IMPACT OF CONSERVATION AND DEVELOPMENT INTERVENTIONS ON LIVELIHOODS AND FOREST RESOURCES MANAGEMENT IN PANGANI RIVER BASIN: A CASE OF MUHEZA DISTRICT, TANZANIA

BY

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ABSTRACT

An increase in human population has led to land scarcity, shortage of water for irrigation and catchments forest degradation in Pangani River Basin. The response to the socio-economic and environmental problems in the basin has been among the endeavors of Conservation and Development Interventions (CDIs). This study was conducted to assess the impact of CDIs on livelihoods and forest resources management at Pangani River Basin in Muheza District, Tanzania. Sustainable livelihood approach was employed to gather livelihoods data. Livelihoods attributes were collected using a number of PRA techniques, questionnaire, focus group discussion, key informant and field observation. Forest inventory was carried out in Kwamkoro forest reserves by laying out 50 sample plots systematically from the forest edge. Different forest parameters were compared to the 1998 record. Contents and structural-functional analyses were applied to analyse socio-economic qualitative data. Statistical Package for Social Science and Macro soft excel was used to analyse the socio-economic various forest parameters data. The study found out that EUCAMP was the major CDIs in the study area. Butterfly farming, fish farming, bee keeping, energy saving stove, collecting and selling of *Allanblackia stulhminii* seeds, bio-intensive gardening, zero grazing dairy cattle, spice cultivation and ecotourism were the livelihoods strategies adopted from CDIs. Land size, household income, forest restoration and livelihood improvement were statistically significantly correlated with CDIs activities at ($p< 0.01$). Further, stems per hectare obtained in 2005 were low compared to stems per hectare observed in 1998 indicating significant decrease. The basal area and wood volume decreased while species diversity indices indicate a slight increase from 3.4 to 3.5 between 1998 and 2007 suggesting that the forest is still facing disturbance. It was concluded that CDIs interventions have not adequately improved people's livelihoods or reduced pressure toward forest resources utilization.

DECLARATION

I, Uhuru Levenson Mwembe, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work and it has neither been submitted nor being concurrently submitted for degree award in any other University**.**

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This dissertation is dedicated to my parents, Levenson Kapotwe Mwembe and Mainesi Tuloline Simchimba that they tuned my youth in favour of education.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

ANR	Amani Natural Reserve
CDIs	Conservation and Development Interventions
EUCADP	East Usambara Conservation and Agriculture Development Project
EUCAMP	East Usambara Conservation Area Management Programme
EUCFP	East Usambara Catchment Project
EUM	East Usambara Mountain
EUTCO	East Usambara Tea Company
FBD	Forestry and Beekeeping Division
FGD	Focus Group Discussion
GEF	Global Environmental Fund
ICDP	Integrated Conservation and Development Project
IGA	Income Generating Activity
IUCN	International Union for Conservation of Nature
KFR	Kwamkoro Forest Reserve
KI	Key Informant
NBP	National Beekeeping Policy
NGOs	Non Governmental Organizations
NIMR	National Institute for Medical Research
NTFP	Non Timber Forest Product
PRA	Participatory Rural Appraisal
PRB	Pangani River Basin
SIS	Strategic Information Sampling
SL	Sustainable Livelihood
SLA	Sustainable Livelihood Approach
TAFORI	Tanzania Forest Research Institute
TCFO	Tanga Catchment Forest Office
TFCG	Tanzania Forest Conservation Group
TSSDP	Tanga Small Scale Dairy Project
URT	United Republic of Tanzania
UWAMA	Umoja wa Wauza Maziwa Amani
VEC	Village Environmental Committee

CHAPTER ONE

1.0 INTRODUCTION

1.1 **Background Information**

Development is a process by which societies' problems are to be solved by implementing a systematic and well-defined change process (Burnell, 2003). The approach, which addresses issues of social and environmental problem through conservation activities, is often referred to as "Conservation and Development Interventions" (CDIs)[1]. According to Toner (2003) outcomes of CDIs are typically measured by the provision of solutions to the problem being addressed. According to Franks (2004) observation, CDIs can only change people's living conditions if long-term social and environmental impacts are taken into account along with economic and institutional sustainability. Also, Fisher *et al*. (2005) reveal that the goal of CDIs has to integrate rural livelihood needs with measures that address conservation priority.

In Africa, large –scale CDIs financed, for most part by multilateral and bilateral donors have been designed and implemented with the aim of achieving sustainable development through integration of delicate ecological balance or the complex social system of natural resource management and improving people's livelihood (Ghai,1992).

[1] Conservation and development intervention as defined in Franks and Blomley (2004) is an approach to the management and conservation of natural resources in areas of significant biodiversity value that aim to reconcile the biodiversity conservation and socio-economic development interests of multiple stakeholders at local, regional, national and international levels.

Many CDIs have been striving to enhance people's livelihoods through conservation of natural resources. Accesses to natural resources are the principal means by which people reduce their vulnerability and pursue livelihood strategies (Carney, 2002; FAO, 2002; Kamuzora, 2004). However, livelihood strategies have frequently been increasingly caught up with processes of change on development policies, programs and projects for which the rural poor have neither control nor the necessary information for them to anticipate the effects of such processes of change (Kajembe *et al.*, 2004). According to Bakarr (2004), development policies have come to a consensus that environment-livelihoods linkages are critical in determining development outcomes that have to be achieved through CDIs.

In Pangani River Basin (PRB), particularly in Muheza District, Tanzania, various CDIs programs and projects have been implemented at various levels, often with an attempt to integrate rural livelihood needs with measures that address conservation priority. In other words, these conservation initiatives have sought to address rural development needs through maximization of benefit in terms of preserving biodiversity at various scales (Angelsen and Wunder, 2003). The examples of CDIs in Muheza District include East Usambara Conservation Area Management Programme (EUCAMP), Tanzania Forest Conservation Group (TFCG), Tanga Small Dairy Development Project and Wildlife Conservation Society of Tanzania. These interventions have impacted either positively or negatively on the forest resources and people's livelihood strategies; but they have received little attention from researchers. This study therefore assesses the impact of CDIs on the livelihoods and forest resources management in Pangani River Basin in Muheza District, Tanga, Tanzania.

1.2 Importance of Catchment Forests in Tanzania

There are about five hundred and forty forest reserves with an estimated total area of about 13 million hectares in Tanzania mainland (Kajembe *et al., 2004).* Most of these reserves have been gazetted for both production and protection purposes. The gazetted areas for protection alone are about 1.4 million hectares (NEMC, 1994). The majority of protection forests are Montane rainforests, reserved as important water catchment areas supplying water for different down stream users (Kajembe *et al.*, 2004). Majority of the world population depends directly on the Montane catchment forest for water to grow food, generate energy, drinking, and for other domestic purposes (Price, 2004).

Mariki (2002) and Emerton *et al.* (2004) point out that Montane catchment forests of Kilimanjaro, Meru, Pare and the Usambara mountains make a significant water contribution to the Pangani River Basin (PRB), which support almost four million people – including over 2.5 million pastoralists and small-scale farmers, and nearly half a million city dwellers with 55 000 ha of irrigated agriculture. The basin also supports three hydropower schemes, which produce nearly 50% of Tanzania's electricity. The East Usambara Mountain (EUM) forests form part of Zigi River Catchment (sub- catchment of Pangani River Basin), which is the principal source of domestic water to Tanga Municipality (with a population estimated at 300 000 people), associated industries, estates and adjacent local communities. The catchment forests play a significant role in enhancing people's livelihoods and hydrological cycle of Tanga Region (IUCN, 2003).

1.3 Pangani River Basin and its Management

The National Water Policy (2002) and Water Utilization Act No.42 of 1974 (Control and Regulation) amended in 1981 (amendment No. 10) devolve the responsibility for water management to the basin level, and nine basins have been identified, including Pangani

Basin (URT, 2002; Mutayoba, 2002). Pangani Basin covers an area of about 58800 km^2. The basin has smaller sub-catchment rivers including the main Pangani River Basin (PRB). Other rivers are Umba, Msangazi, Zigi, and Coastal Rivers (Mukulumuzi).

The PRB covers catchments of an area of 43650 km^2 out of which 3914 km^2 are in Kenya. Administratively, the Basin catchments in Tanzania cover four regions namely Kilimanjaro, Arusha, Manyara and Tanga (Fig. 1). The Kenyan portion of the Basin falls almost entirely within the District of Taita – Taveta (Ngana, 2001; Røhr and Killingtveit, 2002). The Basin is managed by two institutions namely the Pangani Basin Water Office for Tanzania side and the Water Resources Management Authority for the Kenyan side.

The Pangani River Basin is one of Tanzania's most productive areas that are important to the nation for agricultural outputs and hydroelectric power production as well as for global forest and biodiversity resources. The basin hosts an estimated 3.7 million people, of whom 80% depend either directly or indirectly on irrigated agriculture for their livelihoods (IUCN 2003).

