arid Ecosystems-Africa (COMPETE)	EU
5.	Sustainable Costal Communities and Ecosystem Project.	TCMP (USAID)

Wood-fuel-saving technology is just one of the many interventions pursued by TaTEDO. The baseline study establishes the current status in terms of consumption patterns as driving forces of environmental degradation and likely effects on the environment in the selected areas. The programme Integrated Modern Energy Services for Sustainable Development and Poverty Reduction (IMES-PORE) is being implemented in eight (8) regions of the United Republic of Tanzania namely Kilimanjaro, Arusha, Mwanza, Shinyanga, Dar es Salaam, Rukwa, Coast and Tanga. The baseline fieldwork for this report covered the Coast Region, because TaTEDO activities were initiated in this region. Secondary data, especially on charcoal demand and supply, covered more regions including the city of Dar es Salaam.

The goal of the programme is to contribute to sustainable development and poverty reduction by enhancing access to sustainable modern energy technologies and services for consumptive and productive needs in households, Small and Medium-size Enterprises (SMEs) and social service centres. The main objective is to facilitate the scaling-up of access to sustainable modern energy technologies and services. The modern energy technologies and practices earmarked for scaling up were already introduced in some districts through the previous programme which ended in the year 2006. Such technologies and practices include efficient wood fuels stoves, charcoal and firewood baking ovens, improved charcoal production kilns, solar PV and dryers, Multifunctional Platforms (MFPs), bio-gas and the cultivation of multipurpose energy-rich trees.

The key expected outputs after four years of implementation of the programme include

- Increased uptake and use of modern bio-mass energy technologies and services,
- Mitigated environmental adverse effects associated with energy production and use,
- Increased access to electricity, solar-drying and motive power through decentralised energy systems,
- Acquisition, processing, storage and dissemination of enhanced energy and related information,
- Enhanced participatory planning, monitoring and evaluation of the programme activities,
- Strengthened managerial, institutional capacity and core support for TaTEDO and its local partners.

According to the programme-implementation report covering the second half of 2007 and the year 2008, scaling-up activities have started in seventeen districts within earmarked programme regions, including the Kibaha/Kisarawe district where the baseline study was conducted. During the "scaling-up" programme phase, a Participatory Rural Appraisal was conducted for identification of problems, needs, priorities and preparation of local level energy development plans. In addition, awareness and market development campaigns were conducted building local level capacity to install service and maintain technologies, to develop and coach energy entrepreneurs to provide energy services, to establish links with financing institutions and to monitor performance and outcomes of the programme activities.

The approaches employed to implement programme activities included, among others, strengthening local partnership, close collaboration between district authorities, strong participation of villagers and other key stakeholders, entrepreneurship and market development. According to the implementation report, the results attained included the following:

- Raising awareness through educational and promotional materials (including radio and TV programmes, t-shirts, posters and brochures, exhibitions and demonstrations);
- Establishing District Development Sustainable Energy Clusters (DDSECs) and village energy teams in the target regions, to facilitate dissemination of improved wood-fuel technologies;
- Building capacity to design, install, service and maintain different energy technologies though training-of-trainers sessions involving charcoal stove artisans, firewood stove technicians, rural bakers, charcoal producers, tree nursery owners, solar PV technicians, solar dryer carpenters. These sessions provided small-scale rural energy entrepreneurs with enterprise-development skills and linked them to financing institutions. Among other things, the baseline study assessed their level of awareness on improved energy technologies.
- Following collection and analysis of energy-related information from these participants, key information was disseminated to programme stakeholders through internet, newsletters and leaflets in English and Swahili.

3.2.2 The TaTEDO Monitoring and Evaluation System

A review of the monitoring and evaluation system currently used by TaTEDO revealed that this system is not adequately tuned to monitor outcomes and impacts from TaTEDO's interventions as presented in their logframe (Figure 2). The monitoring system involves regular reporting of accomplishments and field activities as required under TaTEDO's contracts with donors, but does not have specific indicators that would gauge how the organisation is moving towards making an impact on the ground.

Discussions with TaTEDO officers revealed that the organisation intends to engage a consultant to design an elaborate monitoring and evaluation system that will monitor incremental changes in relation to their interventions as framed in TaTEDO's strategic plan. The results will depend on the adequacy of the resulting system and of TaTEDO's resources. Should the initiative be successful, it would provide some of the data needed to monitor changes from the reported baseline. Support could usefully be directed to this area of capacity improvement.

3.3 Types of data and Data Collection Methods

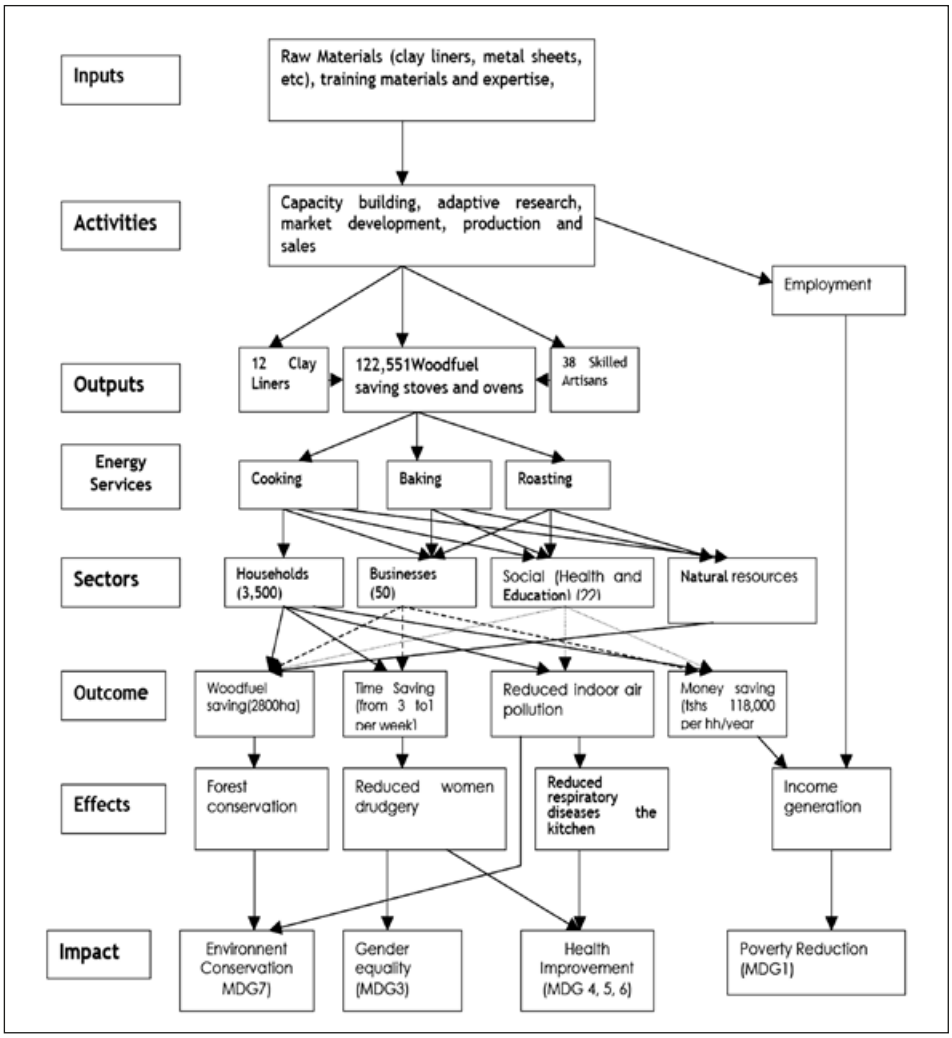
In Ruvu South, the study was carried out in Kipangege (581 households with a population of 2453), Bokomnemela (664 households with a population of 3073) and Kisanga (602 households with a population of 2561). The comparison area included Nambunju (522 households with a population of 2624) and Mbwara (771 households, with a population of 1973). The sample size of 150 households in each study area constituted respectively 8% and 13% of the households in the selected villages in Ruvu South and Rufiji.

The study team identified four types of data sets, used to describe and analyse the socio-economic and environmental situation in the targeted and comparison areas. The baseline study was based on a combination of data sources, both existing documents and primary data collected through field work. The main tools for local data collection were:

Structured questions to TaTEDO. TaTEDO answered a set of structured questions, which focus on the organization's perceptions of the original problems/deficiencies in the programme area, the remedying goals/activities being pursued, the results achieved and the experiences and lessons learned so far.

Village level questionnaire. These questionnaires were administered to about 10 informants in each village. The informants included the village headman, head teachers from village schools, agricultural field staff, religious leaders, traders and health workers. The group was diverse with respect to gender, age, religion, and ethnicity, with the goal of ensuring that it was representative of the key information holders of the village. The information sought was supposed to be common to households in the area, and was used jointly with the information gathered through the household survey. The questionnaires were administered by the country study team leader and an experienced assistant, and the informants seemed to agree on all the major questions posed.

Figure 2: TATEDO's causal chain for improved wood fuel technologies[3]



Household questionnaire. Prior to implementation of the household surveys, five villages (3 from Kibaha/Kisarawe, and 2 from the Rufiji) were selected sampled and households were selected by random draw from the listing of all households in the villages. Questionnaires were administered to a total of 300 households, including 150 from the target area (55 from Bokomnemela, 55 from Kipangege and 40 from Kisanga village) and 75 from each of the villages of Mbwara and Nambunju (the comparison area). For future monitoring purposes, the entire list of households that were interviewed and their locations (GPS readings) are given to Norad as an unpublished Annex. The questionnaire covered a number of issues, such as the following:

- the composition of the household and the internal and external relationships of household members,
- education and health standards, especially as to public/environmental health;
- the household's income -generating activities, food/cash production from farms and neighbouring forests, food sufficiency over time, and major expenditures;
- farming practices and use of forest products; type of work and incomes from their lands and the forests;

3 Numbers slotted inside the logframe boxes (outputs & sectors) indicate what has so far been achieved by TaTEDO by 2008 and will change with time.

- the homestead, including housing standard and building material,
- the household's other main assets;
- access to and collection of firewood/charcoal, fuel use, knowledge of/interest in energy-saving utilities.

All of the socio-economic and environmental data collected related to information needed for monitoring MKUKUTA performance. However, since MKUKUTA performance is measured at national level, the data, which has been collected and/or might later be obtained from subsequent study sites will feed into national level MKUKUTA monitoring.

Natural resource/environmental studies were conducted in Ruvu South and Namakutwa-Namuete Forest Reserves. Table 2 describes the sample plots established for the forest inventory. Permanent, easily recognizable features (*e.g.*, schools and bridges) were selected as starting points for the environmental audit transects and their respective GPS readings were recorded, using transect number, plot number, latitude and longitude. These parameters and data are included in Appendices 5 and 6.

The environmental audits used a standard-format matrix in all the sites. This was done in established transects along which observation plots were laid. The information recorded includes the following: Altitude, climate-weather pattern, land tenure, land utilisation/forest/agriculture, ecosystem/forest type, tree density, canopy cover, standing tree volume, seedling density/number, human disturbance, soil type, pollution, slope gradient, ground cover/grasses/litter, water situation/humidity, erosion/sedimentation, signs of wild animals, signs of endemic species, other land use type, infrastructure on the plot, estimated land market value, charcoal off take regularity, timber and wood off take, other extractive off take, population pressure in the area, and other pressures. The entire list of plots and observations made appears in **Appendix 5**. ***Table 2: Number of plots surveyed***

Village	Transect #	Forest	Number of plots
Target area			
Kisanga (Kisarawe District)	1	Ruvu South FR	5
Bokomnemela (Kibaha District)	2	Ruvu South FR	5
Kipangege (Kibaha District)	3	Ruvu South FR	3
Kipangege (Kibaha District)	3	Kipangege village land forest reserve	3
Comparison area			
Mbwara (Rufiji District)	1	Namakutwa-Namuete FR	5
Nambunju (Rufiji District)	2	Namakutwa-Namuete FR	5
Nambunju (Rufiji District)	3	Namakutwa-Namuete FR	5
Nambunju (Rufiji District)	4	Namakutwa-Namuete FR	2
Total			**33**

The forest inventory along established transects collected quantitative data on the status of the forests. A forest inventory is normally defined as the procedure for obtaining information on the quantity and quality of the woodland resources and other characteristics of the land on which the trees and shrubs are growing. For this report, the forest inventory was important in order to estimate the available stock in forests under the study. The actual inventory was preceded by a reconnaissance survey which established the transects. Then the forest inventory covered sample circular plots with radii of 15m corresponding to an area of 0.071 ha, using a low sampling intensity to assess the standing crop.

The starting point was selected so that the transect lines would include areas highly disturbed and some relatively untouched. The distances between transects and plots were the consistent**.** Measurements recorded in each plot include the following:

- Diameter at breast height (DBH $\geq$ 5 cm);
- Basal diameter (measured 20 cm above ground, for sample trees);
- Tree height (sample trees, two in each plot);
- Species name of each tree;
- Relascope sweep (basal area);
- Regenerants (count); and
- GPS readings (location).

Analysis of stocking parameters utilised the Microsoft Excel package, computing stem density (N), basal area (G) and volume (V). The following list identifies the models used for computation of stem density (Model 1), basal area (Model 2) and volume (Model 3 and 4) respectively:

Computation	Model
$N = \frac{i}{A}$ Where N = Stem density (stem count/ha); i = Stem count; A = Plot area (ha).	1
$G = \sum\left(\frac{g_i}{A * n}\right)$ $g_i = \frac{\pi dbh^2}{4}$ *Where* G = Basal area (inm^2/ha); dbh = Diameter at breast height (cm); Σ = Pi; A = Plot area (ha); n = Number of plots; and g_i = Basal area of a tree/shrub (m^2).	2
$V = 0.0001 d_i^{2.032} * h_i^{0.66}$ (Malimbwi et al. 1994)	3
$V = 0.5 * g_i * h_i$ *Where* V = Volume (in m^3/ha); di = Diameter at breast height (cm); h_i = Tree height	4

Model 3 was used for estimation of volume in Ruvu South which is essentially coastal miombo forest, while estimation in Rufiji used model 4 (a more general model)

Comparison and combination of data sources. All the data sources, plus existing documents were used, *and* compared for consistency to arrive at the best feasible estimate of the status and the driving forces affecting the lands, forests and buffer zones.

4. Socio-economic Baseline Status

4.1 Demographic Status of Household Heads

4.1.1 Gender and marital status

In the target area around Ruvu South, about 61% of the household heads responding to the questionnaire were males, while about 39% were females. About 20% of the females interviewed were speaking on behalf of their husbands, who were not present at the time of the interviews. Seventy-eight percent (78%) of all respondents were married.

In the comparison area in Rufiji about 54% of respondents were males, while about 46% were females. Of the female respondents, 12% were female household heads while 34% were respondents in the absence of their husbands. Similar to the target area, the female headed households were either divorce (including single parenthood) (6%) or loss of male partner though death (6%). About 80% of respondents were married.

According to the 2007 National Household Budget Survey, there has been an increase in the proportion of female-headed households in both urban and rural areas throughout the country since the 1991/92 survey. In the rural areas, the percentage of female-headed households has increased from about 16.7 % in 1991/92 to about 23% in 2007.

4.1.2 Distribution of household heads by age class

The distribution of household heads by age classes for both the target and comparison areas is summarised in Table 3.

Table 3: Age class of household heads

Study sites	Ruvu South (target area)				Rufiji (comparison)		
	Bokom-nemela	Kipangege	Kisanga	Overall	Mbwara	Nambunju	Overall
	f (%) N = 55	f (%) N = 55	f (%) N = 40	f (%) N = 150	f (%) N = 75	f (%) N = 75	f (%) N = 150
Age class (Years)							
< 20	0 (0)	0 (0)	1 (3)	1 (1)	3 (4)	3 (4)	6 (4)
20 - 40	24 (44)	27 (49)	17 (42)	68 (45)	24 (32)	35 (47)	59 (40)
41 - 60	19 (34)	13 (24)	14 (35)	46 (31)	25 (33)	25 (32)	50 (33)
> 60	12 (22)	15 (27)	8 (20)	35 (23)	23 (31)	12 (16)	35 (23)
Total	**55 (100)**	**55 (100)**	**40 (100)**	**150 (100)**	**75 (100)**	**75 (100)**	**150 (100)**

In both areas, the dominant age class was the 20-40 years constituting about 45% in the target area and comparison areas. The next most numerous group was in the 40-60 years age class. The majority of household heads fall within the productive age, capable of actively participating in production activities. This implies that the majority of household heads are mature enough to make independent decisions about household-level interventions, including adoption or rejection of improved technologies.

It is reported nationally that on average about 37.8% of household heads in rural areas fall are 30-44 years of age, and about 31.8% fall within the 45-64 years age classification (National Household Survey, 2007). These estimates are comparable to findings in the study areas.

4.1.3 Educational status of household heads

Table 4 presents the distribution of household heads by educational status. The majority of household heads around Ruvu South have full primary education (64%), while about 21% have no formal education at all. Another 14% attended, but did not complete primary education. Those who did not complete primary education are relatively better off compared to those who did not attend at all, being normally able to can at least read and write.

Table 4: Educational status of household heads

	Ruvu South				Rufiji (comparison)		
Education level	**Bokom-nemela** f (%) N = 55	**Kipangege** f (%) N = 55	**Kisanga** f (%) N = 40	**Overall** f (%) N = 150	**Mbwara** f (%) N = 75	**Nambunju** f (%) N = 75	**Overall** f (%) N = 150
No education	11 (20)	12 (22)	8 (20)	31 (21)	14 (19)	6 (8)	20 (13)
Incomplete primary school	5 (9)	7 (13)	9 (23)	21 (14)	5 (7)	11 (15)	16 (11)
Primary school	38 (69)	35 (64)	23 (58)	96 (64)	55 (73)	53 (71)	108 (72)
Secondary school	1 (1)	1 (2)	0 (0)	2 (1)	1 (1)	5 (7)	6 (4)
Total	**55 (100)**	**55 (100)**	**40 (100)**	**150 (100)**	**75 (100)**	**75 (100)**	**150 (100)**

In the comparison area the situation is not very different, although the literacy level is a bit higher as demonstrated by a higher percentage of those who completed primary education (72%) and lower percentages of those who did not attend school at all (13%) and those who did not complete primary education (11%).

The Household Budget Survey (2007) shows that the rural adult Tanzanian population is made up of 28.5% who have had no formal education, 12.3% have incomplete primary education (of at least four years), 52.4% have complete primary education, while at least 4.1% have attended secondary schools. This data suggest

that the educational status of household heads in both Ruvu South and Rufiji is a bit above the national average of primary education. The proportion with secondary education is below the national average.

4.1.4 Household size and composition

The overall average household size for the three villages in the target area was 4.85, while household size in the comparison area was about 5.61. The reported national average household size for rural areas in Tanzania is about 5.0. It can generally be said that the overall average household sizes for both sites are close to the national average but tends to be higher in the comparison area as opposed to the target area. Table 5 presents a summary of the major findings relating to household composition by gender and age classes.

Table 5: Household composition by gender and age class

	Ruvu South				Rufiji (Control)		
	Bokom-nemela	Kipangege	Kisanga	Overall	Mbwara (Control)	Nambunju (Control)	Overall
Education level	**f (%)**	**f (%)**	**f (%)**	**f (%)**	**f (%)**	**f (%)**	**f (%)**
Male aged < 20 years	53 (19)	61 (21)	41 (21)	155 (21)	34 (20)	26 (19)	60 (19)
Female aged < 20 years	64 (23)	64 (24)	44 (22)	95 (13)	34 (20)	23 (17)	52 (17)
Male aged 20 - 40 years	31 (11)	37 (14)	27 (14)	53 (7)	29 (17)	23 (17)	27 (9)
Female aged 20-40 years	53 (19)	52 (19)	34 (16)	43 (6)	27 (16)	22 (16)	21 (7)
Male aged 41 - 60 years	17 (6)	18 (7)	18 (9)	172 (23)	11 (6)	16 (12)	57 (19)
Female aged 41 - 60 years	19 (7)	15 (6)	19 (10)	139 (18)	9 (5)	11 (8)	49 (16)
Male aged > 60 years	24 (9)	13 (5)	6 (3)	53 (7)	13 (8)	8 (6)	20 (6)
Female aged > 60 years	19 (6)	10 (4)	10 (5)	39 (5)	14 (8)	7 (5)	21 (7)
Total	**280 (100)**	**270 (100)**	**199 (100)**	**749 (100)**	**171 (100)**	**136 (100)**	**307 (100)**

The household population for both the Ruvu South and Rufiji villages are dominated by young people (less than twenty years of age). There are slightly more females than males around Ruvu South. Less than 10% are more than sixty years of age in both areas.

The national household budget survey used different age categories, but recorded a similar trend, with about 37.6% of the rural population in Tanzania made up of females less than 30 years of age, whereas males in the same age category constitute about 33.9%. The national rural population above 60 years of age constitute less than 10%, as found in the study areas.

4.1.5 Main economic activities

Several economic activities were reported from both study sites. These included farming, charcoal making, petty business, livestock keeping, beekeeping, brick making, lumbering, formal employment and casual labour. In both sites, all respondents had more than one economic activity, as a coping strategy against income failures from individual activities. Farming was the major economic activity, practiced by all respondents of both study areas. The relative importance of these economic activities in the two study sites is summarised in Table 6. Since each respondent had more than one economic activity, results presented in Table 6 are not actual percentages of responses for individual activities, but represent relative importance of each activity when aggregated and weighed against the other multiple responses from each respondent.

In Ruvu South, charcoal-making is one of the main economic activities. This activity was more prominent in Kipangege village. This confirms charcoal-making as one of the drivers of environmental destruction in the area. Charcoal-making is much less important in Rufiji, where, collection of medicinal plants was more common than it is in Ruvu South. The possible reason for this difference is that the forests in Rufiji are better stocked with various useful tree species than Ruvu South, and those forests and species have not been seriously damaged by human activities. Brick making was also more common in the Rufiji area. This was a reflection of the demand for bricks for school buildings.

Table 6: Relative importance of different economic activities

	Ruvu South(Target area)				Rufiji (Control)		
Income generating activities	**Bokom-nemela**	**Kipangege**	**Kisanga**	**Overall**	**Mbwara**	**Nambunju**	**Overall**
	f (%)	**f (%)**	**f (%)**	**f (%)**	**f (%)**	**f (%)**	**f (%)**
	N = 55	**N = 55**	**N = 40**	**N = 150**	**N = 75**	**N = 75**	**N = 150**
Farming	41(32)	42(29)	40(54)	123(35)	29(16)	30(18)	59(16)
Livestock keeping	15(12)	15(10)	4(5)	34(10)	9(5)	7(4)	16(4)
Petty business	15(12)	14(10)	8(11)	37(11)	11(6)	8(5)	19(5)
Beekeeping	0(0)	0(0)	0(0)	0(0)	1(1)	0(0)	1(0)
Brick making	5(4)	10(7)	0(0)	15(4)	31(17)	19(11)	50(14)
Lumbering	5(4)	1(1)	0(0)	6(2)	16(9)	12(7)	28(8)
Charcoal making	24(18)	38(26)	12(16)	74(21)	12(6)	21(12)	33(9)
Herb gathering	11(8)	13(9)	0(0)	24(7)	45(24)	38(22)	83(23)
Formal employment	4(3)	6(4)	2(3)	12(3)	3(2)	4(2)	7(2)
Casual labour	10(8)	5(3)	8(11)	23(7)	30(16)	32(19)	62(17)
Total	**130 (100)**	**144 (100)**	**74 (100)**	**348 (100)**	**187 (100)**	**171 (100)**	**358 (100)**

4.2 Available Livelihood Assets for Farmers

Several livelihood assets available to farmers were examined in order to understand opportunities and challenges facing forest adjacent communities. The studied variables included human capital, physical capital (in terms of types and quality of houses and tools), natural capital (energy sources, access to land and water, land tenure and soil fertility).

4.2.1 Natural capital

Access to land was examined on the basis of amount of land owned and cultivated by each household. Table 7 presents the reported averages in relation to these variables. Farmers around Ruvu South forest reserve own more land than what they can cultivate annually. The amount of land cultivated is limited by working tools and manpower: None of the farmers reported using oxen or tractors. In Rufiji, however, farmers cultivate more land than they own because the practice of borrowing land for cultivation is common. Farmers in both study areas depend on hand hoes, thus limiting household agricultural production. There are four main types of land acquisition and land tenure systems in both areas: inheritance, purchase/privatisation, allocation of user rights by the village council, and encroachment into the forests. More than 40% of farmers had inherited land. At least 5% had encroached into the forests, thus being, functionally, drivers of environmental destruction in those forests.

Over 90% of households studied in both Ruvu South and Rufiji depend solely on firewood as their source of energy for cooking. The remainder use combinations of firewood and charcoal for cooking. In both study sites, kerosene is the main source of energy for lighting. The use of electricity is almost non-existent. In all rural areas of Tanzania generally, 10 % of households use only charcoal for cooking (National Household Budget Survey, 2007).

The high dependence on forest resources for cooking poses great threat to the surrounding forests and the environment in general. Therefore, TaTEDO initiative in the villages around Ruvu South is very relevant.

Table 7: Land ownership and cultivation in the villages studied

Study sites	Ruvu South				Rufiji (comparison)		
	Bokom-nemela	Kipangege	Kisanga	Overall	Mbwara	Nambunju	Overall
Variables							
Amount of land possessed (acre)	3.75	3.93	3.35	3.71	3.39	3.49	3.44
Total amount of land cultivated last year (acre)	2.55	2.22	1.59	2.16	3.16	3.96	3.54

Regarding water for domestic use, nearly all households in Ruvu South depend on unprotected wells as their main sources. More than 90% of the households reported that available water was inadequate. In Rufiji, about 10% of households were getting water from "protected sources". The surveys collected information on the source of household drinking water as an approximate indicator of the quality of the water. The high dependence on unprotected water sources suggests that the households in the two areas were vulnerable to water–borne diseases, a phenomenon that effects agricultural productivity both because farmers will spend less time on production activities due to sickness and because a larger percentage of existing meagre financial resources will be used for treatment of patients. The incidence of 100% unprotected water in the study areas is far higher than the national average for rural areas which is 60% (Household Budget Survey 2007).

The respondents were requested to categorise the fertility of their lands. The majority of farmers in Ruvu South (about 70%) considered their land to be of average fertility, while about 15% characterised their land to be of low fertility. Only a small portion of the respondents (15%) considered their soil to be of high fertility. In Rufiji the majority of farmers (about 60%) categorised their soils as having high fertility, while the remaining 40% considered their soils to be of average fertility.

The only tilling method in both areas was the hand hoe. In Ruvu South, the types of crops cultivated included cassava (46%), maize (27%), cowpea (25%) and rice (2%). The farmers in Rufiji reported that they cultivated maize (39%), cassava (29%) rice (21%), millet (8%), Sim-sim (2%) and cowpeas (1%).

In Ruvu South, the major impediments to agricultural productivity were reported to be vermin (46%), drought (38%) and pests (17%). In Rufiji the reported major threats were essentially the same.

4.2.2 Agricultural production, consumption and trade

The study shows that agricultural production is still at the subsistence level: nearly everything produced is consumed at home. In some cases, produce is sold to get some cash, but normally this happens at the expense of food security before the next crop. In Ruvu South, the food crops that may be sold for cash income include maize and cassava. Owing to low productivity, the study showed that only a small percentage of farmers sell crops. On average only about 2.6% of sample households (N = 150) in Ruvu South sell maize while about 7.3% sell cassava. For those households which sell crops for income, the average is only about one bag of maize per year which would fetch about Tsh 30,000/= (US$ 20). In the same area, the household would sell on average about 5 bags of cassava, each fetching about Tsh 10,000/= (US$7). One can therefore say that, on average, each crop-selling household in Ruvu South gets about Tsh 80,000/= (US$ 54) annually by selling food crops.

The farmers in Rufiji had slightly more crops to sell. The main crops sold in Rufiji include maize, rice, cassava, and sim-sim. It is estimated that on average, for those households which sell crops (only about 7%), each household sells about 4 bags of maize, 1 bag of rice, 1 bag of cassava and 1 bag of sim-sim. Maize and cassava fetches on average similar prices to Ruvu South. Additionally, in Rufiji a bag of rice fetched about Tsh 25,000/- (US$ 17) while a bag of sim-sim gets about Tsh 20,000/= (US$ 14). An average farmer who sells crops in Rufiji can be estimated to get about Tsh 175,000/= (US$117) annually from sale of food crops. This is more than double of what an average farmer gets in Ruvu South for the crops that were mentioned during the survey.

Crop production in both Ruvu South and Rufiji District is considered to be well below the available potential. This is mainly attributed to low utilisation of the potentially available cultivatable lands (especially in Rufiji), low agricultural technologies and vermin-caused crop-destruction. The areas near forest and game reserves are especially vulnerable to vermin. Estimates put crop destruction due to vermin up to 40% (DANIDA, 1998). This has a significant impact on food insecurity.

In both study areas, livestock keeping was common, but the livestock component within the overall production system was poorly developed. It is estimated that the whole of Kibaha district has only about 2,000 cattle and 170 goats (Kibaha District profile). Around Ruvu South, only about 1% (N = 150) (two households) of the respondents kept cattle and goats/sheep of traditional breeds. Most of these were immigrants who had settled in the villages. The number of livestock kept was low, whereby on average each livestock-keeping household averaged only about 2 head of cattle and 1 goat/sheep. On average each cow produced only about one litre of milk per day (during the lactation period). Nearly the only livestock kept by about 80% of respondents around Ruvu South was traditional chicken, kept under the free range system. On average, each chicken-keeping household had 7 chickens.

The main reasons for keeping chicken were household consumption (particularly eggs for improving the nutritional status of children and chicken for special occasions including festivals) and sale of chicken and eggs at times of economic hardships. On average each chicken-keeping household was estimated to generate about 20,000/= Tsh ((US$14) annually from sales of chicken and eggs.

In Rufiji the situation was very similar in terms of livestock production and productivity. Only two interviewed households (about 2%) of the respondents kept cattle and goats/sheep of traditional breeds. Each livestock-keeping household had an average of about 1 head of cattle and 1 goat/sheep, lower than in Ruvu South. Milk production was similar to that of Ruvu South, with an average of about one litre per day for the livestock-keeping households About 85% of respondents kept traditional chicken for similar to those identified in Ruvu South. On average each chicken-keeping household had about 10 chickens. It has been estimated that sale of chicken and eggs contributes only about Tsh 18,000/= (US$ 12) to household income.

In both study sites, it was generally observed that the poorly developed livestock production affected agricultural productivity. For example, the use of farmyard manure is not a common practice in either area. In areas where access to modern fertilizers is limited, farm yard manure has often supplemented the fertilizers (Kessy and Oktingati, 1991), but this does not take place in the study areas. This feature contributes to food insecurity.

4.2.3 Human capital

Human capital was assessed on the basis of type and level of education possessed by household members. It is generally accepted that with higher levels of education within the household, the household members get better understanding of existing livelihood challenges and normally become better positioned in generating alternative solutions to existing problems including adoption of improved technologies that are more profitable and environmentally friendly. The educational status of the studied households is presented in section 3.1.3 of this report and the data is summarized in Table 4.

About 21% and 13% of household heads in Ruvu South and Rufiji, respectively, have no formal education. Furthermore, a large part of those who attended primary school did not complete all years. Only a small group of about 4% of households in Rufiji and none from the Ruvu South sample have attended secondary school. Due to the low levels of education, the percentage of respondents who are actually employed civil servants is low and a good number of household heads have to work as casual labourers in times of food shortage.