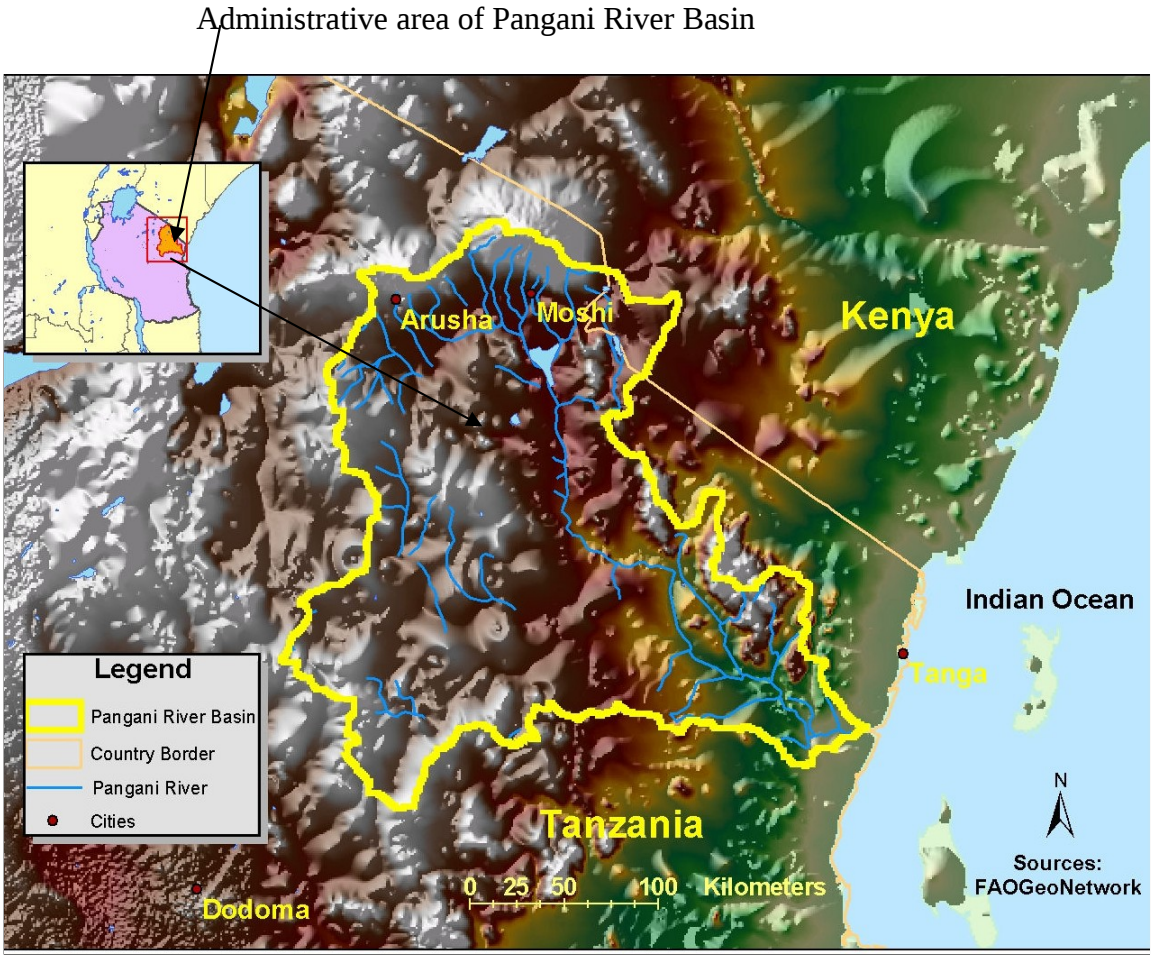

Figure 1: A map of Pangani River Basin with an inset of a map of Tanzania showing the administratively Regions covering the basin.
Source: FAO GeoNetwork, (2004).

1.4 Historical Background of Conservation and Development Interventions in East Usambara Mountain

The reservation of forests for protective and commercial purposes started during the German rule. The main interest of the Germans in the Usambara was commercial agricultural estates (Hamilton and Bensted-Smith, 1989). The first forest reserves were gazetted by the Germans with several motives including economic, climate regulation and safeguarding the biological resources. However, during the latter half of the 20th century, the forest cover was said to have decreased significantly (Schulman *et al*., 1998; Newmark, 2002).

The decrease in the forest cover led to international concern over the future of the forests. The involvement of donors and other international actors in the forest control in the EUM during the post-colonial period had an eventful history. For a start, the focus of Finnish Development Co-operation in the area was first on technical assistance and on support to commercial forestry. At the end of the 1970s, Finland supported two forest inventories (on commercial species only) and the activities of Sikh Saw Mills Ltd, which acquired wood from the area. Later on, the international concerns about forest destruction exerted pressure on the activities and the focus gradually shifted to conservation (Mwalubandu *et al*., 1991).

A new, more inclusive, forest inventory was conducted and organized by IUCN (International Union for Conservation of Nature) for various bio-physical studies in the EUM in the mid-1980s. Subsequently, two donor-funded conservation projects were launched namely; East Usambara Conservation and Agricultural Development Project (EUCADEP). These projects worked with the communities focusing on the public land, and the East Usambara Catchment Forest Project (EUCFP) that initially focused on reserved forests (Stocking and Perkin, 1992). According to Sjöholm *et al*. (2001) the approach of EUCADEP/EUCFP was that of an Integrated Conservation and Development Project as it was targeted to support the conservation efforts through developing the local people's livelihoods.

EUCADEP was implemented in 1987/97 with the technical assistance of IUCN under the Ministry of Agriculture and Livestock Development and funded by the European Economic Community/European Community. The EUCFP operated from 1990 to 2002 and in its final phase, the EUCADEP and the EUCFP were merged and changed the project name to East Usambara Conservation Area Management Project (EUCAMP) (1998/02).

During this phase, the project was co-funded by the Government of Finland and the EU and the Government of Tanzania. The long-term objective of the project was to contribute to global and national efforts in conserving bio-diversity in harmony with the needs of the local people (EUCAMP, 2002).

Conservation and development interventions have put EUM (Amani Natural Reserve) on both the national and international arena for the conservation of ecosystem and genetic resources. However, the internationals have denied the local community access to what has hitherto been traditionally an important source of livelihoods for the local community. This has placed many local communities in social-economic stress, hardships and uncertainty (Jambiya and Sosovele, 2001). However, Hofer (2004) argues that well-designed and properly implemented CDIs programmes are an attractive situation for reconciliation between conservation of biodiversity and environments as a whole and community development projects such as the one in East Usambara Mountains.

1.5 Problem Statement and Justification

An increase in human population has led to land scarcity, shortage of water for irrigation and degradation of catchments forest in Pangani River Basin (IUCN, 2003). The response to the socio-economic and environmental problems in the basin has been among the endeavors of CDIs, and which have culminated into the change of people's livelihood strategies.

Several CDIs such as IUCN- Water and Nature Initiative project, East Usambara Catchments Area Management Project (EUCAMP) and Tanzania Forest Conservation Group (TFCG) have been implemented in Muheza District, in attempting to integrate rural development needs with the measures that address conservation. In spites of the facts that

CDIs have either positive and/ or negative impacts on peoples livelihoods and forest resources, most of the studies conducted in the basin concentrated on conservation and management of biodiversity, hydrology, and water related conflict and rarely touched on issues such as potentials and constraints related to CDIs for livelihoods improvement and forest resources management (Mbomile, 2002; IUCN, 2003; Wallingford, 2003; Turpie *et al.*, 2005).

For example, Jambiya and Sosovele (2001) reported on tighter restriction imposed on access to forest products and shortage of land for crops cultivation to local communities adjacent to Amani Nature Reserve, with inadequate quantitative information on local community's livelihoods strategies. Also there is evidence that sometimes CDIs can lead to undesirable outcomes. For example, Mevlut (2002) reported that in Turkey-Indonesia, CDIs have brought additional hardships, jeopardised people's livelihood strategies, have caused land shortages, low crops yield and thus, exacerbated poverty and forced people to over exploit forest resources as a means of survival. Information to quantify and substantiate whether the CDIs implemented have any impact (positively and/or negatively) on people's livelihood strategies and forest resources is limited in PRB specifically in Muheza District.

Therefore, there is a need to study the impact of CDIs on livelihoods and forest resources management, generating such information is imperative for informing stakeholders such as policy makers, and implementers so that the designed CDIs could successfully accommodate people's livelihoods and forest /natural resources conservation.

1.6 Objectives

1.6.1 Overall objective

The overall objective of this study was to assess the impact of CDIs on people's livelihoods and forest resources management, in Pangani River Basin, Muheza District, Tanzania.

1.6.2 Specific objectives

Specifically the study intended to

1. identify the main activities of CDIs in the study area.
2. analyses the influence CDIs on livelihood strategies of local community.
3. assess the impact of CDI's on the status of forest resources management.
4. assess socio-economic factors influencing CDIs implementation in the study area.

1.7 Research Questions

The following research questions informed the study

a. What are the main activities of CDIs in PRB and specifically Muheza district?
b. What are the consequences of the implementation of CDIs on people's livelihood strategies?
c. What are the impacts of CDIs on the status of forest resources management from 1998 to 2007?
d. What are socio-economic factors influencing CDIs implementation in the study area?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview

This chapter presents the summary of relevant scholarly perspective on sustainable development and CDIs; CDIs and their main activities; sustainable livelihood; livelihood strategies; linkage of livelihoods and forest resources management; linkage of CDIs to forest resources management; impact of CDIs on livelihoods and forest resources management, and policy framework supporting conservation of natural resources and local community livelihoods.

2.2 Sustainable Development and CDIs

Sustainable Development is defined by the World Commission on Environment and Development (1987) as needs negotiated outcomes that are equitably, economically viable, environmentally sound and socially sustainable. According to IUCN (2003), achieving sustainable development is only possible if the interdependency of social development, economics and the environment is recognized and accounted for. In the view of IFAD (2002), equitable approaches to conservation and development require attention to be paid to the rural poor, particularly in improving livelihood strategies, economic development and biodiversity conservation. This has to be done by improving the linkages and balancing the impact of actions on each pillar (social, economic and environment) of sustainable development through CDIs.

However, Ghai (1992) argues that no CDIs strategy is likely to succeed if it does not give central place to livelihood improvement for the impoverished. This requires *inter alia* wide-ranging changes in the access to and the use of resources, investment patterns,

organization and composition of public services. Garnett *et al. (*2007) note that few of the interventions from the local, national and international agencies that respond to the real need of the local people, often end up doing bad than good. There has been a long history of concern about the effectiveness and achievement of CDI's in meeting either conservation or development objectives. Studies on reconciling the local livelihood improvement with the desire to reduce or minimize, or even reverse environment degradation in areas with high biodiversity values have been documented (Lewis *et al.*, 1990; Burgess *et al.*, 2002; Adams *et al*., 2004; McShane and Wells, 2004). However, information on substantiate achievements or failure of CDIs in PRB, particularly in EUM is unknown.

2.3 CDIs and their Main Activities

According to Campebell and Vainio-Mattila (2003), organizations whose primary mission is conservation and development have adopted both CDI approaches in some form and expanded the definition. Franks and Blomley (2004) define CDI as the approach to the management and conservation of natural resources in the area of significant biodiversity value that aim to reconcile the biodiversity conservation and socio-economic development interests of multiple stakeholders at local, regional, national, and international levels.

In East Usambara Mountains, conservation organization have been implementing approaches that aim at building support among the forest reserves adjacent communities sharing the social and economic benefits from the protected areas (Vihemaki, 2005). The objective of these initiative include compensating local people for lack of access to protected areas through providing alternatives opportunities that allow people to benefit economically from conservation while refraining from engaging in environmentally destructive activities so as to attain both environmental and livelihood sustainability.

2.4 Sustainable Livelihood

The Brundtland Commission in 1987 introduced Sustainable Livelihood (SL) in terms of resource ownership, access to basic needs and livelihood security. The International Institute for Sustainable Development describes SL as being "concerned with people's capacities to generate and maintain their means of living, enhance their well-being, and that of the future generations. Sustainable Livelihood Approach (SLA) has been developed by different programmes (UNDP, CARE, Oxfam and DFID) as a way of assessing livelihoods and development interventions. The approaches assume that people require a range of assets (including natural, physical, human, financial, and social) that have to be convert to achieve livelihood outcomes (Carney *et al*., 1999).

Chamber and Canway (1991) define livelihood to comprise people's capacities and their means of living, including food, income and assets. Tangible assets are resources and stores, and intangible asset are claims and access. Livelihoods are environmentally sustainable when maintains or enhances the local and global assets in which livelihoods depend, and have net beneficial effects on other livelihoods. A livelihood is socially sustainable when it can cope with and recover from stress and shocks, and provide for future generations.