4.2.4 Food security and coping strategies

The respondents were asked if they thought their households were food secure or insecure, the reasons for possible inadequate crop harvest, and their coping strategies when their own food supplies run out. Their responses are summarised in Table 8. The majority of households in both study areas perceived themselves to be food insecure. The leading reasons were reported to be drought, poor agricultural

implements and vermin. The severities of these problems vary between villages as reflected by the respective responses.

Sale of forest products, particularly charcoal and firewood, was confirmed as one of the coping strategies particularly in Ruvu South. This serves as one of the driving forces to environmental degradation. Other coping strategies included working as casual labourers, selling of livestock (particularly chicken) and petty business (including selling of fruits like mangoes and pineapples). Although in reality many farmers do reduce the number and quality of meals during food shortage periods, very few admitted this. However, the practice was confirmed during village level discussions. Regarding low dependence on remittances, the reason could be that very few households had sons, daughters and relatives outside their localities to rely upon, because of the generally low levels of education in the Coast Region as compared to other regions.

Table 8: Status of food security and coping strategies

Study sites	**Ruvu South**				**Rufiji (comparison)**		
	Bokom-nemela	**Kipan-gege**	**Kisanga**	**Overall**	**Mbwara**	**Nam-bunju**	**Overall**
	f (%)	**f (%)**	**f (%)**	**f (%)**	**f (%)**	**f (%)**	**f (%)**
	N = 55	**N = 55**	**N = 40**	**N = 150**	**N = 75**	**N = 75**	**N = 150**
(i) Food security							
- Food secure	7 (13)	4 (7)	2 (5)	13 (9)	7 (9)	2 (3)	12 (8)
- Food insecure	48 (87)	51 (93)	38 (95)	137 (91)	68 (91)	73 (97)	138 (92)
Total	**55 (100)**	**55 (100)**	**40 (100)**	**150 (100)**	**75 (100)**	**75 (100)**	**150 (100)**
(ii) Reasons for inadequate crop harvest[4]							
- Use of poor agricultural tools	19 (33)	20 (27)	24 (32)	63 (30)	21 (58)	26 (57)	47 (57)
- Drought	22 (38)	23 (31)	22 (29)	67 (32)	8 (22)	13 (28)	21 (26)
- Poor seed quality	0 (0)	0 (0)	1 (1)	1 (0)	3 (8)	0 (0)	3 (4)
- Poor soil fertility	8 (14)	2 (3)	0 (0)	10 (5)	0 (0)	2 (4)	2 (2)
- Vermin	9 (16)	29 (39)	29 (38)	67 (32)	4 (11)	5 (11)	9 (11)
Total (with multiple responses)	**58 (100)**	**74 (100)**	**76 (100)**	**208 (100)**	**36 (100)**	**46 (100)**	**82 (100)**
(iii) Coping strategies to fill crop deficit							
- Casual labour	24 (25)	31 (28)	7 (19)	62 (26)	77 (45)	59 (37)	136 (41)
- Selling livestock	26 (27)	29 (26)	3 (8)	58 (24)	72 (42)	79 (49)	151 (46)
- Other assets	5 (5)	4 (4)	0 (0)	9 (4)	8 (5)	8 (5)	16 (5)

4 Some farmers gave multiple responses

Study sites	Ruvu South				Rufiji (comparison)		
	Bokom-nemela	Kipan-gege	Kisanga	Overall	Mbwara	Nam-bunju	Overall
	f (%) N = 55	f (%) N = 55	f (%) N = 40	f (%) N = 150	f (%) N = 75	f (%) N = 75	f (%) N = 150
- Harvest forest products (e.g. Firewood, charcoal)	19 (20)	24 (22)	10 (27)	53 (22)	3 (2)	4 (2)	7 (2)
- Petty business	15 (16)	17(15)	11 (30)	43 (18)	7 (4)	6 (4)	13 (4)
- Reduce number/ quality of meal	4 (4)	4 (4)	2 (5)	10 (4)	1 (1)	3 (2)	4 (1)
- Rely on remittances	3 (3)	1 (1)	4 (11)	8 (3)	2 (1)	2 (1)	4 (1)
Total (with multiple responses)	**96 (100)**	**110 (100)**	**37 (100)**	**243 (100)**	**170 (100)**	**161 (100)**	**331 (100)**

For both Ruvu South and Rufiji, the most critical food shortage period was reported to be between the months of September and December (just before the short rains). Another lean period is identified from April to June, just before the new harvest. The length of the shortage period can be longer when the short rains do not fall between November and December. The main harvest usually sustains the households for a about three months (June to September).

4.2.5 Access to agricultural inputs and extension services

A total of eleven variables were used to examine the villages' relative access to various agricultural implements/inputs and extension services. These included respondents' assessment of access to tractors, farm tools, planting materials, fertilisers, pesticides, agricultural extension services, livestock extension services, veterinary extension services, forestry extension services, wildlife extension services and health extension services. The responses indicate that access to almost all these services was poor in both areas. Respondent in both areas reported to have no access to tractors (about 90%), no access to planting materials (about 80%), no access to fertilisers (100%), and no access to pesticides (about 95%). Access to normal farming tools including hoes, machetes, axes and forks was reported to be good, but the situation could have been better for both areas if suppliers were closer to the villages. Farmers have to travel to distant sub-urban areas to purchase farm tools.

The percentage of farmers without access to various extension services and fertilisers in both areas was consistently high. Table 9 presents responses on access to various extension services. This situation aggravates the food insecurity problem as a result of poorly developed agricultural support systems, thus serving as one of the drivers for environmental destruction.

About 67% of respondents have no access to agricultural extension services. The highest reported percentage was from Kisanga village (88%), which is located in

the peripheries of Kisarawe district. Only 3% of respondents have access to livestock services, 4% to veterinary services. About 33% reported access to forestry extension. This reflects interventions by NGOs including CARE Tanzania and Tanzania Forest Conservation Group (TFCG). Recent initiatives by TaTEDO have also contributed in increasing access to forest extension services. This was confirmed by villagers during village-level discussions, which noted that around Ruvu South, the local government extension officers have to address multi-disciplinary issues, due to shortage of staff. The implication is that extension messages conveyed to farmers are more general than specific to a particular discipline.

In Rufiji, reported access to various extension services was equally poor. On average only 14% of farmers reported having access to agricultural extension services and 2% to livestock services. About 3% reported being without access to veterinary services. In terms of forest extension services, the situation in Rufiji was even better than in Ruvu South. On average, about 48% reported that they had access to forestry extension services. This situation is attributed to efforts by WWF Tanzania, which has had several programmes in the area including some for facilitating the establishment of CBFM arrangements (see plate 1). While CBFM has been successful in Rufiji, it has collapsed in Ruvu South.

Table 9: Access to various extension services

Study sites	Ruvu South				Rufiji (comparison)		
	Bokomnemela	Kipangege	Kisanga	Overall	Mbwara	Nambunju	Overall
	f (%) N = 55	f (%) N = 55	f (%) N = 40	f (%) N = 150	f (%) N = 75	f (%) N = 75	f (%) N = 150
Access to agricultural extension services							
- Yes	18 (33)	27 (49)	5 (12)	50 (33)	15 (20)	6 (8)	21 (14)
- No	37 (67)	28 (51)	35 (88)	100 (67)	60 (80)	69 (92)	129 (86)
Total	**55 (100)**	**55 (100)**	**40 (100)**	**150 (100)**	**75 (100)**	**75 (100)**	**150 (100)**
Access to livestock extension services							
- Yes	1 (2)	4 (7)	0 (0)	5 (3)	0 (0)	3 (4)	3 (2)
- No	54 (98)	51 (93)	40 (100)	145 (97)	75 (100)	72 (96)	147 (98)
Total	**55 (100)**	**55 (100)**	**40 (100)**	**150 (100)**	**75 (100)**	**75 (100)**	**150 (100)**
Access to veterinary extension services							
- Yes	3 (5)	3 (5)	0 (0)	6 (4)	2 (3)	2 (3)	4 (3)
- No	52 (95)	52 (95)	40 (100)	144 (96)	73 (97)	73 (97)	146 (97)
Total	**55 (100)**	**55 (100)**	**40 (100)**	**150 (100)**	**75 (100)**	**75 (100)**	**150 (100)**
Access to forestry extension services							
- Yes	16 (29)	21 (38)	12 (30)	49 (33)	36 (48)	36 (48)	72 (48)

Study sites	Ruvu South				Rufiji (comparison)		
	Bokom-nemela	Kipangege	Kisanga	Overall	Mbwara	Nambunju	Overall
	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)
	N = 55	N = 55	N = 40	N = 150	N = 75	N = 75	N = 150
- No	39 (71)	34 (62)	28 (70)	101 (67)	39 (52)	39 (52)	78 (52)
Total	**55 (100)**	**55 (100)**	**40 (100)**	**150 (100)**	**75 (100)**	**75 (100)**	**150 (100)**
Access to wildlife extension services							
- Yes	9 (16)	16 (29)	10 (25)	35 (23)	11 (15)	11 (15)	22 (15)
- No	46 (84)	39 (71)	30 (75)	115 (77)	64 (85)	64 (85)	128 (85)
Total	**55 (100)**	**55 (100)**	**40 (100)**	**150 (100)**	**75 (100)**	**75 (100)**	**150 (100)**
Access to health extension services							
- Yes	16 (29)	26 (47)	18 (45)	60 (40)	14 (19)	18 (24)	32 (21)
- No	39 (71)	29 (53)	22 (55)	90 (60)	61 (81)	57 (76)	118 (79)
Total	**55 (100)**	**55 (100)**	**40 (100)**	**150 (100)**	**75 (100)**	**75 (100)**	**150 (100)**

4.2.6 Access to credit facilities

Access to credit facilities was generally poor in both study areas. In the villages adjacent to the Ruvu South area, only one village (Kipangege) had farmer's credit facility (SACCOS), which was operational, but with limited capital. These were constant credit constraints in both study areas. Formal credits from banks and other financial institutions are not available at all in the survey villages. Villagers complained of low capital availability in all economic activities. This indicates a need for more training and awareness of farmer's credit facilities.

4.3 Forest Product Utilization

Forest product utilisation patterns were examined on the basis of collection and use, mode of access and sources of forest products. The data is summarised in Table 10.

Table 10: Forest products utilisation

Study sites	Ruvu South				Rufiji (Comparison)		
	Bokom-nemela	Kipan-gege	Kisanga	Overall	Mbwara	Nam-bunju	Overall
	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)
	N = 55	N = 55	N = 40	N = 150	N = 75	N = 75	N = 150
(i) Collection and use of forest products							
- Yes	40 (73)	54 (98)	40 (100)	134 (89)	42 (56)	46 (61)	88 (59)
- No	15 (27)	1 (2)	0 (0)	16 (11)	33 (44)	29 (39)	62 (41)
Total	**55 (100)**	**55 (100)**	**40 (100)**	**150 (100)**	**75 (100)**	**75 (100)**	**150 (100)**
(ii) Mode of access to forest products							
- Legal	51 (93)	52 (95)	35 (88)	138 (92)	66 (88)	74 (99)	140 (94)

Study sites	Ruvu South				Rufiji (Comparison)		
	Bokom-nemela	Kipan-gege	Kisanga	Overall	Mbwara	Nam-bunju	Overall
	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)
	N = 55	N = 55	N = 40	N = 150	N = 75	N = 75	N = 150
- Illegal	4 (7)	3 (5)	3 (7)	10 (7)	4 (5)	1 (1)	5 (3)
- Both legal and illegal	0 (0)	0 (0)	2 (5)	2 (1)	5 (7)	0 (0)	5 (3)
Total	**55 (100)**	**55 (100)**	**40 (100)**	**150 (100)**	**75 (100)**	**75 (100)**	**150 (100)**
(iii) Source of forest products							
- Own land	24 (44)	20 (36)	14 (35)	58 (39)	22 (29)	13 (17)	35 (23)
- Public land	14 (25)	34 (62)	25 (63)	73 (49)	36 (48)	42 (56)	78 (52)
- Forest reserve	5 (9)	1 (2)	0 (0)	6 (4)	0 (0)	3 (4)	3 (2)
- Other forest areas	12 (22)	0 (0)	1 (2)	13 (8)	17 (23)	17 (23)	34 (23)
Total	**55 (100)**	**55 (100)**	**40 (100)**	**150 (100)**	**75 (100)**	**75 (100)**	**150 (100)**

All households utilize forest products. Village level discussions in Ruvu South revealed that the collected forest products were the following (in order of importance): charcoal, firewood, building poles, timber, withies and ropes. Discussions with village government and key informants their perception that around Ruvu South Forest Reserve about 70% of forest-products collection was illegal. This result is supported by the high level of destruction observed in the reserved forests in Ruvu South. However, the percentage of households admitting that they collected products illegally was very low (only 7% for Kibaha and 3% for Rufiji). The plausible explanation to this situation is that due to the illegal nature of the activity, respondents were hesitant to report the truth. Alternatively, outsiders could be behind a sizeable part of the destruction, but with some facilitation from local/village level agents. It is the opinion of the team that both explanations are relevant especially in Ruvu South, where most of the charcoal produced illegally is transported to urban areas and charcoal makers in the villages admitted that they were partly financed by big charcoal traders from nearby towns.

In Rufiji the reported forest products collected in order of importance were firewood, poles, withies, timber, vegetables, thatch grass, medicines and charcoal. It was interesting to note that charcoal which was priority number one in Ruvu South was last in Rufiji. Although Rufiji District supplies substantial amounts of charcoal to Dar es Salaam, most of it comes from the northern part of the district (the study areas were further south). Unlike Ruvu South where the village interviews revealed that about 70% of the collections were illegal, the admitted illegal collection in Rufiji was lower for Mbwara village (10%), but at the level of Ruvu South in Nambunju village (75%). The main reason for the difference is that in Mbwara village CBFM efforts are well established with facilitation from WWF (see plate 1). Mbwara villagers have

more control over surrounding forest resources due to well defined roles and responsibilities of different stakeholders. **Appendix 3** includes some quantitative information regarding forest products utilization.

Plate 1: A signpost showing the location of Mbwara CBFM Area in Rufiji

Quantitative estimates of annual household income generated from sale of forest products are summarized in tables 11(a) and 11(b) (based on households that admitted to be involved in selling forest products). Charcoal as a forest product provides a significant contribution to household income in Ruvu South, this is unlike Rufiji where timber earn households the highest among forest products. It is estimated that the average household income from sale of forest products around Ruvu South is about Tsh 185,946.67 (US$ 123), but only about Tsh 99,642.07 (US$67) in the two study areas of Rufiji. The estimated income reported in Tables 11(a & b) is based on unit prices reported by respondents in the study areas. Income generated by households from sale of agricultural crops is less compared to income from sale of forest produce (Tsh 80,000.00 (US$ 54) in Ruvu South and Tsh 175,000.00 (US$ 117.00) in Rufiji). A plausible explanation for this is that, both study sites reported low yields from farming, giving households little interest in selling their agricultural produce, fetching less income from agriculture. In this regard, forests serve as 'safety net' or 'fall-back' income in time of hardship, including times of poor harvest. As a result households rely on forests as an alternative source of income.

Table 11(a): Household annual income from sale of forest products in Ruvu South

Forest product	Bokom-nemela	Kipan-gege	Kisanga	Average quantity	Average unit price (TAS)	Estimated income (TAS)
Firewood sold (head-load)	34.1	4.89	0	13.00	700.00	9,097.67
Charcoal sold (bag)	13.3	23.29	11.82	16.14	6,700.00	108,115.67
Timber sold (number of planks)	0	41.5	0	13.83	4,000.00	55,333.33
Pole sold (number of poles)	15	50	10	25.00	512.00	12,800.00
Mushroom sold (kg)	0.4	2	0	0.80	750.00	600.00
Total						**185,946.67**

Table 11(b): Income from sale of forest products in Rufiji

Forest product	Mbwara	Nambunju	Average quantity	Average unit price (TAS)	Estimated income (TAS)
Firewood sold (head-load)	2	6.29	4.15	366.00	1,517.07
Quantity of charcoal sold (bag)	0	2.5	1.25	4,500.00	5,625.00
Timber sold (number of planks)	19	6	12.50	4,400.00	55,000.00
Pole sold (number of poles)	100	0	50.00	750.00	37,500.00
Total					**99,642.07**

4.3.1 Tree planting practice and purposes

The villagers in both areas have been engaged in tree planting activities both in their own land and in communal land. They noted several different purposes underlying their planting activities (Table 12). Firewood was the most important among the uses of wood products.

4.4 Housing and Other Household Assets

Information regarding living houses was used to assess the socio-economic status of villagers. Villagers with better roofing, wall and floor materials are expected to be better off economically. For consistency and comparison, the data presented is limited to each household's primary building, as shown in table 13.

Table 12: Purposes of tree planting in the study areas

Study sites	Ruvu South				Rufiji (comparison)		
	Bokom-nemela	Kipan-gege	Kisanga	Overall	Mbwara	Nambunju	Overall
Purpose of tree planting	f (%) N = 55	f (%) N = 55	f (%) N = 40	f (%) N = 150	f (%) N = 75	f (%) N = 75	f (%) N = 150
Firewood for domestic use	23 (27)	8 (21)	15 (35)	46 (28)	11 (16)	6 (10)	17 (13)
Timber/pole for own use	5(6)	8 (21)	14 (33)	27 (16)	15 (21)	1 (2)	16 (12)
Timber/pole for sale	8 (10)	0 (0)	0 (0)	8 (5)	0 (0)	0 (0)	0 (0)
Fodder for own use	12 (14)	6 (16)	7 (16)	25 (15)	14 (20)	0 (0)	14 (11)
Fodder for sale	4 (5)	2 (5)	0 (0)	6 (4)	0 (0)	4 (6)	4 (3)
Other domestic use	16 (19)	10 (26)	0 (0)	26 (16)	0 (0)	19 (30)	19 (14)
Other products for sale	3 (4)	0 (0)	6 (14)	9 (5)	4 (6)	16 (25)	20 (15)
Other env'l services	7 (8)	1 (3)	0 (0)	8 (5)	15 (21)	8 (13)	23 (17)
Land demarcation	6 (7)	3 (8)	1 (2)	10 (6)	11 (16)	9 (14)	20 (15)
Total	**84 (100)**	**38 (100)**	**43 (100)**	**165 (100)**	**70 (100)**	**63 (100)**	**133 (100)**

About 92% of households around Ruvu South owned living houses compared to 90% in Rufiji. In Ruvu South, about 60% had roofs of corrugated iron sheets, compared to only 33% in Rufiji. In Ruvu South, 27% had dilapidated thatch grass roofs, compared to 39% in Rufiji. In the opinion of the team, this does not really reflect more poverty in Rufiji, but limited access to iron sheets due to longer distances and high transport costs from the sources (Ikwiriri town and Dar es Salaam). An average of only about 41% of rural households are using corrugated iron sheets nationally, while about 48% use thatched grass (2007 National Household Budget Survey). Ruvu South households are thus above the national average.

In both areas the walls were made up of poles and mud and the floor of most households both in Kibaha and Rufiji had no cement. Average-income households can afford to purchase iron sheets, although they cannot afford to or do not prioritise use of cement walls and floor. The main construction materials for the walls were poles and withies often tied together by metal nails or wild ropes. The high dependence on poles and withies for house construction implies substantial pressure on the existing forests for these materials.

Other household assets that were owned by household heads included radios, chairs, tables, watches, mobile phones, beds, kitchen utensils, mosquito nets, charcoal iron and bicycles. Table 14 presents the percentages of household heads with these assets from both study areas and compared with the estimated national average for rural areas in Tanzania, according to the 2007 National Household Budget Survey.

Table 13: Housing standards

Study sites	**Ruvu South**				**Rufiji (comparison)**		
	Bokom-nemela	**Kipan-gege**	**Kisanga**	**Overall**	**Mbwara**	**Nam-bunju**	**Overall**
	f (%)	**f (%)**	**f (%)**	**f (%)**	**f (%)**	**f (%)**	**f (%)**
	N = 55	**N = 55**	**N = 40**	**N = 150**	**N = 75**	**N = 75**	**N = 150**
(i) Living house holdings							
- Yes	51 (93)	47 (85)	40 (100)	138 (92)	72 (96)	63 (84)	135 (90)
- No	4 (7)	8 (15)	0 (0)	12 (8)	3 (4)	12 (16)	15 (10)
Total	**55 (100)**	**55 (100)**	**40 (100)**	**150 (100)**	**75 (100)**	**75 (100)**	**150 (100)**
(ii) Roof materials							
- Iron sheet	43 (78)	28 (51)	20 (50)	91 (61)	20 (27)	30 (4)	50 (33)
- Well maintained thatched grass	4 (7)	9 (16)	5 (13)	18 (12)	25 (33)	16 (21)	41 (27)
- Dilapidated thatched grass	8 (15)	18 (33)	15 (38)	41 (27)	30 (40)	29 (39)	59 (39)
Total	**55 (100)**	**55 (100)**	**40 (100)**	**150 (100)**	**75 (100)**	**75 (100)**	**150 (100)**
(iii) Wall materials							
- Burnt bricks with plaster	4 (7)	0 (0)	0 (0)	4 (3)	0 (0)	0 (0)	0 (0)
- Burnt bricks without plaster	0 (0)	2 (4)	1 (3)	3 (2)	0 (0)	1 (1)	1 (1)
- Mud walls with plaster	3 (5)	2 (4)	3 (8)	8 (5)	2 (3)	2 (3)	4 (3)
- Mud bricks without plaster	3 (5)	7 (13)	2 (5)	12 (8)	1 (1)	2 (3)	3 (2)
- Well constructed poles and mud	30 (55)	23 (42)	12 (30)	65 (43)	32 (43)	42 (56)	74 (49)
- Poorly constructed poles and mud	15 (27)	21 (38)	22 (55)	58 (39)	40 (53)	28 (37)	68 (45)
Total	**55 (100)**	**55 (100)**	**40 (100)**	**150 (100)**	**75 (100)**	**75 (100)**	**150 (100)**

Study sites	Ruvu South				Rufiji (comparison)		
	Bokom-nemela	Kipan-gege	Kisanga	Overall	Mbwara	Nam-bunju	Overall
	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)
	N = 55	N = 55	N = 40	N = 150	N = 75	N = 75	N = 150
(iv) Floor material							
- Cement	14 (25)	5 (9)	2 (5)	21 (14)	4 (5)	8 (11)	12 (8)
- No cement	41 (75)	50 (91)	38 (95)	129 (86)	71 (95)	67 (89)	138 (92)
Total	**55 (100)**	**55 (100)**	**40 (100)**	**150 (100)**	**75 (100)**	**75 (100)**	**150 (100)**

Table 14: Ownership of other household assets

Asset	Average % Ruvu South	Average % Rufiji	Average % National (rural)
Radios	65	56	62.2
Chairs.	80	90	76.6
Tables	70	65	63.6
Watches	30	40	39.5
Mobile phones	10	15	13.9
Beds	100	100	89.5
Kitchen utensils	100	100	93.7
Mosquito nets	40	35	61.3
Charcoal iron	15	20	18.4
Bicycles	35	30	45.4
Motorcycles			1.2

Respondents from both study areas were above the estimated national average in terms of ownership of some of the above assets and lower on others. It is interesting to note the ownership of bicycles by at least 35% of households in Kibaha. Transporting crops and especially charcoal to market is one of the main reasons for owning bicycles. Ownership of mosquito nets is also relatively high in both sites because of recent anti-malaria campaigns through which pregnant mothers get nets at subsidized prices. The increasing use of mobile phones around Ruvu South area has prompted TaTEDO to propose and initiate the introduction of simple mobile phone chargers which use solar energy in the area. This is because substantial travel time is currently spent by household's members to charge their mobile phones in areas where there is electricity. If such chargers are introduced the time saved could be used more productively.

4.5 Awareness of Improved Stoves and Energy Saving Cooking Methods

Inquiries into villagers' awareness of the existence of improved stoves, yielded varying answers even within the same study area. In Ruvu South for example, 78%

of respondents from Kipangege Village were aware, while only 35% from Bokomnemela answered affirmatively. This is most likely because TaTEDO staff had already initiated awareness visits and PR related to the improved stoves in Kipangege, but not in Bokomnemela. In the two study sites in Rufiji the majority of villagers were unaware (93% for Nambunju and 60% for Mbwara) of improved stoves. Mbwara is more exposed to the outside world and has more immigrants compared to Nambunju. Some of the respondents who were aware stated that they got information from various media, including newspapers and radio programmes.

About 60% of households in both study areas do their cooking outside the living house, except for the rainy season when most of the cooking is done indoors. This preference for outside cooking is partly due to the small size of most of the living houses. More than 80% of households in both sites use traditional three-stone stoves for cooking. However, in Kipangege (Ruvu South) where awareness-raising for TaTEDO initiatives had already been done, a few households had installed improved stoves (Plate No 2 & 3), but these were not regularly used, because villagers had only recently been through TaTEDO's awareness-building meetings for improved stoves. The stoves were part of the demonstrations supported by TaTEDO as part of their scaling up strategies. More demonstrations and time will be needed to change farmers' attitudes and practices in favour of the improved stoves.

Plate 2 and 3: Improved stoves in Kipangege village, Ruvu South

4.6 Common diseases and Access to Health Services

Around Ruvu South Forest Reserve, all the three villages are served by one dispensary which is located close to the Ward headquarters at Soga. As a result, the percentage of respondents who reported having no access to health extension services (Table 9) was on overall average lower (60%) around the target area. The dispensary is relatively poorly stocked in terms of medicines but it has a medical assistant (who makes prescriptions), as well as nurses and clinic attendants. After prescriptions, most patients must purchase medicine in medical stores in nearby suburban areas. This is very costly given the farmers' low levels of income. However, some medicines for common diseases like malaria and dehydration caused by diarrhoea are available in the dispensary. Patients (with the exception of children under 5 and very elderly people) have to contribute some cash to cover part of costs for medical services.

The most common diseases reported in the area are summarised in Table 15. The table also provides district-level information on the severity of the reported diseases, by age categories.

Malaria is the leading cause of out-patient attendances. The disease occurs through most of the year but becomes more prevalent during rainy seasons. Other diseases commonly affecting both under and above five year age classifications are pneumonia, acute respiratory diseases, diarrhoea, intestinal worms and anaemia. Some of these diseases are known to be related to smoky cooking environments, but most villages did not associate the two. Respiratory and eye infections were often related to seasonal changes of weather patterns.

Table 15: Main out-patient diagnoses around Ruvu South

SN	DIAGNOSIS	% for < 5yrs	% for 5+ years%	% for all ages
1	Malaria	45.6	47.6	47.0
2	Acute respiratory diseases	11.5	17.9	16.0
3	Pneumonia	11.3	6.2	7.8
4	Diarrhoea	6.0	5.1	5.4
5	Intestinal Worms	4.4	4.3	4.3
6	Anaemia	2.3	2.2	2.2
7	Urinary tract disease	5.2	3.5	4.0
8	Eye infection	7.8	3.9	5.1
9	Skin infection	5.9	3.1	3.9
10	Sexually transmitted diseases	-	6	4.3
	TOTAL	**100**	**100**	**100**

Source: Kibaha District Profile

In Rufiji, the survey villages had no dispensary or health service. An average of 40% of the respondents travelled as much as 2 km for health services. Most of the diseases reported in Ruvu South were also found in Rufiji. The following were the main health problems in order of importance in Rufiji: malaria, anaemia, respiratory tract infections, eye infections, skin diseases, worms, diarrhoea, pneumonia, nutritional disorders, dysentery, ear infections and water borne diseases. In Rufiji, reported prevalence of sexually transmitted diseases including HIV/AIDS are on the increase. For example in Nyamwage (not part of this survey) where there is a HIV screening facility, it was reported that HIV cases are one-third of the frequency found in the study villages. This suggests a need for education and counselling campaigns.

5. Environmental Baseline 2009

As generally observed, forests in both study areas were disturbed by a variety of human activities, including charcoal making, firewood collection, encroachment and hunting of wild animals. The forest reserve in Ruvu South was more severely disturbed than the Rufiji area. This is attributed to the lack of serious efforts to protect the reserve. During its work, the study team met with charcoal makers working outside charcoal making kilns (Plates 4 & 5) in the middle of the forest, and found piles of harvested poles and withies awaiting transportation. All the kilns used for production of charcoal in the area are traditional earth kilns with very low efficiency. According to Malimbwi and Zahabu (2007), data from twenty-one sampled kilns in Kitulangalo forests around Morogoro revealed a mean traditional kiln efficiency of 19.1% (and individual efficiency ranging from 11-30%). This finding aligns with those reported by Chidumayo (1991), Sawe & Meena, (1994) and Kaale (1998)), which rated charcoal kiln efficiency from 10-20%. Improved kilns promoted by TaTEDO have the potential of increasing efficiency range to 65-100%.

Plates 4 and 5: Fresh and burning charcoal kilns inside Ruvu South Forest Reserve

There was no functioning Joint Forest Management (JFM) system in Ruvu South, which could have stipulated the rights and responsibilities of the government and the local community. Lack of such a system creates a vacuum enabling current levels dysfunction between forest-management and private forest use. If the present trend continues, the Ruvu South Forest Reserve will diminish or be destroyed within a very short period of time.

There are three main categories of charcoal producers: full time, seasonal and occasional. Full time producers live within the forest areas and produce charcoal throughout the year, shifting to new areas when the sources become depleted.

Seasonal producers practice agriculture as their main occupation and produce charcoal only in off-farming periods. Occasional producers make charcoal to meet specific cash needs during the year. This category includes those who make charcoal in the process of land clearing for agriculture.

According to Malimbwi & Zahabu (2007), annual household income of communities adjacent to the Morogoro – Dar es Salaam highway in the Coast Region have increased from US$ 176 to 645 in the ten year period from 1992 to 2002 (Table 16). About 75% of farmers in charcoal producing areas of this region had charcoal as an important source of income.

Table 16: Estimated household income from charcoal in Eastern Tanzania (1992 – 2002)

Year of study	Household income/year (US$)	Source
1992	176	Monela *et al.* 1993
2000	445	Monela *et al.* 2000
2002	645	CHAPOSA 2002

This income from charcoal was found to be above the minimum wage paid to most private sector and government employees during the 1992-2002 period, thus attracting more people to engage in charcoal making. Migration to charcoal producing areas is a common phenomenon. Charcoal-making requires neither formal education nor large capital investment, although it is time consuming and labour intensive. In eastern Tanzania, 40% of the charcoal-makers have no formal education (CHAPOSA, 2002). The required labour is usually drawn from household members or other producers collaborating for specific tasks in the production process.

5.1 Analysis of Specific Parameters from Environmental Audit

Appendix 5 summarises the descriptive statistics for the studied parameters in the plots during the environmental audit survey. The next sub-sections briefly analyse and discuss the main parameters to provide an impression of environmental status of the studied areas.

5.1.1 Altitude, forest types and climate

In Tanzania, coastal forests (not including the mangrove forests) are found from sea level up to 600 MASL and up to 200 km inland from the coast. For this study, transects for environmental audit were established in three distinct areas, namely: in Ruvu South Forest Reserve, in Kipangege village land Forest Reserve, and in the Namakutwa-Namuete Forest Reserve (Rufiji area). Forest altitudes ranged from 154 to 246 with a mean of 189 as Ruvu South. The mean altitude in the Rufiji areas was about 248 MASL. Both areas are located along the coastal area of Tanzania with relatively low altitudes compared to the central and northern parts of the country. During the survey, the climate in both sites was characterised by commencement of the short rainy season, with some indication of regeneration after the long dry spell.