2.5 **Livelihood Strategies**

The livelihood strategies consist of natural resource based activities like cultivation of crops and livestock keeping and non-natural based activities such as trade, manufacturing and services (FOA, 2005). Ambrose –Oji (2004); Kamuzora (2004) in different studies identified key determinants influencing livelihood strategies of poor people in developing countries. The factors includes the ability to accumulate diverse range of assets and stores of values, the capacity to undertake labour in agriculture and non –agricultural work, the

policy environment and economic context, access to credit and loans, knowledge and its uncertainty and inter-and –intra household relationships, social and political networks, and local economies.

Scoones (1998) identified three major livelihood strategies undertaken by a smallholder farmer adjacent and far from the protected areas in the developing countries, these are intensification or extensification of existing productive activity, diversification by adapting additional productive activities, and migration to develop productive activities elsewhere. Besides Scoones (1998) asserts that in the analysis of livelihood strategies it is important to address the following two issues; First, the sequence, that is, the productive use of certain assets may require prior access to and use of other assets. The second issue is substitution, which refers to the liquidation or depletion of one asset to accumulate another (i.e. natural capital to financial capital). Further, Verma (2001) notes that the manner in which how people adapt to changes and attempt to find alternative means of accessing resources and sustaining their livelihoods, various in response to the changing local environment.

2.6 Livelihood Outcomes

According to Neefjes (2000), livelihood outcomes are the achievements generated from livelihood strategies such as more income (e.g. cash); increased well-being (e.g. non material goods, like self-esteem, health status, access to services, sense of inclusion); reduced vulnerability (e.g. better resilience through increase in asset status); improved food security (e.g. increase in financial capital in order to buy food); and a more sustainable use of natural resources (e.g. appropriate property rights). Woodhouse *et al*. (2002) observe that livelihood outcome is the basis for assessing the sustainability of particular interventions towards improving livelihoods and natural resources products and utilization.

2.7 Linkage of Livelihoods and Forest Resources Management

Livelihoods comprise capabilities, assets and activities required as a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base (Carney *et al.,* 1999; IFAD, 2002; Fisher *et al.,* 2005). Forest resources are essential for livelihoods in a variety of ways. In developing countries for example, maintenance of diverse forest resources can be important in providing livelihood security at times of seasonal food shortage (by providing alternative foods and other resources) and at times of crisis such as drought, crop failure or even market failure (Mohasi and Calder, 2001).

Agrawal and Clark (2001) and Garnett (2007) reveal that ineffective CDIs and practices pursued either by governments, sectoral development, or macro-economic reforms have all too often jeopardized poor people's livelihoods by destroying the resource base. Wunder (2001) for example, notes that the potential of tropical forests to lift people out of poverty is very limited due to CDIs failure to capture people's livelihood strategies.

According to Dove (1993), forest conservation and development project is unlikely to lead to poverty reduction because the poor tend only to have the rights to low value forest products, and over utilize them because of limited alternative livelihood strategies. However, Emerton (2000); Burgess *et al*. (2002) and Luoga *et al*. (2005) suggested that a key feature of achieving linkage is to determine incentive strategy that involves relationship between biodiversity and the local people by providing the people with an opportunity to benefit directly from biodiversity, and thus presumably have an incentive to stop external threat to biodiversity. The strategies recognizes local people's role in maintaining biodiversity.

2.8 Linkage of CDIs to Forest Resources Management

The CDIs, in line with Tanzania National Forestry Policy (1998), provide an instrument for managing forests to achieve sustainable development without undue reduction of their inherent values and future productivity. The goal of CDIs is achieved through promoting protection, restoration and sustainable use of forest resources so that forests could provide full range of potential goods and services (FAO, 2004).

Conservation Programmes appear to be the best possible alternative that ensures forest protection, yield better performance and promote livelihoods improvement (Mallik, 2000). Improvement of forest and tree resources in both forest reserve and public lands has been reported (Jambiya and Sosovele, 2001; Kajembe and Monela, 2004; Luoga *et al*., 2005). However, Fisher *et al.* (2005) argue that the CDI have had difficulty in establishing species conservation targets such as the extent of an ecosystem, or the number of species to be conserved.

2.9 Impact of CDIs on Livelihoods and Forest Resources Management

Clearly, CDIs can be very important to livelihood security of the rural people and forest resource base. The CDI's attempt to link conservation of biological diversity within a protected area to social and economic development outside that protected area. Incentives are typically provided to the local communities in the form of shared decision making, employment, revenue sharing, limited harvesting of plant and animal species, income generating activities or provision of community facilities and public service in exchange with the communities support for conservation (Burgess *et al.*, 2002).

However, Fisher *et al.* (2005) note that, the economic benefits generated by CDIs projects have not usually been enough either as an incentive or as an alternative to prevent the

activities that exert pressure on the protected areas. Salafsky and Wollenberg (2000); Garnett, (2007) also argue that where few projects have been able to provide the range of income-generating activities, benefits from such project activities have not been distributed fairly; most benefits have been accrued by wealthier sections of the community or elites groups, rather than the poorest groups or marginalized class of the community. Drawing on a broader range of examples, Wells *et al.* (2004) identify a range factors that have been associated with CDIs failure in the past; these include over-optimistic goals, weak assumptions, unconvincing local participation, targeting of the wrong threats, uncertain financial sustainability, low benefit generation, accessibility and the need by donors for rapid success readily identifiable as their own.

Adams *et al*. (2004) suggest that shortcomings arise from the failure to recognize four realities of integrating conservation and development: (1) poverty and conservation are separate policy realms with little opportunity for integration, (2) conservation will be undermined unless poverty is alleviated, (3) there is a moral obligation for conservation not to compromise poverty reduction, and (4) poverty reduction itself depends on the conservation of living resources. Sayer and Campbell (2004) suggest that successful CDIs require an understanding of existing environmental and social trajectories as well as action research and the use of both local and external knowledge. All significant stakeholders must be involved, and these stakeholders must also help to determine appropriate measures of success.

2.10 Policy Framework Supporting Conservation of Natural Resources and Community Livelihoods

2.10.1 National Forest Policy (1998)

The operational forest policy of 1998 gives emphasis on the management of forest resources and delegates management responsibility to the forest sector. Among the main features of the policy are participatory forest management, decentralization and privatization in order to address local, national and global demands of forest products and services (URT, 1998). These are radical divergences from the earlier policy (1957) that restricted management to the state authorities focusing more on preservation and controlled utilization. The policy change is a result of emerging macro-economic policies and global environmental management trends. It is also a result of the pressure in recognition of the rights of the communities and the roles of the private sector in managing forest resources as well as availing the opportunities for the forest resources to contribute to poverty alleviation. Policy change provided an opportunity for CDIs to develop project based forest conservation and income generating activities in EUM e.g. agro forestry, beekeeping, butterfly farming and ecotourism.

2.10.2 Land Policy (1995)

Land tenure issues are crucial to local communities as over 80% of the population depends on agriculture and other land based resources (Mariki, 2002). Land Policy have sets direction for land reform, which include significant changes to land acquisition, holding and transfer. The land reform distinguishes between land under the authority of the Central Government and that under the authority of the Village Governments. Elected village councils are the land managers charged with the supervision of adjudication and registration of village land within their villages on behalf of the village assembly.

The National Land Policy provides incentives for efficient use of land and its resources including forest. The Policy encourages legal ownership of land by individuals, private sector, communities and villages through acquisition of title deeds. This is meant to reduce land use conflicts and increase the value of land. The National Land Policy links land development with other policies of all land-based sectors. The natural resources especially forest and wildlife sectors benefit from this clearly defined matter in the areas of land tenure and development of forests and wildlife resources in the general lands. The Policy provide opportunities for CDIs to develop land use plans, which take into account all activities based on forest resource conservation and enhance production of natural resources based on income generating activities in EUM.

2.10.3 National Agricultural Policy (1997)

The ultimate goal of the policy is the improvement of the well being of the local people whose main livelihood depends on agriculture. The focus is to commercialize agriculture so as to increase income levels and alleviate poverty. Commercialization of agriculture may lead to more expansion of agricultural areas with the objective of increasing output for more income hence promoting more conflicts. However, the probability of occurrence of more conflicts has been taken care of through integration approach. Several issues are embodied in the policy one of them being the adoption of integrated agricultural programmes for sustainable use of natural resources such as land, soil, water and vegetation in order to address conservation of environment issues.

Several programmes have been established to implement integrated agricultural approaches effectively. Such programmes include Participatory Agriculture Development and Empowerment Programme, Agriculture Marketing and Development Programme, Agriculture Sector Development Programme, and Agriculture Sector Development

Strategy. In the long run integration of agricultural land uses may reduce pressure on the already land constraint areas like EUM. Agriculture Policy is pertinent for developing agricultural based income generating opportunity in EUM.

2.10.4 National Livestock Policy (2006)

The Livestock Policy (2006) advocates resettlement of livestock owners in overgrazed areas to lower over stocked parts of the country. The implementation of this approach is leading to large scale clearing of forest lands to create rangelands as well as land use conflicts between grazers and cultivators. Better options need to be looked into especially through agro forestry, agri-silvi- pastoral systems and zero grazing. Also, the introduction of better breeds and range management will reduce nomadism, which will reduced poor land use system and conflicts. The policy fosters a more productive management strategy and considers livestock as a household income security; it also contributes more to direct household daily welfare as regards with improving livelihoods. The policy is instrumental for CDIs to intensify development of dairy cattle keeping in EUM.

2.10.5 National Water Policy (2002)

The Overall objective of the National Water Policy (2002) focuses its on ensuring sustainable supply of good quality water in sufficient quantities for domestic, livestock, irrigation, industrial and other uses. The emphasis is on the need to ensure conservation and more efficient utilization of existing water resources through such measures as institutional improvements leading to better planning and management of water resources, and more effective provision of water supply services; greater attention to proper soil management around water sources and conservation of trees/ forests in order to prevent soil erosion and flooding. Other measures include improved measures to monitor and

control water quality so as to prevent contamination of water by industrial wastes, sewage, poorly planned sanitation as well as excessive use of pesticides and fertilizers.

The National Water Policy advocates integrated water resource management and adopts a comprehensive policy framework and the treatment of water both as social and economic good. The policy also comprises environment protection and greater participation of stakeholders as water user groups thus providing a framework for sustainable management of water resource and improvement of people's well-being (URT, 2002). The Water Policy offers an opportunity for CDIs to develop income generating activities in EUM since water constitutes a critical resource in the production of agricultural products, which form an important source of income and livelihoods security in the study area.

2.10.6 National Environmental Policy (1997)

The National environment policy recognizes that the state of the environment has limiting implications to social and economic development and that the human welfare is ultimately based upon the products and services that nature provides. The policy emphasizes on the management and conservation of natural resource with the aim of combating desertification, conservation of biological diversity, managing renewable natural resources and controlling pollution. The policy highlights the necessity of adopting multi-sectoral integration of policies, strategies and programmes when implementing CDIs intended to reconcile local livelihood and natural resource management.