5.1.2 Ownership and utilization of forests

Most forest land in Tanzania is state-owned forest reserves, except for "village land" (including "VLFRs") – a separate category of land tenure/ownership – which is owned and administered by village level governments, in consultation with village councils and general village assemblies. The Kipangege VLFR represents 9% of the total number of plots sampled. The remaining 91% of plots were located in government-owned forest reserves in Ruvu South and Rufiji. The team found that the state-owned forest reserves (e.g. Ruvu South) were exposed to more severe degradation than the South Ruvu VLFR.

5.1.3 Canopy closure

Canopy closure often serves as an indicator of the level of forest disturbance. Undisturbed forests, especially 'montane forests' are expected to have higher percentage of canopy closure than lowland forests. The Ruvu South (government-controlled) Forest Reserve had an average of 18% canopy closure, the Rufiji Government Reserve was about 54%, while the Kipangege VLFR had a mean closure of 38%. The low numbers in Ruvu South FR are explained by illegal cutting activities. Villagers in Kipangege have instituted strict rules and penalties against forest destruction in the VLFR, which thus is regenerating rapidly.

5.1.4 Forest inventory data

Forest stocking parameters, including tree density, tree volume, seedling density and basal area (i.e. cross section of tree trunks at their base), are provided in Table 17. The Kipangege village land forest reserve contains the highest number of stems per unit area (Table 17). One plausible explanation is that Kipangege VLFR was formerly highly disturbed, stimulating regeneration, leading to a high stem density. Currently, Kipangege village is determined to protect the Kipangege VLFR, which was once severely degraded, for future sustainable use.

The higher stem density per hectare in the regenerating VLFR was balanced by small stem sizes (on the basis of diameter at breast height); resulting in a low stand volume (3.15m3/ha) for Kipangege as compared to the Rufiji area where the stems are few, but of much greater diameter, resulting in a relatively higher volume (5.8m3/ha). A 2007 study by Malimbwi and Zahabu showed that, in general, forests public land had higher mean stem numbers per ha, but lower mean basal area and volume per ha than the woodland in the reserve land around Kitulangalo forests in Morogoro, where the large number of stems indicated increased levels of exploitation, which led to increased regeneration. This explains why the volume and basal-area parameters in the forest reserve (FR) in Ruvu South were not significantly different from the regenerating VLFR.

Since stem density in Ruvu South FR is higher than in Namakutwa-Namuete FR, this implies that Namakutwa-Namuete FR is less disturbed than Ruvu South Forest Reserve. It is very likely that the marketing of charcoal and firewood in Dar es Salaam which is very near to Ruvu South, is the key driver for forest exploitation in that area.

Stocking in terms of basal area and volume of standing tree crop is generally poor in Kipangege VLFR and Ruvu South forest reserve (FR) compared to Namakutwa-Namuete FR. However, there are patches of relatively untouched forest in the southern parts of Ruvu South FR, which are comparable to Namakutwa-Namuete FR. Poor stocking in basal area and volume of standing crop imply absence of trees with reasonable diameter at breast height (dbh). The analysed and summarised data from all the plots where forest inventory was conducted is appended to this report in **Appendix 6**.

5.1.5 Magnitude and types of human disturbances

The magnitude of human disturbances was categorised as either high, average, low or none. Many plots in the surveyed areas had high or average levels of disturbance. Some plots in the innermost cores of the forests had no disturbance, but this study indicates that Ruvu South and Kipangege VLFR are highly disturbed compared to Rufiji. Unlike Ruvu South, which is greatly affected by charcoal-making (an activity requiring clear-cutting of trees and shrubs including saplings), the highest level of disturbance in Rufiji is attributed to fire.

Table 17: Tree stocking of the studied areas

Parameters	Mean values from the three sites		
	Ruvu South Forest Reserve	Kipangege VLFR	Rufiji site
Tree density (Stems/ha)	61.25	194.67	32.56
Basal Area (m^2/ha)	0.56	0.57	0.76
Volume (m^3/ha)	3.85	3.15	5.80
Seedling density (count/plot)	12.50	40.33	44.06

5.1.6 Terrain type and soil erosion

Most of the plots in Ruvu South and Kipangege covered either flat terrain or gently sloping land. This was generally true in Rufiji, but about 10% of the Rufiji plots were located on rather steep slopes. Regarding soil erosion, minor sheet erosion was observed in about 30% of the plots in Ruvu South and 20% in Kipangege.

5.1.7 Signs and evidence of wild animals

These were signs of wildlife in about 42% of the plots in Ruvu South, 87% of the plots in Rufiji and in all of the three plots in the Kipangege VLFR. The main evidence of wild animals were animal footsteps, droppings and sighting in Rufiji, while in Ruvu south and Kipangege it was mostly droppings. This suggests that there are more wild animals in Rufiji site compared to Ruvu South area, as a result of lower levels of human disturbance.

5.2 Wood Fuel Demand and Environmental Destruction

5.2.1 Charcoal consumption in Dar es Salaam city

Fuel-wood accounts for 92% of the primary energy consumed. Petroleum and electricity account only for 7% and 1 % respectively (Ishengoma & Ngaga, 2001). Most of the industrial wood energy is consumed by small-scale industries which

include food processing/service sectors (brewing, fish smoking, salt production, baking, restaurants, schools, hospitals and food vending), agro-processing industries (tobacco curing, tea drying and beeswax processing), and production of building materials (burnt bricks, lime, pottery and ceramics) and their producers (blacksmiths and foundries). These industries and activities (while directly relying on wood energy) provide employment and income for rural people particularly during off-season in the agricultural cycle. A recent study found that about 76% of the charcoal commercial dealers started their businesses between 2005 and 2007, of which 34% started during the year 2007 (Malimbwi & Zahabu, 2007). Most were attracted to this business due to their need for alternative income generating activities, the increase in charcoal demand and price, the low initial capital and running costs of charcoal-making and the fact that it is a very fast paying business. The study noted that charcoal production had degraded 24.6 % of closed woodland and 50.8% of open woodland around Dar es Salaam.

Tanzania's energy policy of 1997 emphasises the development and use of indigenous energy sources such as bio-energy, coal, natural gas and hydropower. (URT, 1997.) Less than 2% of the energy development budget is allocated to wood energy programmes, however, and fuel wood is still regarded as a minor forest product with little market value. (URT, 2001.) The majority of wood-fuel consumers cannot afford the high investment costs associated with alternative commercial energy sources (Moyo *et al*., 1993). Availability, reliability of supply and cheaper prices render wood fuels preferable to alternative sources of energy.

Several researchers have concluded that, based on the present economic forces, the majority of urban population in Tanzania will continue to depend on wood fuel for the foreseeable future (Moyo *et al*., 1993; URT, 1998; Luoga *et al*., 2000). Due to the anticipated steady increase in population at 2.8%/year, the rate of actual consumption of firewood and charcoal is expected to increase considerably, putting stress on natural forests, possibly resulting in deforestation of the forest ecosystems. Studies have shown that charcoal production in the past have contributed to large-scale deforestation in Tanzania. Further, they indicate that tree species suitable for charcoal production have been depleted at the roadsides, so that the average distance to charcoal production sites has increased and tree cover has decreased in areas where charcoal making is practiced (Malimbwi and Zahabu, 2007). Such observations have wide policy implications, given the increased charcoal from the growing urban population with limited reliable and affordable alternative sources of energy.

It is estimated that charcoal is consumed by 94% of the households, either alone or mixed with other fuels. Only 6% of the households do not use charcoal. About 78% of households in Dar es Salaam city use charcoal as their first energy source choice (Table 18).

A 2005 study of wood fuel consumption in Dar es Salaam city and Morogoro Municipality (Mbwambo *et al*.) estimated that about 4,900,980 bags (137,227 tons) of charcoal weighing 28 kg/bag and 7,261 m3 of firewood were supplied to Dar-es-Salaam Region for the previous five years via four the main natural resource

checkpoints (Mbagala, Kibaha, Gongo la Mboto and Boko). Morogoro, which is only about 200 km west of Dar es Salaam, has supplied a total of 225,177 bags (6,300 tons) of charcoal weighing 28 kg/bag and a total of 1,478.13 m3 of firewood between 2001 and 2004 alone. The study estimated that about 82,358 trees were harvested from more than 2,000 ha of woodlands and forests for this charcoal production. This is something of an underestimation, as the checkpoints do not record charcoal and firewood transported by bicycles.

The period between 2003 and 2004 witnessed an increase in charcoal and firewood supplied to Dar-es-Salaam, a period that coincided with the introduction of new and higher electricity tariffs. For example, the study estimated that about 45% of respondents in Morogoro urban area, and 44% in Kinondoni District in Dar es Salaam used combinations of charcoal, electricity and kerosene as their sources of energy. Charcoal and electricity combination was used by 34% and 37% of Morogoro, and Kinondoni residents respectively. Revised power tariffs structure reduced subsidies on electricity from 100 to 50 units, at 30 Tsh each in year 2004, which caused the customers to use a combination of energy sources.

A recent study commissioned by WWF Tanzania (Malimbwi *et al*., 2007) estimated that 6 777 bags of charcoal (approximately 56 kg each) enter the city at check points every day, while the actual amount of charcoal consumed per day in Dar es Salaam was estimated to exceed 28 000 bags. Contrary to observations by CHAPOSA (2002), approximately 50% of the charcoal currently consumed enters the city through Kilwa road, while about 24% comes in over Morogoro road. Previous studies indicated that charcoal production for Dar es Salaam city occurred primarily in the Coast and Morogoro Regions, and that the range of actual areas of production had changed from 50 km radius in the 1970s to about 200 km in the 1990s (van Beukering *et al*., 2007). Clearly, the significant increase in the distance to charcoal sources signals fuel scarcity within the closer ranges of the city.

Table 18: Household fuel preferences in Dar es Salaam (1991/92, 2000/01 and 2007)

Type of fuel	Percentage preference		
	1991/92	2000/01	2007
Charcoal	51	69	78
Kerosene	28	25	13
Electricity	15	4	5
Firewood	1	2	4

Source: CHAPOSA (2002) and Malimbwi *et al.* (2007)

The Malimbwi study also concluded that there has been a 12% reduction in the use of kerosene between 2001 and 2007. In the same period, users of charcoal as a primary source of energy increased from 69% to 78%., while the percentage of users for whom electricity is their first choice has remained constant, firewood use has increased by 2-4%.

Assuming a current population of 3 million people in Dar es Salaam, and an average household size of 4.2, the total number of households is 714 286. Based on the conclusion that charcoal is the primary source of energy for 78% of households, it appears that 521 429 households use 22 526 bags of charcoal daily in Dar es Salaam. This exerts a great pressure to nearby forests, including the Ruvu South Forest Reserve.

Apart from the households, charcoal is also the major source of energy for various institutions/organisations. The quantity of charcoal consumed per day depends on the number of persons served and the level of energy mix. Table 19 shows the amount of charcoal used by various institutions/organisations to prepare one hot meal.

Table 19: Amount of charcoal estimated to prepare one hot meal

Organisation	Amount of charcoal used to prepare one hot meal
Hotels, bars and small scale food vendors	3 bags for 1 000 persons
Schools	1 bag for 150 students
Hospitals	1 bag for 200 patients
Army camps	2 bags for 1 000 army staff

Based on the above analysis, the estimated total charcoal consumption in Dar es Salaam is at 28 759 (56-kg) bags per day (Table 20). Due to population increase and the increase on the percentage of households using charcoal as the first choice fuel, the recent estimates (Malimbwi and Zahabu, 2007) seem to be more realistic than other recent studies (CHAPOSA 2002 estimated 24 576 bags while van Beukering et al. (2007) estimated 24 951 bags, assuming constant consumption since 2002), despite the crude estimation especially of the consumption by organisations.

Table 20: Estimated daily consumption of charcoal in Dar es Salaam

Organisation	Amount of charcoal (bags of 56 kg/day)		
	This study (2007)	CHAPOSA (2002)	van Beukering *et al.* (2007)*
Households	22 526	18 158	
Hotels, bars and food vendors	4 200	8 047	
Schools	2 000	8	
Hospitals	25	2	
Army		8	
Total	**28 759**	**26 215**	**24 951**

*Based on 2005 estimate of 17 million bags of 30 kg per year

5.2.2 Impact of charcoal demand on forest resources

According to CHAPOSA (2002), charcoal production was responsible for degradation of 29 268 ha (24.6%) of closed woodland, and for the deforestation of 116 069 ha (23 308 ha of closed woodland and 92 761 ha of open woodland) in the catchment area that supplied charcoal to Dar es Salaam City. Where there is bush-land in that area, most of it is regenerating from coppice, indicating that trees had been cut (most probably for charcoal production.)

A number of other factors, however, also play important roles in influencing the trend of woodland development in current and previous charcoal-production areas. Woodlands used for charcoal production would normally regenerate by coppicing and recruitment from stunted saplings, if there is no further disturbance, increasing the potential of the area to supply charcoal over a much longer time period. According to Hosier (1993) woodlands appear to recover relatively well following harvesting for charcoal production. Human disturbances, such as grazing, frequent fires and extended cultivation periods may prolong the recovery period

After removal or death of the above-ground parts of the trees, most woodland stumps produce sucker shoots. During the establishment period, the number of shoots through inter-shoot competition, so that only dominant shoots contribute to the next generation of woodland re-growth. Sucker shoots grow relatively faster than shoots of stunted old seedlings, because stumps retain their well-developed root systems after tree cutting. However, the rate of stem-height growth in re-growth woodland declines after 5–6 years and remains extremely slow thereafter (Chidumayo, 1993).

Compounding the problem, demand and supply of charcoal changed markedly. Population growth for Dar es Salaam city has been estimated at about 6% per annum (National Bureau of Statistics 2002). In 2006, the Ministry of Natural Resources and Tourism temporarily banned harvesting of forests for charcoal production. This reduced the charcoal supply and correspondingly increased demand and the price on the consumer side. On the supply side, a price increase reflected the fact that producers were taking a legal risk by making charcoal illegally. Even after the ban was lifted, prices remained high because distances to charcoal sources and costs of transportation had increased. Forests on the outskirts of the city had been depleted, forcing traders to fetch charcoal farther from Dar es Salaam.

6. Environmental Integration in Overall Portfolio

The Terms of Reference of this assignment refers to several recent studies of bilateral assistance, which indicate that "environment" has not been properly integrated as a cross-cutting issue in bilateral development assistance. Norway's 2004-05 aid statistics state that only 15-20% of the budget for the Norwegian development cooperation in general relates to environmental assistance, whether using a definition of environment as "general environment" (DAC-code 410), or assistance where environment is the main or an important purpose".

The study on inclusion of environmental concerns into general development assistance was a part of the Tanzania country case study. The standards against which the assessments were made are the Norwegian development assistance policies, including the Norwegian Action Plan for Environmental Support in Development Cooperation during 2007-2015.

The selected projects are non-explicit environmental in character. The projects were purposely selected in sectors/areas in which environmental aspects are essential, like agriculture, road construction, oil exploration and general budget support. The selected projects are also relatively large, since it is mandatory to carry out appraisals, which include environmental issues for projects above NOK 15 million (Norad's Manual).

The resource constraints of the study only enabled the coverage by a random sample of 5-10 per cent of relevant projects implemented in Tanzania in 2007-2008. The study was undertaken as a light desk review of the archive files at the Norwegian Embassy in Dar es Salaam. The projects selected for desk review in Tanzania were:

- Songwe -Tunduma Road Rehabilitation (TAN-99/318)
- National Archives, Petroleum Database (TAN-05/016)
- Rural Roads (TAN-02/230)
- General budget support-Poverty Reduction (TAN-07/39)
- PANTIL 1. Agriculture, Sokoine University (TAN-05/053).

The team's findings are presented below:

6.1 Songwe-Tunduma Road Rehabilitation (TAN-0015/ TAN-99/318)

The goal of this project is to rehabilitate 70 kms of the Tan-Zam highway in Mbozi District of Mbeya Region. The project activities include road base compacting, asphalt surfacing, road camps, diversion roads, earthworks, road shoulders,

culverts, side drains, road marking, guard rails, surveys, health education for workers, including condom distribution to retard the spread of HIV/AIDS, and more.