2.10.7 National Fisheries Policy (1997)

The main goal of the National Fisheries Policy and Strategy is to promote conservation, development and sustainable management of fisheries resources for the benefit of present and future generations. This is to be achieved by putting into efficient use the available

resources in order to increase fish production so as to improve fish availability and hence contribute to economic development. This entails improving productivity of fishery resources both in terms of quantity and quality through enhancing knowledge and skills of fishermen and provision of credits. Support is also required towards strategic and applied research. Marketing of fish products also needs to be improved. Organizing fishermen into groups will serve multiple objectives in technical backstopping for improving the fish farming established in EUM.

2.10.8 National Beekeeping Policy (1998)

The National Beekeeping Policy (NBP) consists of the vision and mission of beekeeping development in Tanzania. The National Beekeeping Programme is a framework on which different beekeeping sub-programmes, which implement the NBP, are based. The programme has three sub programmes: (a) Beekeeping Development Programme. Whose objective is “sustainable existence of honeybees, diversity of bee forage and ensured supply of improved quality and quantity of bee products”. This is implemented through land use planning, Conservation of bee forage and improvement of quantity and quality of bee products; (b) Legal and Regulatory Framework development; and (c) Institutions and Human Resources Development.

The National Beekeeping Policy and Strategy clearly identified bottlenecks such as inefficient beekeeping practices, the use of unproductive processing and packaging techniques, which affect negatively the quality and quantity of bee products; poor maintenance of quality and quantity of bee products; and protection of the environment. The Beekeeping Development Project (2001) has iterated specific directions that address most of the problems highlighted in the National Beekeeping Programme (2001). All of

these initiatives are designed to enhance opportunities for conservation and development interventions.

2.10.9 National Strategy for Growth and Reduction of Poverty (2005)

The National Strategy for Growth and Reduction of Poverty (NSGRP) (better known for its Kiswahili acronym MKUKUTA**)** is a national organize framework that places on poverty reduction high on the country's development agenda. The NSGRP is informed by the aspirations of Tanzania's Development Vision of 2025 for high and shared growth, high quality livelihood, peace, stability and unity, good governance, high quality education and international competitiveness. The strategies are also committed to the Millennium Development Goals, as internationally agreed targets for reducing poverty, hunger, diseases, illiteracy, environmental degradation and discrimination against women by 2015.

The NSGRP strives to widen space for country's ownership and effective participation of civil society, private sector development and fruitful local and external partnerships in development and commitment to regional and other international initiatives for social and economic development (URT, 2005). Therefore, NSGRP provides a framework for CDIs programmes to design and implement objectives toward improving human economic capabilities, survival and social well-being, limiting the vulnerability and provide options for income generating opportunity thus reducing pressure on over dependence on natural resources including forests in the study area.

2.10.11 Conceptual framework

The conceptual framework (Fig. 2) indicates positive and negative influences of CDIs on livelihoods and forest resources management. Positive outcomes include sustainable forest resource management, environmental conservation, and improved livelihood and reduced

poverty. Negative outcomes include loss of livelihood, increasing poverty, forest depletion and environmental degradation.

It is hypothesized that inappropriate CDIs that do not in their objectives, address socio-economic parameters such as income, employment, food security and wellbeing, environment aspects which include unsustainable utilization, protection and restoration of forest resources impact negatively on the livelihoods and forest resources, causing loss of livelihoods strategies such as unemployment, decrease in agriculture and livestock production, decrease in income sources (non-farm activities) and increased deforestation and environment degradation.

Deforestation occurs when CDIs fail to integrate local community needs and forest resource base, leading to over utilization of forest resources. Loss of livelihoods occur when local communities fail to withstand shocks and stress in coping strategies for changing local environment. Ghai (1992) argues that, in such a situation, local communities attempt to find the alternative means of accessing the resources to sustaining their livelihoods. This drive increases overexploitation of forest resources causing deforestation and environmental degradation.

On the other hand, CDIs could impact positively on the livelihood and on the status of forest resources. The influence on livelihoods strategies include off-forest resource based activities like cultivation of crops and livestock keeping, trade, employment, manufacturing and services. Such strategies may in turn influences income levels, increased well-being, reduced vulnerability, improved food security, leading to more sustainable use of natural resources.

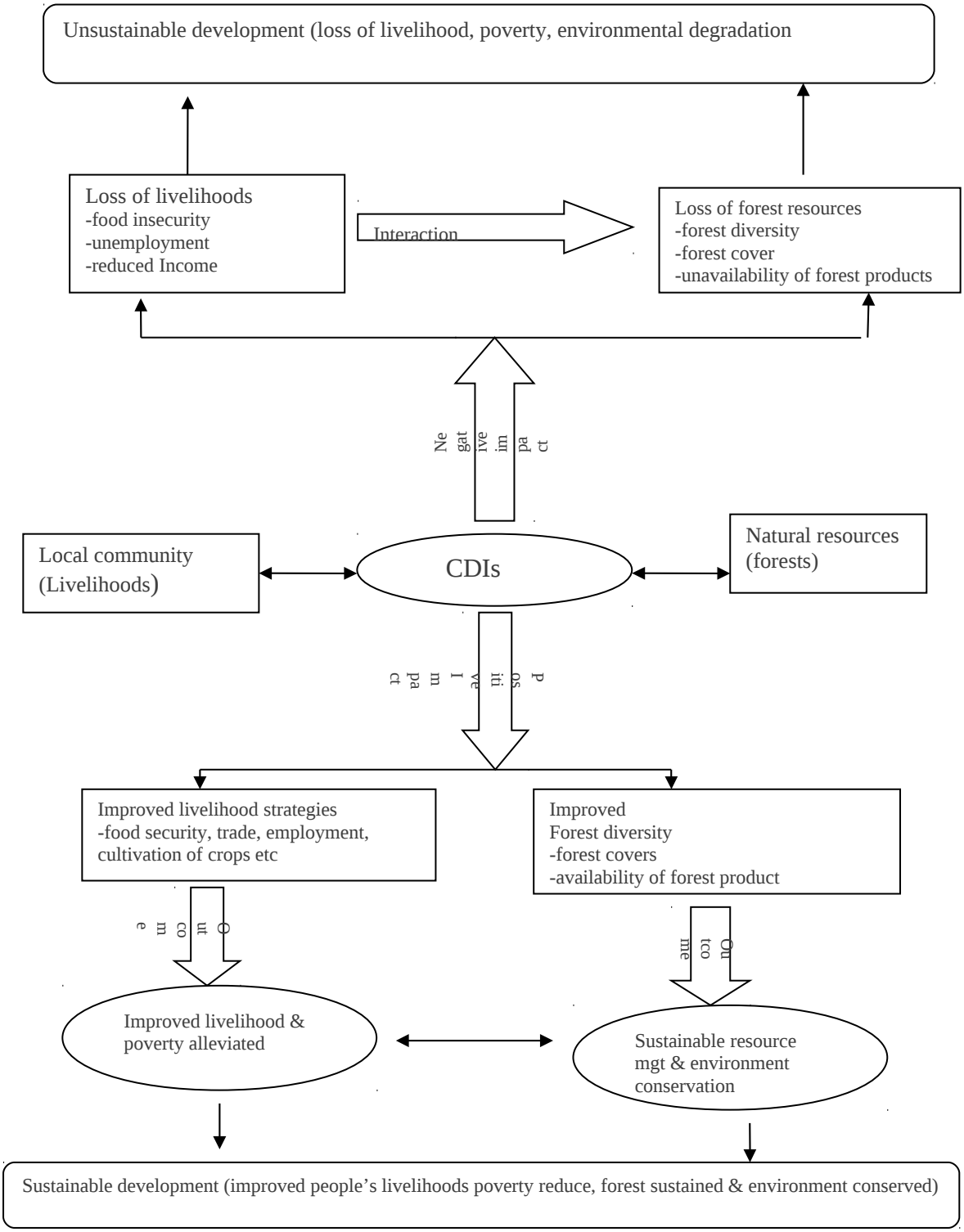

Figure 2: Conceptual framework

CHAPTER THREE

3.0 STUDY AREA AND METHODS

This chapter presents the methodology used in this study. It covers the description of the study area, research design, sampling procedure, data collection methods, and data analysis techniques.

3.1 Description of the Study Area

3.1.1 Location

The study was conducted in four villages at Amani Division in East Usambara Mountain (EUM), located in Muheza district, Tanga Region (Fig. 3), situated between Latitude 4° 48' and 5° 13'S, Longitude 38° 32' and 38° 48'E. The study area forms part of Pangani River Basin (PRB). Furthermore, the study area forms the major catchment area for Zigi River sub catchment of PRB which is the primary water source for Tanga and lowland areas (Ngana, 2001; IUCN, 2003). The study also borders Kenya to the North, Tanga District and Indian Ocean to the East, Pangani District to the South, Lushoto and Korongwe Districts to the West. Administratively, Muheza District is divided into 4 divisions comprising 23 wards with 100 Villages.