The project contract documents comprise a section about environmental oriented activities. This includes landscape preservation, preservation of trees and scrubs, prevention of water pollution, abatement of air pollution, noise abatement, light abatement disposal of waste materials and cleanup. The construction consultant's report covering these works seems to be incomplete in the sense that it basically states that each item was taken care of, without giving any specification or proof to that effect. Neither was there any indication on file that supervision of these environmentally related tasks had been carried out.

6.2 National Archives: Petroleum Database (TAN-0094/ TAN-05/016)

The objective of this project is to enhance the capacity of the National Archive of Petroleum Data in Tanzania Petroleum Development Corporation (TPDC) to transcribe, store and manage all relevant petroleum data which the upstream petrol industry needs in order to operate efficiently in Tanzania. The Norwegian Petroleum Directorate has been a key advisor and contributor to the establishment of this archive.

The archive project includes seismic data tapes and other data storage, construction of adequate office space, professional training and consultancies in operation, marketing, sales, distribution, information, and regional cooperation including also Mozambique.

The Frame Agreement between Norad and the Norwegian Petroleum Directorate of 2000, mentions under "technical support" that the Norwegian Petroleum Directorate shall make available professional petroleum competence and advice to Norad within the sector, including petroleum resource management, health/environmental/ safety advice, geo-techniques, economy and administration. These items were however not included in the formal agreement between Norway and Tanzania because Tanzania did not explicitly request such assistance, but rather focused on the need for saving petroleum data and tapes to permanent disks for archival. The team finds that the task of saving the archived data did not neglect the integration of environmental concerns, because such data had presumably not been collected. However, the problem lies with the initial petroleum database, which seems not to have included environmental data.

6.3 Support to Development in the Roads Sector (TAN-2303/ TAN-02/230)

This programme, which began in 2005, was a follow-up of a previous road project, TAN-045. Norway has for decades been a major player in the Tanzanian road sector together with the World Bank, EU and Danida.

There is no proper project agreement for this project, a fact which has caused a number of problems. Originally the project was thought to be a multi-donor road sector programme, but ended up being a bilateral project. The Local Government Transport Program (LGTP) originally focused on rural transport in the context of this project, but included later urban transport as well.

The project's strategy aims at improving basic access to markets and service centres. The activities include strengthening government institutions, capacity building, labour based work methods and road maintenance.

At the feasibility stage, several relevant issues were mentioned, including that the project would lead to improved access to socio-political and cultural services, increased investment in agriculture, improved access to health and education, and increased diversification. A number of cross-cutting issues were mainstreamed in the LGTP feasibility study like HIV/AIDS, safety, gender, environment, and good governance.

However, these appears subsequently to have been dropped, since very little of these intentions were included in later project documentation.

The Norwegian support to the Road Sector Program (RSP) 2005-2009 underwent considerable changes in 2006 which led to a re-alignment of the programme defined in an addendum in 2007 where the project's focus on rural roads was strengthened in support of MKUKUTA (the Tanzanian national development strategy).

The Norad Mission Report number 4 of 4th April 2007 for the Road Sector Programme, Tanzania 2005-2009 states under paragraph 5.2.8 the need to adopt strategies that minimizes negative environmental impacts, respect cultural values, etc. and refers to a statement that these items will be comprehensively covered in the capacity building sessions planned. There is no documentation indicating that these good intentions were ever followed up, except through a. capacity building programme, which may include knowledge about how impact assessments are to be done. This is hardly adequate in this respect. Unless explicitly included in the projects, it is not likely that environmental assessments will be done, particularly if future support to the road sector, as presently planned, is given as budget support.

6.4 Poverty Reduction Budget Support Facility (TAN-2295/ TAN-07/39)

This programme supports Tanzania's national strategy for poverty reduction (MKUKUTA), which builds on the government paper Tanzania's "Development Vision 2025". The vision and the strategy contain vital issues, among others: improved governance, anti-corruption, sound macro-economic management, democratization, human rights and reduction of poverty. MKUKUTA is separated into three main chapters: 1) growth and poverty, 2) quality of life – social well-being, 3) governance. In chapter 2) a further detailing can be found which states that quality of life includes reduced vulnerability (to disasters), promotion of a healthy environment, and sustainable use of natural resources.

In a recent appraisal of the budget support, it was concluded that there had been some achievements in the implementation of the National Environmental Management Act, which was deemed "satisfactory".

The team finds that the environment is mentioned and included at the general project planning level. However, there are practically no indications on file that

environmental matters have been mainstreamed or played any role for the subsequent poverty reduction budget support facility follow-up.

6.5 PANTIL 1, Agriculture, Sokoine University of Agriculture (TAN-05/053)

The Programme for Agriculture and Natural Resources Transformation for Improved Livelihoods (PANTIL) is based on four national strategies:

i) The Agricultural Sector Development Strategy (ASDS) 2001, which is seeking to stimulate growth and reduce poverty;
ii) The Rural Development Strategy (RDS) which provides the framework for poverty reduction, unemployment reduction, reduction of environmental degradation, the combat of HIV/AIDS and more.
iii) The National Forest Policy (NFPT), which calls for improvement in the management of forests and natural resources, and
iv) The Wildlife Policy of 1998, which seeks to safeguard biodiversity resources and to foment sustainable use of wildlife

The main goals for PANTIL are: a) growth, b) poverty reduction, and c) improved social wellbeing.

The diverse contents of the programme include agribusiness, GIS, zoological laboratory, library, demand driven research, small holder farmer empowerment, capacity building, job market preparation, strategic interventions, gender, HIV/AIDS combat, economic growth, and social well being.

The team finds that limited attention has been given by Norad to the environmental agenda of the Sokoine University. This may be because it has been assumed that Sokoine, as a natural resources-focused university, is automatically mainstreaming environment in its activities and training. This may not necessarily be so. The team finds a lack of attention in the project to the links between environment and poverty.

7. Driving Forces for Environmental Degradation

The size of land is currently not a limitation for the average farmer around the study areas in Ruvu South and Rufiji. However, only a small minority around Ruvu South found the soils of be of high fertility. None of the households used fertilizers or manure and only 5% used pesticides. There were hardly any cattle in the study villages which could provide draught power or manure. All the tilling was done with the use of the hand hoe and. About 13 % of households in both Ruvu South and Rufiji considered themselves as food insecure. The recurrence of droughts, vermin and pests was an important reason for this.

More than 90% of respondents reported that their water supplies were inadequate/ insecure for irrigation or drinking. Community members are vulnerable to water-borne diseases, which lower productivity, and entails relatively high health expenses. The villagers have poor access to important livelihood related government and private services. A very high proportion of respondents (80 to 100%) do not have access to various government extension services and agricultural inputs. This situation aggravates the food insecurity problem.

Although 64% of household heads in Ruvu South had attended primary school, a seventh of these did not complete their education. More than a fifth of household heads did not have any formal education. Malaria is by far the most important cause of out-patient attendance throughout the year to the one dispensary that is serving the study area. Acute respiratory diseases and pneumonia constitute a fourth of the attendances.

The sale and heavy household reliance on forest products (over 90%) particularly charcoal and firewood was confirmed as one of the main coping strategies for dealing with this insecurity, particularly so in Ruvu South. The high dependence on poles and withies for house construction purposes imply further pressures on the existing forests. About 5% of the interviewed households own land that was originally obtained through encroachment of forest reserves.

The agricultural policy directs that farmers should be supported to improve productivity, food security and market-oriented production. The forest policy promotes participatory forest management through CBFM and JFM, as laid out in the National Forestry Programme. As demonstrated by the Ruvu South situation, the incomplete process of developing JFM agreements has left an institutional vacuum and a noticeable lack of operational norms. Special attention needs to be given to the

finalisation of JFM agreements, in order to increase control over the natural resources, including alternative livelihood options for charcoal producers.

Charcoal production has been responsible for degradation of about a fourth of closed woodland, and for the deforestation of 20 ha of closed woodland and more than 50% of open woodland in the catchment area that supplied charcoal to Dar es Salaam City (including Ruvu South. This has led to a considerable reduction of the volume of wood that is left, and narrowed the options for the area's and the national forest and energy policy.

Annex 1:
GPS Readings, Centre of Environmental Audit Plots

Kisanga village Kisarawe District (Ruvu South forest reserve)

TRANSECT #	PLOT #	LATITUDE	LONGTUDE
1	1	9227837	492418
1	2	9228690	490587
1	3	9229589	488726
1	4	9230222	486822
1	5	9230896	484908

Bokomnemela village, Kibaha District (Ruvu South forest reserve)

TRANSECT #	PLOT #	LATITUDE	LONGTUDE
2	1	9240174	490697
2	2	9239195	491002
2	3	9238111	491461
2	4	9237400	491880
2	5	9236429	492128

Kipangege village, Kibaha District (village land forest reserve)

TRANSECT #	PLOT #	LATITUDE	LONGTUDE
3	1	9240539	481350
3	2	9239630	481320
3	3	9238716	481301

Kipangege village, Kibaha District (Ruvu South forest reserve)

TRANSECT #	PLOT #	LATITUDE	LONGTUDE
3	1	9232470	484352
3	2	9233765	482475
3	3	9235213	481246

Mbwara village, Rufiji District (Namakutwa-Namuete forest reserve)

TRANSECT #	PLOT #	LATITUDE	LONGTUDE
1	1	9087094	500623
1	2	9086864	500817
1	3	9086718	501077
1	4	9086578	501343
1	5	9086388	501575

Nambunju village, Rufiji District (Namakutwa-Namuete forest reserve)

TRANSECT #	PLOT #	LATITUDE	LONGTUDE
2	1	9081912	499989
2	2	9081914	500196
2	3	9082346	500465
2	4	9082138	500750
2	5	9082080	501044
3	6	9083694	499315
3	7	9083736	499620
3	8	9083920	499928
3	9	9083822	500209
3	10	9083758	500502
4	1	9081043	501135
4	2	9081195	500836

Annex 2:
Statistics, Crop Production and Consumption

2a: Bokomnemela village	No. of hh	Minimum	Maximum	Mean	Std. Deviation
Crop harvest: Maize (Bag)	55	0.5	9	2.67	3.19
Crop harvest: Rice (Bag)	20	7	16	11.50	6.36
Crop harvest: Cassava (Bag)	50	1	25	9.25	9.03
Crop harvest: Cow pea (Bag)	25	0.5	2	1.00	0.93
Crop harvest: Millet (Bag)	10	3	4	3.50	0.71
Crop harvest: Sim-sim (Bag)	10	0	10	2.90	3.84
Crop consumed: Maize (Bag)	55	0.5	5	2.25	3.93
Crop consumed: Rice (Bag)	20	7	13	9.50	6.36
Crop consumed: Cassava (Bag)	50	1	15	4.91	4.76
Crop consumed: Cow pea (Bag)	25	1	2	1.33	0.58
Crop consumed: Millet (Bag)	10	0	2	0.60	0.89
Crop consumed: Sim-sim (Bag)	10	3	4	3.50	0.71
Crop sold: Maize (Bag)	2	0	1.5	2.08	0.11
Crop sold: Cassava (Bag)	3	1.2	2.0	1.67	4.04

2b Kipangege village	No. of hh	Minimum	Maximum	Mean	Std. Deviation
Crop harvest: Maize (Bag)	55	1	11	3.1	0
Crop harvest: Rice (Bag)	12	2	2	2	.
Crop harvest: Cassava (Bag)	53	1	21	7.2	0.67
Crop harvest: Cow pea (Bag)	16	0	2	1.22	0.80
Crop harvest: Sim-sim (Bag)	26	0	0.29	0.14	0.09
Crop consumed Maize (Bag)	55	1	10	2.9	0
Crop consumed Rice (Bag)	12	0.5	2	1.2	.
Crop consumed: Cassava (Bag)	53	1	13	6.2	0.58
Crop consumed: Cow pea (Bag)	16	0.5	2	1.39	0.60
Crop consumed: Sim-sim (Bag)	26	0	1	0.60	0.55
Crop sold: Maize (Bag)	4	1	2.9	1.4	0.09
Crop sold: Cassava (Bag)	3	1.2	3.2	2.67	4.04

2c Kisanga village	No. of hh	Minimum	Maximum	Mean	Std. Deviation
Crop harvest: Maize (Bag)	40	1	2	1.15	0.34
Crop harvest: Cassava (Bag)	40	1	30	5.26	7.08
Crop harvest: Cow pea (Bag)	22	1	1	1.00	0.00
Crop consumed: Maize (Bag)	40	1	2	1.15	0.34
Crop consumed: Cassava (Bag)	40	0.25	15	2.88	3.35
Crop consumed: Cow pea (Bag)	22	1	1	1.00	0.00
Crop sold: Maize (Bag)	1	1	1	1.00	.
Crop sold: Cassava (Bag)	8	0.25	15	5.63	4.03

2d: Mbwara (comparison)	No. of hh	Minimum	Maximum	Mean	Std. Deviation
Crop harvest: Maize (Bag)	75	1	30	5.27	5.42
Crop harvest: Rice (Bag)	53	1	50	9.00	12.59
Crop harvest: Cassava (Bag)	73	0.75	50	11.10	12.27
Crop harvest: Cow pea (Bag)	30	1	25	4.45	5.68
Crop harvest: Millet (Bag)	23	0	13	6.0	6.56
Crop harvest: Sim-sim (Bag)	41	0	25	8.71	7.56
Crop consumed: Maize (Bag)	75	1	24	4.32	2.84
Crop consumed: Rice (Bag)	53	1	46	7.10	16.94
Crop consumed: Cassava (Bag)	73	0.75	25	6.32	5.81
Crop consumed: Cow pea (Bag)	30	1	15	3.45	6.68
Crop consumed: Millet (Bag)	23	1	12	4.36	5.46
Crop consumed: Sim-sim (Bag)	41	0	15	6.2	2.16
Crop sold: Maize (Bag)	6	1	12	2.6	6.96
Crop sold: Rice (Bag)	10	0	6	2.18	1.94
Crop sold: Cassava (Bag)	12	1	15	5.25	4.58
Crop sold: Cow pea (Bag)	1	2	2	2.00	.
Crop sold: Millet (Bag)	2	0	3	1.20	1.64
Crop sold: Sim-sim (Bag)	18	0	3	0.28	0.83

2e: Nambunju village (comparison)	No. of hh	Minimum	Maximum	Mean	Std. Deviation
Crop harvest: Maize (Bag)	75	1	20	3.38	3.91
Crop harvest: Rice (Bag)	45	0.5	10	5.03	3.79
Crop harvest: Cassava (Bag)	74	0.25	12	1.25	0.89
Crop harvest: Cow pea (Bag)	52	0.5	15	3.75	5.33
Crop harvest: Millet (Bag)	32	0.5	20	4.33	5.63
Crop harvest: Sim-sim (Bag)	27	1	30	13.00	13.29
Crop consumed: Maize (Bag)	75	0.5	17	2.64	1.90
Crop consumed: Rice (Bag)	45	0.5	10	3.56	3.07
Crop consumed: Cassava (Bag)	74	0.25	8	1.2	3.76
Crop consumed Cow pea (Bag)	52	1	11	2.50	5.33
Crop consumed: Millet (Bag)	32	1	13	1.67	0.98
Crop consumed: Sim-sim (Bag)	27	1	26	2.25	2.18
Crop sold: Maize (Bag)	5	1	5	1.30	1.58
Crop sold: Rice (Bag)	8	0.5	5	2.19	1.81
Crop sold: Cassava (Bag)	4	0.5	6.2	1.10	0.55
Crop sold: Sim-sim (Bag)	7	0	13	2.08	4.87
Crop sold: Millet (Bag)	12	0	18	2.00	5.19

Annex 3:
Statistics, Utilisation of Forest Products and Services

3a: Bokomnemela village	N	Minimum	Maximum	Mean	Std. Deviation
Quantity of Firewood collected (Head-load)	50	94	230	115.1	41.9
Quantity of Charcoal collected (Bag)	34	1	45	7.2	9.4
Quantity of Timber collected (Number of plank)	14	1	5	2.9	0.4
Quantity of Pole collected (Number of pole)	19	2	50	6.7	12.0
Quantity of Withes collected (Number of pieces)	14	2	2	2.0	0.0
Quantity of Honey collected (Litre)	14	2	2	2.0	0.0
Quantity of Rope collected (Kg)	16	2	25	3.8	5.8
Quantity of Medicinal vegetable collected (Kg)	16	1	30	20.7	74.5
Quantity of Wild vegetable collected (Kg)	15	2	3	2.1	0.3
Quantity of Mushroom collected (Kg)	13	2	16	9.3	5.4
Quantity of Firewood for own use (Head-load)	37	72	192	95.3	31.3
Quantity of Charcoal for own use (Bag)	7	1	15	4.1	5.0
Quantity of Timber for own use (Number of plank)	1	8	3	1.2	.
Quantity of Pole for own use (Number of pole)	4	5	20	5.2	21.4
Quantity of Rope for own use (Kg)	2	7	25	16.0	12.7
Quantity of Medicinal vegetable for own use (Kg)	1	30	30	30.0	.
Quantity of Wild vegetable for own use (Kg)	1	3	3	3.0	.

3a: Bokomnemela village	N	Minimum	Maximum	Mean	Std. Deviation
Quantity of Mushroom for own use (Kg)	12	2	16	9.6	5.1
Quantity of Firewood sold (Head-load)	8	0	50	34.1	69.7
Quantity of Charcoal sold (Bag)	13	2	45	13.3	11.5
Quantity of Timber sold (Number of plank)	1	0	0	0.0	.
Quantity of Pole sold (Number of pole)	1	15	30	2.5	.
Quantity of Medicinal vegetable sold (Kg)	1	4	4	4.0	.
Quantity of Mushroom sold (Kg)	10	0	4	0.4	1.3
Unit price of Firewood (TSH/Head-load)	7	3	2500	515.0	948.4
Unit price of Charcoal (TSH/Bag)	20	4500	15000	7950.0	6956.4
Unit price of Timber (TSH/plank)	1	8	8	8.0	.
Unit price of Pole (TSH/pole)	1	700	700	700.0	.
Unit price of Mushroom (TSH/Kg)	1	100	100	100.0	.
Time taken to fetch Firewood (Minutes)	37	5	200	120.0	62.6
Time taken to fetch Charcoal (Minutes)	21	20	360	258.1	136.8
Time taken to fetch Timber (Minutes)	1	800	800	800	.
Time taken to fetch Pole (Minutes)	5	120	1440	456.0	552.5
Time taken to fetch Rope (Minutes)	2	120	240	180.0	84.9
Time taken to fetch Medicinal vegetable (Minutes)	2	120	120	120.0	0.0
Time taken to fetch Wild vegetable (Minutes)	1	120	120	120.0	.
Time taken to fetch Mushroom (Minutes)	1	120	120	120.0	.
Distance covered to fetch Firewood (Km)	29	0.5	8	1.7	0.8
Distance covered to fetch Charcoal (Km)	18	1	10	4.5	2.9
Distance covered to fetch Pole (Km)	4	2	20	6.5	9.0
Distance covered to fetch Rope (Km)	2	2	3	2.5	0.7

3a: Bokomnemela village	N	Minimum	Maximum	Mean	Std. Deviation
Distance covered to fetch Medicinal vegetable (Km)	2	2	2	2.0	0.0
Distance covered to fetch Wild vegetable (Km)	1	2	2	2.0	.
Distance covered to fetch Mushroom (Km)	1	2	2	2.0	.

3b: Kipangege village	N	Minimum	Maximum	Mean	Std. Deviation
Quantity of Firewood collected (Head-load)	45	1	486	122.73	74.44
Quantity of Charcoal collected (Bag)	29	2	96	15.66	19.62
Quantity of Timber collected (Number of plank)	11	1	20	2.64	0.50
Quantity of Pole collected (Number of pole)	14	1	100	11.07	26.38
Quantity of Withes collected (Number of pieces)	10	2	2	2.00	0.00
Quantity of Honey collected (Litre)	11	1	2	1.82	0.40
Quantity of Rope collected (Kg)	10	1	2	1.80	0.42
Quantity of Medicinal vegetable collected (Kg)	9	2	2	2.00	0.00
Quantity of Wild vegetable collected (Kg)	9	2	2	2.00	0.00
Quantity of Mushroom collected (Kg)	12	1	14	8.67	2.66
Quantity of Firewood for own use (Head-load)	42	1	144	15.26	24.25
Quantity of Charcoal for own use (Bag)	11	1	25	8.82	8.68
Quantity of Timber for own use (Number of plank)	3	3	8	2.00	44.17
Quantity of Pole for own use (Number of pole)	7	1	50	25.57	36.82
Quantity of Honey for own use (Litre)	1	2	2	2.00	.
Quantity of Medicinal vegetable for own use (Kg)	1	500	500	500.00	.
Quantity of Wild vegetable for own use (Kg)	2	2	700	351.00	493.56

3b: Kipangege village	N	Minimum	Maximum	Mean	Std. Deviation
Quantity of Mushroom for own use (Kg)	13	1	10	9.15	3.49
Quantity of Firewood sold (Head-load)	9	0	125	104.89	18.48
Quantity of Charcoal sold (Bag)	24	2	96	23.29	20.29
Quantity of Timber sold (Number of plank)	2	3	12	14.50	54.45
Quantity of Pole sold (Number of pole)	1	50	50	50.00	.
Quantity of Honey sold (Litre)	1	2	2	2.00	.
Quantity of Mushroom sold (Kg)	6	0	40	6.67	16.33
Unit price of Firewood (TSH/Head-load)	9	0	800	788.78	329.24
Unit price of Charcoal (TSH/Bag)	24	3000	12000	5791.67	2462.40
Unit price of Mushroom (TSH/Kg)	1	500	500	500.00	.
Time taken to fetch Firewood (Minutes)	35	5	240	88.77	31.70
Time taken to fetch Charcoal (Minutes)	23	15	240	87.83	87.21
Time taken to fetch Timber (Minutes)	0				
Time taken to fetch Pole (Minutes)	5	30	320	134.00	53.54
Time taken to fetch Wild vegetable (Minutes)	1	120	120	120.00	.
Distance covered to fetch Firewood (Km)	35	0.5	10	2.46	2.00
Distance covered to fetch Charcoal (Km)	24	0.5	11	4.65	4.08
Distance covered to fetch Pole (Km)	5	0.5	8	4.10	3.25
Distance covered to fetch Medicinal vegetable (Km)	2	5	7	6.00	1.41
Distance covered to fetch Wild vegetable (Km)	1	8	8	8.00	.
Distance covered to fetch Mushroom (Km)	2	5	10	7.50	3.54

3c: Kisanga village	N	Minimum	Maximum	Mean	Std. Deviation
Quantity of Firewood collected (Head-load)	34	1	323	126.68	15.40
Quantity of Charcoal collected (Bag)	19	1	40	9.74	9.28
Quantity of Pole collected (Number of pole)	6	2	15	9.50	5.24
Quantity of Rope collected (Kg)	2	3	3	3	0
Quantity of Firewood for own use (Head-load)	30	1	203	111.13	15.64
Quantity of Charcoal for own use (Bag)	15	0.5	5	1.50	1.09
Quantity of Pole for own use (Number of pole)	4	2	15	9.25	6.75
Quantity of Rope for own use (Kg)	2	3	3	3	0
Quantity of Charcoal sold (Bag)	14	3	40	11.82	9.55
Quantity of Pole sold (Number of pole)	2	10	10	10	0
Unit price of Charcoal (TSH/Bag)	17	15000	30000	15147.06	1765.69
Unit price of Pole (TSH/pole)	1	600	600	600.00	.
Time taken to fetch Firewood (Minutes)	33	5	180	50.76	14.83
Time taken to fetch Charcoal (Minutes)	17	10	240	172.94	96.23
Time taken to fetch Pole (Minutes)	6	20	240	93.33	78.66
Time taken to fetch Rope (Minutes)	2	60	240	150.00	127.28
Distance covered to fetch Firewood (Km)	32	0.2	7.5	1.96	3.66
Distance covered to fetch Charcoal (Km)	13	0.5	4	2.15	1.20
Distance covered to fetch Pole (Km)	6	0.5	5	2.17	1.69
Distance covered to fetch Rope (Km)	3	0.5	2	1.00	0.87

3d: Mbwara village	N	Minimum	Maximum	Mean	Std. Deviation
Quanty of Firewood collected (Head-load)	74	1	225	96.68	6.64
Quantity of Charcoal collected (Bag)	45	2	2	2.00	0.00
Quantity of Timber collected (Number of plank)	47	1	30	2.94	4.82
Quantity of Pole collected (Number of pole)	56	1	100	5.98	14.67
Quantity of Withes collected (Number of pieces)	45	2	2	2.00	0.00
Quantity of Honey collected (Litre)	45	1	2	1.96	0.21
Quantity of Rope collected (Kg)	45	1	2	1.96	0.21
Quantity of Medicinal vegetable collected (Kg)	45	2	2	2.00	0.00
Quantity of Wild vegetable collected (Kg)	45	1	2	1.89	0.32
Quantity of Mushroom collected (Kg)	45	3	20	7.31	3.70
Quanty of Firewood for own use (Head-load)	28	2	225	96.51	5.16
Quantity of Timber for own use (Number of plank)	1	12	12	12.00	.
Quantity of Pole for own use (Number of pole)	9	1	40	15.89	13.15
Quantity of Rope for own use (Kg)	1	3	3	3	.
Quantity of Wild vegetable for own use (Kg)	4	1	10	4.75	3.77
Quantity of Mushroom for own use (Kg)	45	3	20	7.31	3.70
Quanty of Firewood sold (Head-load)	1	2	2	2	.
Quantity of Timber sold (Number of plank)	2	8	18	9	15.56
Quantity of Pole sold (Number of pole)	1	100	60	100	.
Quantity of Honey sold (Litre)	1	3	3	3	.
Quantity of Wild vegetable sold (Kg)	4	1	10	4.75	3.77
Unit price of Timber (TSH/plank)	1	4400	4400	4400	.
Unit price of Pole (TSH/pole)	2	500	1500	1000	707.11
Time taken to fetch Firewood (Minutes)	28	2	180	39.18	37.61

3d: Mbwara village	N	Minimum	Maximum	Mean	Std. Deviation
Time taken to fetch Timber (Minutes)	2	120	120	120	0.00
Time taken to fetch Pole (Minutes)	11	5	120	48.64	35.36
Distance covered to fetch Firewood (Km)	23	0.2	2	0.79	0.48
Distance covered to fetch Timber (Km)	1	5	5	5.00	.
Distance covered to fetch Pole (Km)	11	0.5	5	1.64	1.40

3e: Nambunju village	N	Minimum	Maximum	Mean	Std. Deviation
Quantity of Firewood collected (Head-load)	74	1	140	76.41	7.95
Quantity of Charcoal collected (Bag)	47	1	5	2.04	0.46
Quantity of Timber collected (Number of plank)	45	1	12	1.91	0.29
Quantity of Pole collected (Number of pole)	53	1	40	2.57	1.97
Quantity of Withes collected (Number of pieces)	45	2	2	2.00	0.00
Quantity of Honey collected (Litre)	45	1	2	1.96	0.21
Quantity of Rope collected (Kg)	44	1	2	1.98	0.15
Quantity of Medicinal vegetable collected (Kg)	46	2	6	2.09	0.59
Quantity of Wild vegetable collected (Kg)	45	1	2	1.93	0.25
Quantity of Mushroom collected (Kg)	42	1	70	14.90	12.45
Quantity of Firewood for own use (Head-load)	28	1	140	71.82	9.91
Quantity of Charcoal for own use (Bag)	1	15	15	15.00	.
Quantity of Timber for own use (Number of plank)	1	6	6	6.00	.
Quantity of Pole for own use (Number of pole)	6	1	30	5.17	4.12
Quantity of Honey for own use (Litre)	1	8	8	8.00	.
Quantity of Mushroom for own use (Kg)	42	1	70	14.43	12.16

3e: Nambunju village	N	Minimum	Maximum	Mean	Std. Deviation
Quantity of Firewood sold (Head-load)	7	1	16	6.29	5.50
Quantity of Charcoal sold (Bag)	2	0	5	2.50	3.54
Quantity of Timber sold (Number of plank)	1	6	6	6.00	.
Quantity of Honey sold (Litre)	1	8	10	8.00	.
Quantity of Mushroom sold (Kg)	42	0	20	0.48	3.09
Unit price of Firewood (TSH/Head-load)	7	0	700	428.57	89.01
Unit price of Charcoal (TSH/Bag)	4	5500	8000	4537.50	792.32
Unit price of Pole (TSH/pole)	1	200	200	200.00	.
Unit price of Honey (TSH/Litre)	1	0	0	0.00	.
Unit price of Mushroom (TSH/Kg)	1	100	100	100.00	.
Time taken to fetch Firewood (Minutes)	25	8	180	43.32	47.75
Time taken to fetch Charcoal (Minutes)	2	20	100	110.00	92.96
Time taken to fetch Pole (Minutes)	8	10	20	13.13	4.58
Time taken to fetch Medicinal vegetable (Minutes)	1	10	10	10.00	.
Time taken to fetch Wild vegetable (Minutes)	1	60	60	60.00	.
Distance covered to fetch Firewood (Km)	25	0.5	9.5	1.94	6.55
Distance covered to fetch Charcoal (Km)	1	0.5	0.5	0.50	.
Distance covered to fetch Pole (Km)	8	0.5	0.5	0.50	0.00
Distance covered to fetch Medicinal vegetable (Km)	1	0.5	0.5	0.50	.