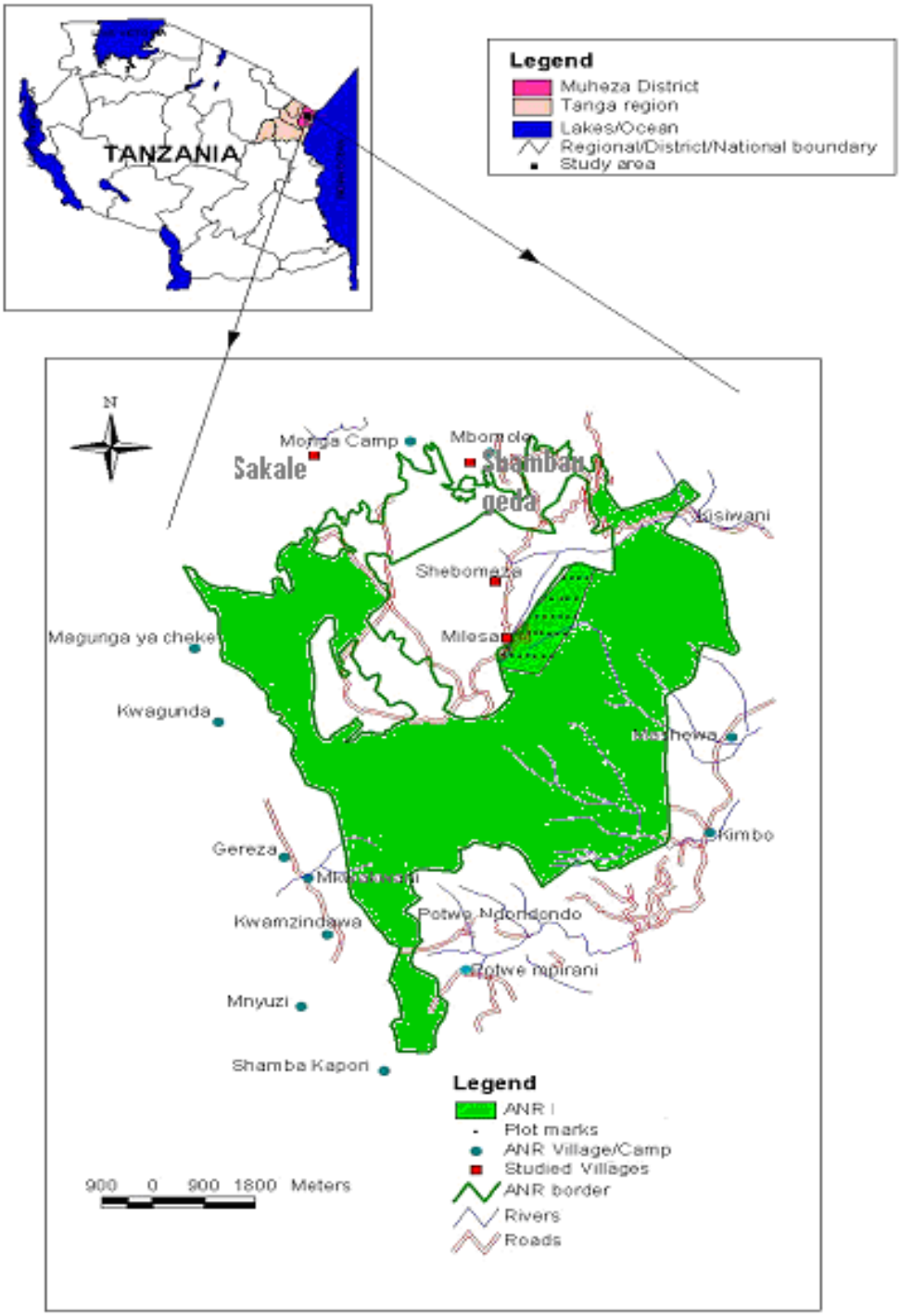

Figure 3: Location of the study villages and forest reserves in east Usambara Mountain, Muheza District.

Source: Amani General Management Plan (2007)

3.1.2 Population

According to the 2002 Population Census, Muheza District had a total population of 169 782 people, of whom 84 721 were males (49.9%) and 85 061 females (50.1%). The District had a growth rate of about 1.4% per year. In 2002, there were 38 814 households with an average household size of 4.4 persons. The mean population density was about 85 persons per km^2, compared with 4.6 of average household size and average population density of 61 people per km^2 of Tanga region (URT, 2003). The 2002 population census showed that Amani Division has a population of about 31 469 people, with an additional 4000 people living and working in tea plantations in the area.

The main ethnic groups are Sambaa, Zigua and Pare that comprise 74.6 % (N=87). Small ethnic groups of immigrants make 25.4% (N=29) including Changa, Nyakyusa, Ngoni, Kuria, Bena, Yao, Hehe, Nyamwezi, Digo and Makua. These groups originated from Mbeya, Iringa, Kigoma, Mtwala, Tabora, Songea and Mara. The reasons for in-migration were to seek employment in Tea Estate (EUTCO), agriculture farming and non- farms activities e.g. petty business and wage employment.

3.1.3 Climate

The climate of the East Usambara is characterized by two rain seasons. March to May is the long rain period while October to December is characterized with short rains. Occasionally, long rains tend to be heavy but the annual average varies from 1000 mm to 2000 mm. The Amani division receives annual rainfall of 1945 mm with recorded extremes of 1377 mm and 3505 mm. The humidity is very high with an annual mean temperature of 20.8ºC degrees. The mean daily temperature has a maximum of 24.6º C and a minimum of 16.3ºC (URT, 2007).

3.1.4 Natural vegetation

Muheza district has two forest types which include low land forest and sub Montane rain forest, which occur below and above 800 m above the seal level. Hamilton and Mwasha (1989) noted that despite the difference in altitude and forest cover, floristic variation continues with altitude. Muheza District has a large area of forest reserves most of which are concentrated in Amani division. These include portions of the Usambaras in the Eastern Arc Mountains in Tanzania that are scenic and renowned internationally for the diversity and endemic species of flora and fauna (EAMCEF, 2005). There are 12 forest reserves (including Amani Nature Reserve) covering about 24 579 hectares. The forest contributes significantly to ecosystem stability through conservation of forest biodiversity, water catchments, soil fertility and support people's livelihood through provisions of forest products and environmental services (URT, 2007).

3.1.5 Land use patterns and socio-economic activities

Crop cultivation, livestock husbandry and forestry are the main land uses in Muheza District. About 85% of the District is suitable for agriculture and livestock activities (URT, 2007). Agriculture is the main economic activity employing almost 75% of the District population. The District has about 416 616 hectares of arable land of which 271 766 hectares or 65.2% is under cultivation. In principle, there is enough land available for the cultivation of crops and livestock keeping. However, the land tenure and lease hold systems limit land utilization by smallholder farmers. Large tracts of land are leased to large-scale farmers for growing sisal and tea while the customary land tenure system leave many people without or with insufficient land for their use.

The main economic activity in the study area is agriculture whereby villagers cultivate both cash and food crops. Cardamom is the main and the highest income earning crop;

other cash crops are cinnamon, black pepper, and cloves, all of which form a critical source of household incomes to the communities. Food crops include maize, beans, cassava, and banana. The community also practices livestock keeping which is mainly done on zero-grazing basis as one of the secondary sources of income.

3.2 Methodology

3.2.1 Research design and sampling procedure

A cross-section research design was used in this study. According to Bailey (1994), the cross-section design allows data to be collected at a single point in time, and the method can be used for descriptive studies as well as for determining the relationship between variables. Purposive sampling was employed in choosing villages. Four villages namely Sakale, Shambangeda, Mlesa and Shebomeza out of 18 villages in East Usambara Mountain were purposefully selected. Two villages (Mlesa and Shebomeza) were closer to Amani Nature Reserve, easily accessible, and implemented CDIs. While other two villages (Sakale and Shambagenda) which were far from Amani Nature Reserve are inaccessible and do not implement CDIs. These two villages that do not practice CDIs were used as a control site.

Household was used as a sampling unity for this study. The decisive factor in choosing the household as the sample unit is that in developing countries, the household[2] is the most commonly unit of production as well as consumption (Casley, 1987). Sampling intensity of 5% or more of the total number of households was used in each village (Grinnel, 2001). Random sampling technique was applied in the selection of 116 households for the interview (Table 1).

[2] A household comprises a person, or a group of persons, generally bound by ties of kinship and who live together under a single roof or within a single compound, and who share a community life in that they are answerable to the same head and share a common source of food (Casley, 1987).

Table 1: Village population and sampled households

Village	Population	No. Household	Sampled household	Percentage
Mlesa	2235	515	27	5.24
Sakale	1499	345	37	10.72
Shambangeda	1000	174	29	16.66
Shebomeza	1337	151	23	15.23
Total	6071	1185	116	

3.2.2 Reconnaissance survey and questionnaire pre-testing

A reconnaissance survey was conducted prior to the conduct of this study, with the intention of getting the general picture, familiarisation with the study area, selecting the study villages and discussions with village leaders inselecting a field team. During reconnaissance survey, the structured questionnaires were pre-tested in five households in ABC-Msasa village for further improvement; meanwhile the research assistants were trained.

3.2.3 Data collection

3.2.3.1 Livelihoods and socio –economic data

Sustainable Livelihood Approach (SLA) framework was employed to assess livelihoods and socio-economic data. The SLA has been widely adopted as a useful analytical tool for designing livelihoods related to development research and especially as a framework for guiding participatory assessment of CDIs. According to Ashley (2000), SLA has an instinctive appeal, it is useful in generating insights and recommendations, it synthesizes perspectives of different disciplines and provides an explicit focus on what matters to poor people when impacted by interventions. However, there are several approaches for SLA that are normally used. Some of these include CARE's, Oxfam GB's and DFID's (Carney *et al.*, 1999).

In this study, DFID's SLA was adopted because it takes into consideration the transformation of assets (capital) into livelihood outcomes. It was also based on multi-dimensional understanding of people's livelihoods. The SLA was used together with information on local community livelihood strategy, socio-economic activities, and natural resource utilization pattern and trends. However, SLA was backed by various primary data collection tools, these included Questionnaire survey, Participatory Rural Appraisal, Participant observation, Focus group discussion, and Key informants.

3.2.3.1.1 Participatory rural appraisal

Participatory rural appraisal (PRA) tools were used to collect primary data. As a research tool, the PRA opens up discussion and facilitates collection of key data about local condition as quickly as possible. The use of diverse sources including the assembled lore of the villagers themselves was also employed to ensure that comprehensive information was also collected (Kothari, 2005). Investigating community's livelihoods strategies through a variety of means made it possible to cross-check the collected data and increased the accuracy of the information.

A variety of PRA techniques were utilized, these included 1) *resource mapping* that was used to tap information on resource condition (such as availability of fuel wood, building pole, land and water) and utilization pattern in the study area; 2) *Venn diagrams* that was used to explore stakeholder's linkage between the existing activities of CDIs and livelihoods strategies; 3) *Timelines* these were used to establish the chronological trends of events, since every community has a heritage of experience and environmental knowledge that influences present attitudes and behavior such as change of important livelihood strategies and outcomes, natural resource based utilization and conservation. However, the technique was aimed to explore constraints and achievements of CDIs as far back as it can

be remembered by the local community; 4) *Seasonal diagramming* this was utilized to gather information on the distribution of livelihood activities such as agricultural labour, food availability, employment, off-farm activities, and the collection of natural forest products. This technique helped to highlight seasonal fluctuations, and to indicate how people adapted to the changing environment situation in a particular period.

3.2.3.1.2 Household questionnaire survey

The questionnaire survey (Appendix 1) was administered to randomly sampled households. The open and closed-ended questions were used to gain in-depth information on certain phenomena related to socio-economic status (such as age, gender, education, family size, income); livelihood strategies such as agricultural farming, livestock farming, employment, trade, beekeeping and fish farming; forest management and conservation efforts such as access, utilization pattern and restriction. Also information on problems and achievement of CDIs on people's livelihood and interaction to forest resources/products in the area was collected. A total of 116 households out of 1185 households in the four villages were interviewed (see Table 1). Out of these households 55% of the respondents interviewed were male headed and 45% were female headed.

3.2.3.1.3 Focus group discussion

The Focus Group Discussion (FGD) was conducted by using checklists (Appendix 2). The team for FGD comprised both men and women. The group included 8-10 participants in each village. A total of 36 participants were involved, comprising 22 men and 14 women (Table 2). Village government leaders, village environmental committee members, influential people, religion leaders, income generating group's representatives and extension officers in each village were involved in the focus group discussion.

The FGD was used to cross check the information obtained from PRA and from household questionnaire survey. Issues such as livelihood strategies, access and utilization of forest products, and interventions toward conserving forest resources and improving people's livelihoods were intensively discussed.

Table 2: Participants of focus group discussion

Village	Participants		
	Men	**Women**	**Total**
Mlesa	6	2	8
Sakale	6	4	10
Shambangeda	3	5	8
Shebomeza	7	3	10
Total	22	14	36

3.2.3.1.4 Key informant

During Key Informant (KI) interviews, Strategic Informant Sampling (SIS*)* was used where the people who were thought to have most and relevant information were consulted for discussions. By using this method, information was obtained from the District Natural Resource Officer, District Forest Officer, District Catchment Forest officer, District fisher's Officer, District Beekeeping Officer, District planning officer, and District Executive Director in Muheza Districts headquarters. In Amani division, discussions were held by village leaders (chairman and Village Executive Officer), The Manager of butterfly farming (TCFG) in Amani field office, Umoja wa Wauza Maziwa Amani (UWAMA), the Conservator of Amani Nature Reserve, the Kwamkoro Tea Estate Manpower officer and the extension staff. In all the interviews conducted, discussion was guided by a check list of questions (Appendix 2).

3.2.3.1.5 Field observation

Field observation techniques was used to collect information through regarding adoption of soil and water conservation practices, fish farming, beekeeping, energy saving stove and butterfly farming of individual household in the villages. Information on forest product utilization pattern, encroachment into forest reserves were also gathered by this method. The method was used to supplement and cross-check the validity of information that was collected through PRA, questionnaire survey, focus group discussion and key informant interviews. Observing operations in the field gives an opportunity to discuss with the community on what, why and how things are implemented. Mettrick, (1993) insists that it is always essential to keep one's eyes open when visiting the communities to check what one is told against what is observed.

3.2.3.2 Ecological data

Forest resource inventory was conducted in Kwamkoro Forest Reserve (KFR). This forest had an area of 275 ha and it is among six forest reserves merged to form Amani Nature Reserve (ANR). Other forest reserves include Amani-East, Amani-West, Amani-Zigi, Kwamsambia and Mnyuzi Scarp, forming a total area of 8380 ha of Amani Nature Reserve (AGMP, 2006).

The main reasons of selecting KFR for ecological study are as follows: First, the forest was highly vulnerable to human activities and through this the catchments quality have been negatively affected by commercial clear- felling and selective logging that took place between t 1970s and 1980s. Prittila (1993) identified some of the impacts of commercial logging in KFR such as land slide and siltation of Zigi River which is the source of water to Tanga Municipality. Secondly, the forest has been under CDIs intervention since 1997. Third, a similar study which was undertaken in KFR in 1998 by Kessy and Temu (1998)

revealed evidence of human disturbance in forest reserve. This was used as a baseline study. During inventory, Tree parameters such as diameter and height were measured. Indicators of human disturbance such as new and old cut of trees, dead stump, debarked and a number of wild animal traps were recorded.

A systematic sampling design was employed to locate sampling units in the KFR, in order to cover the whole area, the KFR was divided into five transect lines that was placed 2.5 km apart starting from the edge of the forest. Ten concentric circular plots were located along each transect line. In order to avoid edge effects, the first plot was established 20 m from the forest edge. Other plots were located consecutively along the transect line at an interval of 100 m from the first plots. The distance between the plot in transects was 1000 m from the edge of the forest. Temporary concentric sample plot of size 0.071 ha with 0.05% of sampling intensity were established systematically along the transect lines that run parallel to each other (Fig. 4) (Philip, 1992). The Transects were laid down on a map and then on the ground with the help of GPS to locate coordinate of commencing transect points and compass to maintain distances and direction. Instruments such as Diameter tape and Caliper were used for diameter measurement, while hypsometer and graduated pole were used for height measurement.

Measurements in each sample plots were as follows;

- Within 5m radius all trees with dbh ≥4 cm <10 cm were recorded.
- Within 10m radius all trees with dbh≥ 10 cm <20 cm were recorded.
- Within 15m radius all trees with dbh ≥ 20 cm were recorded.

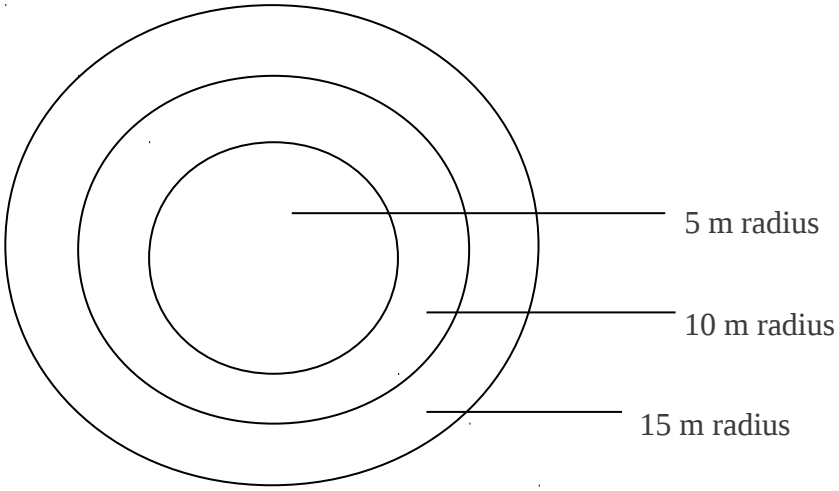

Figure 4: Concentric circular shape of nested sample plots

In each plot, one tree closest to the plot centre was measured for height. This was used for height estimation and computation of tree volumes. Tree identification was done with the assistance of one staff from TAFORI, who identified all trees in scientific names during field inventory. Some of the trees which were not easily identified in the field were collected and cross-checked with the help of botanical books.

3.2.3.3 Secondary data collection

Extensive literature survey was conducted where books, publications, brochures/ Journal and documents related to the topic under study were reviewed. Much of the literature and reports were obtained from Muheza Districts Council, Amani Natural Reserve Office, Projects/Program office, and from Wards and Village executive's offices. Other relevant materials used in this study were obtained from SUA Library and the internet.

3.2.4 Data analysis

3.2.4.1 Qualitative data analysis

The data collected from PRA, Key informant and Focus group discussion were analysed with local communities and the results were communicated back to them for verification and custody. The content and structural –functional analysis was employed to analyse qualitative data. The content and structural –functional analysis is a method for analysing the symbolic content of any communication (Singleton *et al.*, 1993). According to Kajembe *et al*. (2003), the technique helps the researchers in ascertaining values and attitudes of the respondents thereby generating themes and tendencies. This implies that verbal discussion from different respondents was broken into meaningful units of information or themes under livelihoods strategies, impact of CDIs, and forest resources management.

3.2.4.2 Quantitative data analysis

The data collected from questionnaire interview, open-ended and closed questions were summarized and coded and analysed by using Statistical Package for Social Science (SPSS 11.5). Most of the analysis under quantitative data falls under the domain of descriptive statistics and inferential statistics. In this regard, cross tabulations was employed. The analyzed data was presented in tabular form, pie chart, means, frequencies and percentages.

Simple Correlation analysis was used to show the relationship between activities of CDIs and livelihoods outcome (e.g. income, land size, employment, well being). The Pearson product of moment coefficient of correlation (or simply, the coefficient of correlation r) was employed to depict the relationship. This was computed (sample of n measurements on x and y) as follows;

$$\mathbf{r} = \frac{SS_{XY}}{\sqrt{SS_{XX}\,SS_{YY}}}$$

Where

SS_{XX} =Sum of square of X scores

SS_{yy} =Sum of square of Y scores

SSxy = Sum

A value of r near or equal to 0 implies little or no linear relationship between variable x and y, The closer the value of r to 1 or to -1 implies the stronger the liner relationship between x and y the statistical significant of r was tested by a simple t-test at $P<0.05$ significance.

Logistic regression analyses were used to establish the relationships between CDIs activities and socio-economic factors influencing achievement and constraint of CDIs. The logistic regressions were as follows:

$Y_i = 1/1+e^{-z}$

Where;

Y_i	=	the i^{th} probability of event to occur for the dependent variable (a binary/ dichotomous variable with value of 1 if there is influence on CDIs implementation and 0 if otherwise).
Z	=	$\beta_o+\beta_1X_1+\beta_2X_2+ \ldots\ldots\beta_nX_n+ e$
Z	=	the i^{th} observation value (score) of the dependent variable representing response to combination of independent variables.
β_o	=	constant term of the model without the independent variables
β_1 to β_n	=	coefficients of independent variables
e	=	natural logarithm base (2.718)
I	=	1, 2 ….n; where n is the total number of variables

X_1 to X_n = independent variables such as Promotion IGA, Forest protection and management, Stakeholder participation, Employment and source of income, Balance conservation with community development, Lack of capital and access to financial service, inadequate of resources and material supports, inadequate extension service and inadequate reliable markets.

3.2.5 Forest stand parameter analysis

The Microsoft excels- spreadsheet software was used to analyze the inventory data. The parameters computed include number of stems per hectare (stems/ha), basal area (m^2/ha) and volume (m^3/ha)**.** Since only sample trees were measured for total height**,** a model was developed for height –diameter relationship as follows.

$$Ln (Ht) = 1.8254 + 0.2487 Ln (dbh)^2$$

(R^2 = 0.858, SE = 0.098)

The number of stems per ha (N- Stems / ha.), Basal area per ha (G-m^2/ha.) and volume per ha (V- m^3/ha.) were calculated as follows:

$$N = \sum i / (a * n)$$

$$G = \sum gi / (a* n)$$

$$V = \sum vi / (a*n)$$

Where

H = Total tree height (m)

D = Diameter at breast height (dbh)

R^2 = Coefficient of determination

SE= Standard error

i = Individual tree

gi = Basal area of a tree (= π * D^2) / 400) (M^3)

vi = volume of a tree (= gi * H* f) (m^3)

f = form factor (= 0.5)

a = plot area (where radius = 5m, 10m, 15m)

Shannon-Wiener Index of Diversity (H') was used to determine tree species diversity. This is the most widely used index of diversity, which combines species richness and evenness and is not affected by sample size. Philip (1992) points out that, Shannon-Wiener Index of Diversity measure information content of a sample; and since information content is a measure of uncertainty, the large the Shannon-Wiener Index value H' the greater the uncertainty. The index increases with the number of species in the community but in practice, for biological communities H' does not exceed 5.0. The Shannon-Wiener Index function was calculated using the following formula (Kent and Coker, 1992).

$$H' = -\sum_{i=1}^{s} (pi \log_a pi)$$

Where;

H' = Shannon index of diversity,

s` = number of species,

p_i = the proportion of individuals or the abundance of species in the sample,

$\log_a$ = the logarithm to base a (any base of logarithm may be taken), and

- Negative sign multiplied with the rest of variables in order to make H' positive.

$\sum$ = Summation symbol

Tables, pie charts and graph were used to summaries the inventory data.