Annex 4: All Plots Surveyed for Environmental Household

Nambunju village, Rufiji District (Namakutwa-Namuete forest reserve)

ID	Transect	Plot	Altitude	Slope	Land tenure	Land utilisation	Ecosystem	Canopy cover (%)	Standing tree volume (m^3/ha)	Seedling density (#/ Plot)	Human disturbance
1	1	1	380	Flat	central government	forest reserve	coastal forest(humid)	70	11.23	45	low
2	1	2	348	Steep	central government forest reserve (CG-FR)	forest reserve	coastal forest	60	5.54	103	low
3	1	3	233	Gentle	CG-FR	forest reserve	coastal forest	open	1.37	2	fire
4	1	4	242	gentle slope	CG-FR	forest reserve	coastal forest	50	4.15	68	low
5	1	5	270	Gentle	CG-FR	forest reserve	coastal forest	70	8.62	65	none
6	1	6	317	Gentle	CG-FR	forest reserve	coastal forest	60	4.06	50	none
7	1	7	357	Gentle	CG-FR	forest reserve	coastal forest	80	1.56	38	none, intact
8	2	1	221	Gentle	CG-FR	forest reserve	coastal forest	60	0.66	56	none
9	2	2	241	Gentle	CG-FR	forest reserve	coastal forest	80	0.01	49	none
10	2	3	267	Flat	CG-FR	forest reserve	coastal forest	70	5.71	55	none
12	2	4	255	Flat	CG-FR	forest reserve	coastal forest	50	0.92	60	none
13	2	5	233	Flat	CG-FR	forest reserve	coastal forest	95	3.69	45	none

Mbwara village, Rufiji District (Namakutwa-Namuete forest reserve)

ID	Transect	Plot	Altitude	Slope	Land tenure	Land utilisation	Ecosystem	Canopy cover (%)	Standing tree volume (m^3/ha)	Seedling density (#/ Plot)	Human disturbance
1	3	1	144	Gentle	CG-FR	forest reserve	coastal forest	75	0.71	20	low
2	3	2	174	slightly steep	CG-FR	forest reserve	coastal forest	30	14.19	22	fire, tree cutting
3	3	3	192	Gentle	CG-FR	forest reserve	coastal forest	45	17.72	40	fire
4	3	4	214	Gentle	CG-FR	forest reserve	coastal forest	25	7.82	30	fire
5	3	5	222	Gentle	CG-FR	forest reserve	coastal forest	25	14.18	30	none

Kipangege village, Kibaha District (Village land forest reserve)

ID	Transect	Plot	Altitude	Slope	Land tenure	Land utilisation	Ecosystem	Canopy cover (%)	Standing tree volume (m^3/ha)	Seedling density (#/ Plot)	Human disturbance
1	1	1	158	Gentle	CG-FR	forest reserve	coastal forest	40	2.21	15	95% degraded by fire and charcoal extraction
2	1	2	152	Flat	CG-FR	forest reserve	coastal forest	50	2.35	79	low, previously cut, coppicing stumps
3	1	3	148	Flat	CG-FR	forest reserve	coastal forest	30	4.00	21	Low (currently), previous charcoal kilns

Kipangege village, Kibaha District (Ruvu South forest reserve)

ID	Transect	Plot	Altitude	Slope	Land tenure	Land utilisation	Ecosystem	Canopy cover (%)	Standing tree volume (m^3/ha)	Seedling density (#/ Plot)	Human disturbance
1	1	1	185	Flat	CG-FR	forest reserve	coastal forest	35	3.09	21	35% degraded for firewood, pole cutting
2	1	2	164	Flat	CG-FR	forest reserve	coastal forest	30	0.69	6	high, 80% - charcoal, pole extraction
3	1	3	168		CG-FR	forest reserve	coastal forest	20	6.71	6	high,80% -charcoal, pole extraction

Bokomnemela village, Kibaha District (Ruvu South forest reserve)

ID	Transect	Plot	Altitude	Slope	Land tenure	Land utilisation	Ecosystem	Canopy cover (%)	Standing tree volume (m^3/ha)	Seedling density (#/ Plot)	Human disturbance
1	1	1	154	Flat	CG-FR	forest reserve	coastal forest	15	0.45	13	high 85%
2	1	2	175	slight 1%	CG-FR	forest reserve	coastal forest	30	1.68	4	slight 20%
3	1	3	167	Slight	CG-FR	forest reserve	coastal forest	10	1.25	9	average 65%
4	1	4	182	Flat	CG-FR	forest reserve	coastal forest	20	1.74	15	average 50%
5	1	5	175	Flat	CG-FR	forest reserve	coastal forest	15	1.33	23	high 70%

Kisanga village Kisarawe District (Ruvu South forest reserve)

ID	Transect	Plot	Altitude	Slope	Land tenure	Land utilisation	Ecosystem	Canopy cover (%)	Standing tree volume (m^3/ha)	Seedling density (#/ Plot)	Human disturbance
1	1	1	246	Flat	CG-FR	forest reserve	coastal forest	20	11.14	13	none
2	1	2	218	Gentle	CG-FR	forest reserve	coastal forest	15	4.04	7	high 70%
3	1	3	210	Flat	CG-FR	forest reserve	coastal forest	20	8.07	24	low 30%
4	1	4	199	Gentle	CG-FR	forest reserve	coastal forest	15	7.78	6	low 30%
5	1	5	214	flat	CG-FR	forest reserve	coastal forest	10	1.32	24	none
					CG-FR	forest reserve	coastal forest				

Nambunju village, Rufiji District (Namakutwa-Namuete forest reserve)

ID	Transect	Plot	Ground cover (%)	Water sanitation	Erosion	Wild animals	Other land use	Charcoal off-take	Timber off-take	Other off-take	Population pressure
1	1	1	litter=90%	semi-humid	no	elephant droppings	n/a	no	no	medicine	low
2	1	2	litter=60%	semi-humid	slight	elephant droppings	n/a	no	no	no	low
3	1	3	bare with few burnt grasses	semi-humid	no	pigs, kima, baboon	n/a	no	no	n/a	low
4	1	4	40%	semi-humid	No	pigs	none	no	no	n/a	no/low
5	1	5	60% covered with litter	semi-humid	No	pigs, impala	none	no	yes(timber)	n/a	low

ID	Transect	Plot	Ground cover (%)	Water sanitation	Erosion	Wild animals	Other land use	Charcoal off-take	Timber off-take	Other off-take	Population pressure
6	1	6	45%	semi-humid	slight	none	n/a	no	no	medicinal plants	low
7	1	7	80% covered with litters	semi-humid	none	pigs, elephants, antelopes	none	no	none	medicinal plants, firewood	low
8	2	1	50% covered with litter	semi-humid	no	antelopes	none	no	no	medicinal plants	low
9	2	2	70% covered by grasses and litter	semi-humid	no	antelopes	no	no	no	no	low
10	2	3	50%	semi-humid	slight	antelopes, elephants and wild dogs	no	no	no	no	low
11	2	4	90% covered by grasses and litter	semi-humid	no	antelopes, bush pigs, elephants	no	no	no	no	low
12	2	5	85% covered by litter and seedlings	semi-humid	no	antelopes, bush pigs, elephants	no	no	no	n/a	low

Mbwara village, Rufiji District (Namakutwa-Namuete forest reserve)

ID	Transect	Plot	Ground cover (%)	Water sanitation	Erosion	Wild animals	Other land use	Charcoal off-take	Timber off-take	Other extractive off-take	Population pressure
1	3	1	maize and cassava well weeded	humidity moderate	none	yes	agriculture	no	no	no/ medicinal plants	low
2	3	2	70% covered with grasses	semi-humid	none	baboons, pigs	none other than forest reserve	no	yes	no	low
3	3	3	60% covered with grasses	semi-humid	none	elephant, baboons	forest reserve	none	no	no	low
4	3	4	70% covered with grasses	semi-humid	none	elephant, antelopes	No	none	yes	medicinal plants	low
5	3	5	90% covered with grasses	semi-humid	none	no	none	none	yes (timbering)	None	low

Kipangege village, Kibaha District (Village land forest reserve)

ID	Transect	Plot	Ground cover (%)	Water sanitation	Erosion	Wild animals	Other land use	Charcoal off-take	Timber off-take	Other extractive off-take	Population pressure
1	1	1	30	semi-humid	minor sheet erosion	no	n/a	no charcoal off take, initially massive charcoal, building mat off take	none	no	low
2	1	2	20	semi-humid	minor sheet erosion	stain bug foot steps	no	currently none, previously charcoal off take	no	some medicinal plants	low
3	1	3	30-60	semi-humid	minor sheet erosion	wildlife tracks	n/a	currently none, previously charcoal extraction	currently none, previously timber, firewood extraction	no	low

Kipangege village, Kibaha District (Ruvu South forest reserve)

ID	Transect	Plot	Ground cover (%)	Water sanitation	Erosion	Wild animals	Other land use	Charcoal off-take	Timber off-take	Other extractive off-take	Population pressure
1	1	1	95	semi-humid	no	baboons, elephant etc	n/a	charcoal kiln around, heavy	timber, poles, withes	unknown	low
2	1	2	50	semi-humid	no	buffalo footsteps etc	n/a	intensive charcoaling	large stump	perhaps medicinal plants	low
3	1	3	60	semi-humid	no	wildlife tracks	n/a	heavy charcoal off-take, secondary forest, degraded by charcoal off-take	no	no evidence	low

Bokomnemela village, Kibaha District (Ruvu South forest reserve)

ID	Transect	Plot	Ground cover (%)	Water sanitation	Erosion	Wild animals	Other land use	Charcoal off-take	Timber off-take	Other extractive off-take	Population pressure
1	1	1	65	semi-humid	no	no	n/a	charcoal kiln	no	firewood, medicinal plants perhaps	low
2	1	2	70	semi-humid	minor sheet erosion	foot steps	no	high	no/low	firewood, poles	low

ID	Transect	Plot	Ground cover (%)	Water sanitation	Erosion	Wild animals	Other land use	Charcoal off-take	Timber off-take	Other extractive off-take	Population pressure
3	1	3	65	semi-humid	no	no	no	no, previously cut	no, previously cut	no evidence	low
4	1	4	60	semi-humid	no	no	no	charcoal kiln	poles, firewood	no evidence	low
5	1	5	50	semi-humid	no minor sheet erosion	no	no	currently and previous	no	no evidence	low

Kisanga village Kisarawe District (Ruvu South forest reserve)

ID	Transect	Plot	Ground cover (%)	Water sanitation	Erosion	Wild animals	Other land use	Charcoal off-take	Timber off-take	Other extractive off-take	Population pressure
1	1	1	95	semi-humid	no	no	no	no	no	poles	low
2	1	2	70	semi-humid	slight sheet erosion	foot steps	no	yes, charcoal kiln around	no	no evidence	low
3	1	3	90	semi-humid	no	no	no	no	no		low
4	1	4	70	semi-humid	minor sheet erosion	no	no	no	no	no evidence	low
5	1	5	90	semi-humid	no	foot steps	no	no	no	no evidence	low

Annex 5:
Descriptive Statistics

Ruvu South FR	N	Minimum	Maximum	Mean	Std. Deviation
Altitude (m)	12	154	246	189.33	27.75
Canopy cover (%)	12	10	30	18.33	6.51
Estimates of stocking parameters(N) (Stems/ha)	12	23	102	61.25	30.01
Estimates of stocking parameters(G) (m^2/ha)	12	0.09	1.47	0.56	0.48
Estimates of stocking parameters(V) (m^3/ha)	12	0.45	11.14	3.85	3.63
Seedling density (Counts/Plot)	12	4	24	12.50	7.53
Ground cover/grasses/litter (%)	12	50	95	69.58	14.99

Kipangege village land FR	N	Minimum	Maximum	Mean	Std. Deviation
Altitude (m)	3	148	185	161.67	20.31
Canopy cover (%)	3	30	50	38.33	10.41
Estimates of stocking parameters(N) (Stems/ha)	3	117	264	194.67	73.85
Estimates of stocking parameters(G) (m^2/ha)	3	0.46	0.69	0.57	0.12
Estimates of stocking parameters(V) (m^3/ha)	3	2.35	4	3.15	0.83
Seedling density (Counts/Plot)	3	21	79	40.33	33.49
Ground cover/grasses/litter (%)	3	20	95	45.00	43.30

Namakutwa-Namuete FR	N	Minimum	Maximum	Mean	Std. Deviation
Altitude (m)	18	144	380	248.22	66.68
Canopy cover (%)	18	0	95	54.72	24.04
Estimates of stocking parameters(N) (Stems/ha)	18	1	90	32.56	23.89
Estimates of stocking parameters(G) (m^2/ha)	18	0	2.34	0.76	0.68
Estimates of stocking parameters(V) (m^3/ha)	18	0.01	17.72	5.80	5.39
Seedling density (Counts/Plot)	18	2	103	44.06	23.25
Ground cover/grasses/litter (%)	18	5	90	62.78	23.34

Annex 6:
Inventory Data from Surveyed Plots

Appendix 6 (a): BOKOMNEMELA SITE

PLOT #	N (Stems/ha)	G (m^2/ha)	V (m^3/ha)
P1	37	0.09	0.45
P2	102	0.30	1.68
P3	40	0.21	1.25
P4	79	0.29	1.74
P5	48	0.22	1.33
Mean	**61**	**0.22**	**1.29**
Standard error	**13**	**0.04**	**0.23**
Standard dev	**28**	**0.08**	**0.51**
N	**5**	**5.00**	**5.00**
TSx	**25**	**0.08**	**0.45**
Lower limit	**37**	**0.09**	**0.45**
Upper limit	**102**	**0.30**	**1.74**
Precision (%)	**41**	**35.64**	**34.95**

Appendix 6 (b): KIPANGEGE SITE (VLFR)

PLOT #	N (Stems/ha)	G (m^2/ha)	V (m^3/ha)
P1	90	0.40	2.21
P2	203	0.46	2.35
P3	264	0.69	4.00
Mean	**186**	**0.52**	**2.85**
Standard error	**51**	**0.09**	**0.57**
Standard dev	**89**	**0.15**	**0.99**
N	**3**	**3.00**	**3.00**
TSx	**100**	**0.18**	**1.12**
Lower limit	**90**	**0.40**	**2.21**
Upper limit	**264**	**0.69**	**3.99**
Precision (%)	**54**	**34.92**	**39.20**

Appendix 6 (c): KIPANGEGE SITE (RUVU-SOUTH FR)

PLOT #	N (Stems/ha)	G (m^2/ha)	V (m^3/ha)
P1	117	0.57	3.09
P2	28	0.14	0.69
P3	50	0.75	6.71
Mean	**65**	**0.49**	**3.50**
Standard error	**27**	**0.18**	**1.75**
Standard dev	**46**	**0.31**	**3.03**
N	**3**	**3.00**	**3.00**
TSx	**53**	**0.35**	**3.43**
Lower limit	**28**	**0.14**	**0.69**
Upper limit	**117**	**0.75**	**6.71**
Precision (%)	**81**	**72.00**	**98.00**

Appendix 6 (d): KISANGA SITE

PLOT #	N (Stems/ha)	G (m^2/ha)	V (m^3/ha)
P1	102	1.47	11.14
P2	23	0.69	4.04
P3	85	1.23	8.07
P4	99	1.10	7.78
P5	42	0.25	1.32
Mean	**70**	**0.95**	**7.75**
Standard error	**16**	**0.22**	**1.45**
Standard dev	**36**	**0.48**	**2.91**
N	**5**	**5.00**	**5.00**
TSx	**31**	**0.43**	**2.84**
Lower limit	**23**	**0.25**	**4.04**
Upper limit	**102**	**1.46**	**11.14**
Precision (%)	**45**	**45.39**	**36.67**

Appendix 6 (e): NAMBUNJU SITE

PLOT #	N (Stems/ha)	G (m^2/ha)	V (m^3/ha)
P1	46	1.30	11.23
P2	28	0.73	5.54
P3	8	0.17	1.37
P4	11	0.57	4.15

PLOT #	N (Stems/ha)	G (m^2/ha)	V (m^3/ha)
P5	27	1.19	8.62
P6	12	0.54	4.06
P7	20	0.26	1.56
P8	15	0.13	0.66
P9	1	0.00	0.01
P10	27	0.71	5.71
P11	27	0.16	0.92
P12	54	0.47	3.69
Mean	**24**	**0.50**	**4.43**
Standard error	**4**	**0.12**	**1.02**
Standard dev	**16**	**0.44**	**3.68**
N	**12**	**12.00**	**12.00**
TSx	**9**	**0.24**	**2.00**
Lower limit	**2**	**0.00**	**0.00**
Upper limit	**54**	**1.30**	**11.23**
Precision (%)	**36**	**47.04**	**45.13**

Appendix 6 (f): MBWARA SITE

PLOT #	N (Stems/ha)	G (m^2/ha)	V (m^3/ha)
P1	6	0.11	0.71
P2	42	1.93	14.19
P3	59	2.34	17.72
P4	62	1.09	7.82
P5	51	1.63	14.18
Mean	**44**	**1.40**	**10.92**
Standard error	**10**	**0.38**	**3.01**
Standard dev	**23**	**0.86**	**6.73**
N	**5**	**5.00**	**5.00**
TSx	**20**	**0.74**	**5.90**
Lower limit	**6**	**11.00**	**0.71**
Upper limit	**62**	**2.34**	**17.72**
Precision (%)	**46**	**53.20**	**54.03**

Annex 7:
Data Collection Tools

This instrument has been forwarded to Norad as a separate document, but can be requested directly from Scanteam.

The tools include:

(1): Questionnaire (Target and control areas) – Household questionnaire:

a. Household identification variables
b. Household baseline data
c. Livelihood data
d. Forest use and energy/stove data

(2): Village Level checklist

(3): Forest inventory form

(4): Environmental auditing form

Annex 8: References

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