The species Importance Value Index (IVI) was calculated as the sum of Relative Density (Rel.Dens), Relative Frequency (Rel.Frq) and Relative Dominance (Rel.Dom). This parameter was calculated as follows (Kent and Coker, 1992):-

$$\text{Relative Density} = \frac{\text{Number of individual of a particular species} \times 100}{\text{Number of individual of all species under consideration}}$$

$$\text{Relative frequency} = \frac{\text{Frequency of occurrence (plot) of particular species} \times 100}{\text{Frequency of occurrence of all species under consideration}}$$

$$\text{Relative Dominance} = \frac{\text{Basal area of a particular species} \times 100}{\text{Total basal area of all species under consideration}}$$

3.3 Limitation of the Study

Several limitations were encountered during the study, these included among others:

1. Influences of CDIs on people's livelihood were based on memory specifically the data before CDIs. Thus more time was consumed in responding to issues and some time there was no responses. This problem was complemented by additional information obtained from focus group discussion, Key informants and actual field observation.

2. Difficult in GPS reading and height measurement caused by closed forest and steep slope. However a directional compass and tape measure were used for supplementing measurement.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Overview

This chapter discusses the findings on general characteristic of the respondents in the study villages; CDIs and their main activities implemented; impact of CDIs on local community livelihood strategies; the status of forest resource management; and the socio-economic factors influencing CDIs in the study area.

4.2 General Characteristics

General characteristics examined include Age, family sizes, marital status, and education level of the respondents.

4.2.1 Age of respondents

Age is an important parameter in socio- economic analysis since different age groups perform different sets of activities in most societies. The results show that the people in the age of between 19 and 30 comprised about 24.1%, middle age of between 30 and 45 were 31.1%, and those between 45 to 60 years were about 32.8%, whereas those above 61 years were 10.3% (Table 3). It is also revealed that age in both villages in the studies ranges from 30 to 60 years, which is the productive age. Generally, the results imply that most of the respondents interviewed were mature people, who might have been involved in the implementation of CDIs project activities and/or witnessed the impact of CDIs in their vicinity. According to Nkurlu (2002), the age of a person is usually a factor in explaining the level of production and efficiency. Therefore, mature people with more resources, experience and authority are more inclined to try new technologies initiated in their vicinity.

Table 3: Age of respondents

Variable	Village responses				Total %(N=116)
	Sakale %(n=37)	Shambagenda % (n=29)	Mlesa % (n=27)	Shebomeza % (n=23)	
Age (year)					
< 19	2.7	0.0	0.0	0.0	0.9
Between 19 - 30	32.4	24.1	18.5	17.4	24.1
Between 30 - 45	32.4	34.5	33.3	26.1	31.9
Between 45- 60	24.3	31.0	40.7	39.1	32.8
> 60	8.1	10.3	7.4	17.4	10.3
Total	100.0	100.0	100.0	100.0	100.0

4.2.2 Marital status

The results in Table 4 revealed that 84.5% of the respondents were married, followed by 6.0% of the widowed, while 5.0% were single and about 4.3% were divorced. This implies that most of the respondents interviewed in the study area were mature and have obligation of meeting the basic needs for the family, and could contribute to the success and sustainability of the CDI's because these people are settled (Salami *et al*., 2002). Contrary to the group of those who are single, might be mobile. For instance, someone trained on a certain CDIs technologies could be married to other area or migrate to town for wage employment.

4.2.3 Family size

The results in Table 4 show that about 52% had household size ranging between 6 and 10 people, while 43.1% of the household size ranged from 1 to 5 people and minority (5.2%) of these household sizes ranged from 11 to 15 people. The results further indicate that the study area had an average size of 6.2 people per household, which was relatively higher than the national average of 5 people per household in Tanzania mainland and 5.6 people in Tanga region (NBS, 2003). Bird *et al.* (2005) reported that in the rural areas the household size tends to be relatively higher than in the urban area. The implication of large household size is that food and other natural resource base automatically have to be

available to meet the demand of the increase in the number of people in the households. The reason attributed to higher household size could be in-migration people being attracted by employment opportunities in Tea Estates and Agriculture farming. Other reasons might be due to inadequate emphasis in family planning resulting from high birth rates in the study area.

Table 4: Marital status and family size of respondents

Variable	Village responses				Total
	Sakale %(n=37)	Shambagenda % (n=29)	Mlesa % (n=27)	Shebomeza % (n=23)	%(N=116)
Marital status					
Single	5.4	10.3	0.0	4.3	5.2
Married	89.2	79.3	88.9	78.3	84.5
Divorced	2.7	3.4	7.42	4.3	4.3
Windowed	2.7	6.9	3.71	13.0	6.0
Total	100.0	100.0	100.0	100.0	100.0
Family size					
1-5 person	40.5	34.5	51.9	47.8	43.1
6-10 person	51.4	58.6	44.4	52.2	51.7
11-15 person	8.1	6.9	3.7	0.0	5.2
Total	100.0	100.0	100.0	100.0	100.0

4.2.4 Education level of respondents

The results show that 73.3% of the sample population had attended primary school education level, while 17.2% had no formal education. The study further revealed that the study area had high level of literacy of adults with about 73.3% having with primary school education. This rate is higher compared to the average literacy level of Tanzania mainland (56%) (NBS, 2003). Education is perceived as being among the factors that influence individual up-take of an innovation and it informs and creates a desire to individual to learn more and seek resources and any other information regarding the improvement of his/her well-being and sustainable use of natural resources. Therefore, education enhances working efficiency, productivity and enabled household to use resources and adopt new technologies, leading to improvement of livelihoods.

Table 5: Education level of respondents

Education level	Village responses				Total
	Sakale %(n=37)	Shambagenda % (n=29)	Mlesa % (n=27)	Shebomeza % (n=23)	%(N=116)
No formal education	16.2	17.2	14.8	21.7	17.2
Primary school level	78.4	69.0	74.1	69.6	73.3
Secondary school level	2.7	13.8	11.1	8.7	8.6
Diploma	2.7	0.0	0.0	0.0	0.9
Total	100.0	100.0	100.0	100.0	100.0

4.3 CDIs Identification and their Main Activities

This section presents the findings on the identified CDIs in existence in the study area; their main activities implemented; local community awareness and stakeholder collaboration.

4.3.1 CDIs identification

Identification of CDIs was important in order to determine programme/ project with wide implementation and the perception of stakeholders. Table 6 indicates that about 42% of the respondents ranked East Usambara Conservation Area Management Programme (EUCAMP) as a major CDI in their locality, while 19% mentioned East Usamabra Butterfly Farming Project which is under Tanzania Forest Conservation group (TFCG) and about 39% didn't respond to this question.

It was noted that EUCAMP was implemented in Mlesa and Shebomeza villages, which was closer to Amani Nature Reserve and which is easily accessible by road. Further, TFCG fund Butterfly Farming Project in Shembagenda village as one among the pilot village implementing butterfly farming project. In addition, it was discovered that no CDI was implemented in Sakale village. Sakale village is located 60 km from Muheza district where social services are found. Remoteness of the village could be a reason for not

implementing CDI, despite being situated on the upper Catchments of Zigi River which is the source of water to Hale Hydropower Station, Tanga Municipal and other down stream uses. For this reason, Sakale village was supposed to be included in the intervention to safeguard Zigi River Catchment for the purpose of maintaining flow of water in the river, environmental services and enhancing community well-being.

Table 6: Response on identification of CDIs

Project /programme	**Village responses**				**Total**
	Sakale %(n=37)	Shambagenda % (n=29)	Mlesa % (n=27)	Shebomeza % (n=23)	% (N=116**)**
TFCG	0.0	75.9	0.0	0.0	19.0
EUCAMP	0.0	0.0(0)	96.3	100.0	42.2
No intervention	100.0	24.1	3.7	0.0	38.8
Total	100.0	100.0	100.0	100.0	100.0

Other institutions, project and programme were also identified as being involved on supporting activities that geared toward improving people's livelihood and enhancing conservation of natural resources in the study area. Table 7 presents the lists of other institutions, projects and programme showing their objective and responsibility in the study area. Both institutions and project contributed on community livelihood by creating employment, enhancing household income, ensuring conservation of the environmental resources, implemented sector policies and disseminating research findings to other stakeholders within and outside the country.

Table 7: List of institutions, projects /programme and their objectives and responsibilities in East Usambara Mountain

Institution/Project/Programme	Objective	Activities
Village government	Administration and mobilize community for village development.	• Protect forest reserve and water sources e.g. conduct patrol. • Formulate and enforce environmental bye- laws. • Sign contract /agreement with other authority on behalf of community for village developments services.
District council	Provision of social service and sector policies implementation	• Promotes environmental education and awareness • Protect natural resource (i.e. forest ,wildlife and water sources) • Make follow up on implemented conservation and development intervention • Approve bye- laws formulated by village environmental committees
Religious institution	Provision of moral and spiritual support to community members	• Improve social cohesion among community • Contribute development activities and social service e.g school, hospital water etc
East Usambara Tea Company limited (EUTCO)	Tea production and conservation of forest catchment	• Protect watershed and natural resource falling within their lease land • Contribute on development activities and social service to local community • Promote tea cultivation to out grower • provide employment to local community
Umoja wa Wauza Maziwa (UWAMA) (since 2002 to 2007)	Promote zero grazing dairy cow to enhance milk production	• Improve dairy breed for milk production • Provide knowledge in dairy farming and environment conservation • Promote soil fertility through farm manure
Amani Nature Reserve authority (Since 1997 to 2007)	Conservation and protection of biological diversity, support local livelihoods	• Manage Amani Nature Reserve • Support adjacent communities development service • Create employment to local community
Mlingano Agricultural Research Institutes	Conduct research and disseminate finding on fruits and spices production	• Improve production of seedling of spice and fruit trees • Provide knowledge on propagation and management of spice trees • Disseminate research finding to stakeholder

Institution/Project/Programme	Objective	Activities
National Institute for Medical Research (NIMR)	Conduct research on malaria for health improvement	• Conduct research and disseminate finding on malaria and related disease, • Provide social service to local community e.g. healthy service
Marikitanda Tea Research Institute(MTRI)	Conduct research for improvement of tea production	• Conduct research on tea propagation technology and plant trees for fuel wood • Disseminate research finding to tea out grower and tea estates
Tanzania Forest Research Institutes (TAFORI)	Conduct forest research	• Conduct forest research activities in Amni Botanical garden, Kwamkoro arboretum and other part of Amani Nature Reserve • Disseminate research finding
Tanzania Forest Conservation Group (TFCG) (1993 to 2007)	Support forest conservation and improvement of local livelihoods	• Collaborate in conservation activities • Improve household income through butterfly farming project • Conduct environmental education to local community
East Usambara Conservation and Agriculture Development Project(EUCADEP) (1987-1997)	Promote agricultural and community development	• Project worked with local people to assist them with agriculture development and to reduce their reliance upon the forest. • Promoted soil and water conservation practices
East Usamabara Catchment Forest Project (EUCFP) (from 1990 to 1998)	Conservation and protection of catchment forest	• Promoted conservation of catchments forest reserves and supported improvement of livelihood forest adjacent community.
East Usambara Conservation Areas Management Programme (EUCAMP) (from1998 to 2002)	Conservation of biological diversity and improving local livelihood	• Support conservation and management of natural resource (forest catchment) • upgraded the East Usambara Mountains Forest (Amani Nature Reserve) into Man and Biosphere Reserve (MAB) • introduced income generating activities i.e fish farming ,beekeeping , farm forestry, wood saving stove, bio-intensive gardening
UNILIVER project(from 2004 to 2007)	Promote processing and marketing of non-forest product	• Provide training on collection and selling *Allanblackia* seed • Enhance households income by providing market for *Allanblakia* seed • Promote domestication *Allanblakia* sp to local community
Eastern Arc Mountain Conservation Endowment Fund (from 2005 to 2007)	Conservation and management of eastern arc mountains	• Support conservation activities in East Usambara Mountain forest (Muheza District and Amani Nature reserve)

		• Provide conservation education to local community

4.3.2 Main activities implemented by CDIs

Table 8 shows the main activities implemented by EUCAMP. About 30% of the sample revealed that the project promoted energy saving stoves and 28.4% mentioned commercial tree nursery. While about 22% of the respondents mentioned beekeeping and 19.4% indicated fish farming. Most of the activities were implemented in Mlesa, Shebomeza and Shambageda villages, while no interventions were implemented in the Sakale village.

Table 8: Environmental activities implemented by EUCAMP

Activity	Village multiple responses				Total
	Sakale %(n=37)	Shambagenda %(n=29)	Mlesa %(n=27)	Shebomeza %(n=23)	%(N=116)
Fish farming	0.0	11.4	22.6	20.3	19.4
Beekeeping	0.0	13.6	24.7	23.4	21.9
Energy saving stoves	0.0	40.9	26.9	28.1	30.3
Commercial tree nursery	0.0	34.1	25.8	28.1	28.4
Total	0.0	21.9	46.3	31.8	100.0

Further, it was observed that in Mlesa, Shebomeza and shambagenda villages there were other activities, which were being implemented by other CDIs such as TFCG, UNILIVER and Tanga Small Scale Dairly Project. The environmental interventions includes Soil and water conservation practices, farm forestry (agro forestry), collection and selling of *Allamblankia* seeds, vegetable garden, butterfly farming and zero grazing of dairy cattle. Activities implemented by CDIs are discussed in the following sub section.

4.3.2.1 Soil and water conservation practices

The land use systems practiced by most farmers in EUM do not demonstrate productive use of land nor is it environmentally sustainable. The major task of the CDIs, including EUCAMP were training on soil and water conservation practices aiming at increasing

productivity of the farmland by reducing soil erosion, introducing organic manure, and reducing shifting cultivation, which demands large areas of forest to be cleared for additional farm.

However, the adoption of soil and water conservation practices in the study area is not very promising even through farmers were trained. Only few farmers were observed building terraces on their farms, many people plants along rather than across the slopes. For instance, it was reported in the sampled villages that a total of 77 farmers' received training, but only 23 adopted the skills. This was confirmed by EUCAMP (2002) evaluation report, which reported that out of 524 farmers who were trained on soil and water conservation techniques in the project area, only 159 farmers started practicing the acquired skills. Farming lands in the study area were often at fairly steep slopes and need special attention on soil and water protection.

4.3.2.2 Farm forestry

Farm forestry including tree retention and planting of commercial and other multipurpose trees in integrated land management and land husbandry were conducted by EUCAMP, with a long term target of having the local people have sufficiency and sustainable forest products while reducing pressure toward forest reserve. During the project operation, planted trees increased from 10 702 in 1999 to 22 000 in 2002 in Amani Division (EUCAMP, 2002).

In the study villages, non-competitive tree species like *Grevillea*, *Calliandra* and the nitrogen fixing *Leucaena*, *Gliricidia* and *Albizia* were observed being planted on the farm boundaries. Inter planting trees with annual crops, combined with other soil and water conserving techniques were also observed being practiced. Further, it was revealed that

farmers in the study villages were increasingly interested in planting trees on their farms, mainly because firewood and building materials were becoming scarce, and that more restrictions were imposed by ANR authority in the reserve. However, it was noted that although people were willing to raise seedlings and plant trees in their farms, there was often lack of technical knowledge and material support to establish tree nurseries. Technical knowledge and material support are encouraged in order to reduce pressure on natural forests and reduce conflicts among stakeholders.

4.3.2.3 Energy saving woodstoves

In EUM wood fuel is the main source of energy and collecting firewood is the task of women and girls (Mbeyale, 1999). In order to reduce the workload of women and pressure to natural forests, few women were trained on building, maintaining and using energy saving wood stoves by EUCAMP and TFCG. The fuel –saving stoves were easily and cost effectively spread through the training of trainer's techniques, whereby the trained farmers were used as trainers in other villages. EUCAMP (2002) reported on the increase of the adoption rate of fuel saving stoves from 107 farmers in 1999 to 530 farmers in 2002 in Amani Division.

A focused group discussion with women in the sample villages, estimated that 65% of the total households used fuel saving stoves. Further, they added that the stoves could save energy at more than 50%; and the frequencies of going to collect fire wood had been reduced from 5 to 3 per week for a family size of 4-7 people in a household. White and Mustalahti (2005) reported that women in Amani acknowledged a big saving in firewood of 50-70% when they use the energy saving stoves. It was noted further that the sanitation of the kitchen has been improved because of less smoke spreading around the house, contributing to human health. Properly dried fire wood and well –designed, well built and

used improved stoves with chimneys reduce kitchen pollution substantially (Karekezi and Turyareba 1995; Smith, 2006). Improved stoves may have social (e.g. time –saving), ecological (e.g. tree-conserving) and economic (fuel saving) benefits.

4.3.2.4 Beekeeping

Before the implementation of CDIs, illegal hunting and collecting of wild honey by local villagers was reported as the main activity in the forest reserves. This was regarded as a copping strategy with food insecurity in the households. The farmers used traditional beehives made from tree logs. EUCAMP and TFCG introduced modern beehives and equipment to improve beekeeping industry meanwhile conserving the natural forest and creating alternative food and income sources to the households.

It was reported that in Mlesa and Shebomeza villages only 10 and 5 people respectively were still practicing beekeeping, and very few of them harvested honey, whose production estimates ranged from 1-2 liters per beehive as opposed to other parts (Morogoro, Tabora, Iringa, etc) of the country where one beehive produces up to 15 liters of honey (WWF, 2006) (Plate 1. show modern bee hive estimated to produces 15lts of honey).

The reasons given for having a fewer number of people practicing beekeeping were high prices of improved beehives, which cost Tsh. 35 000/= per hive and unreliable market for the products within and outside the villages. Bradbear (2003) cited limited access to transport and market information as the main reason for beekeepers in remote rural areas to receive low prices for their produce. Communities are normally constrained with inaccessibility to market information and capital investments.

Plate 1: **Tanzania Top Bar hive commonly used in other parts of the country**
Source: WWF (2006).

4.3.2.5 Spices cultivation

Most valuable cash crop (promoted by EUADP) in the EUM was cardamon, which is grown under tree covers. The most preferred site for cardamom cultivation is the natural forest. In the establishment of the ANR, areas of cardamon cultivation using trees with good cover were included in these reserves after an agreement with the villagers. The cultivation of other spices as alternative valuable cash crops, like black pepper, clove and cinnamon, were introduced to farmers to replace cardamom cultivation. Restricted access to land by ANR for cardamom cultivation was the cause of significant loss of household income. For instance, in Mlesa village, one acre of cardamom was able to fetch an income of between Tsh. 200 000/= to 350 000/= Tsh. per household, this had a great contribution to households income. For instance, Roe *et al.* (2002) observe that to some poor communities in the rural areas a small amount of income can make a critical different in the households copping strategies.

4.3.2.6 Butterfly farming

In 2003, Tanzania Forest Conservation Group (TFCG) initiated Amani Butterfly Project with the aim of improving livelihoods of rural communities and promoting biodiversity conservation adjacent to ANR. About 50% of the farmers in Shambagenda village were noted to be involved in butterfly farming. Farmers were trained by the project on flight cages designing; breeding cages, sleeves, and butterfly nets, marketing butterfly pupae. The project also provided material support on such things as tree seeds, nets and polythene tube (Plate 2).

TFCG butterfly field manager reported that about 400 people were engaged on butterfly farming in EUM and about 5% of these people depended entirely on butterfly farming, accruing an average of Tshs. 45 000/= per month to their households. Further, the revenue generated from the sales was distributed according to agreed principle; i.e. 65% goes to butterfly farmers, 28% is retained to run field office and 7% goes to the village to support community development projects (WWF, 2006).

Plate 2: Butterfly houses in Shambagenda village, Muheza District.

4.3.2.7 Zero grazing dairy cattle

Zero grazing dairy cattle was promoted by Tanga Small Scale Dairy Project, and in the study area it was operated by "Umoja wa Wauza Maziwa Amani" (UWAMA). The main objective of the project is to promote milk production and enhance household income. The project provides training, heifers' and extension services to farmers. Currently, the project is well received and many farmers adopted the technology innovations (Plate 3)**.** The project is beneficial to the farmer and had a very high potential to household food security, income and soil fertility improvement through farm manure (AGMP, 2007). The milk collection point was Amani center, where farmers sell their milk. It was noted that although the project, which introduced dairy farming, had phased out, the farmers still continue practice project skills. This is a sign of sustainability and acceptance of the project within the community.

Plate 3: Household dairy cattle farming in Amani Division, Muheza District.
Source: WWF (2006)

4.3.2.8 Fish farming

Before EUCAMP interventions fishing was mainly done in the rivers. During field survey, the people were observed fishing in Zigi River. Fish farming in dams and ponds was initiated by EUCAMP in collaboration with the Tanzania's Government (Plate 4). Community groups were trained on modern fish farming technology. Since 1999, there was an increase of the number of fish farmers during the project lifetime, but an abrupt drop occurred after the FINNIDA funding stopped (Fisher officer, Syvester, G. Person communication, 2007). According to Sylvester, until the end of the project, 200 fish ponds were constructed and planted with fingerlings in Amani Division. During the project operation, 134 community groups were trained on fish management and provided with fingerlings. Tilapia (*Oreochromis*) was the fish species practiced in the study area. Fish farming has no negative impact on the environment and has the potential to increase the availability of nutrition and household income once sold and consumed as food.

Plate 4: One of the fish ponds at Shebomeza village in Muheza District.

4.3.2.9 Collection and selling indigenous *Allanblankia* seeds

There is a great potential for the local community in the study villages to benefit from the collection and sales of Non Timber Forest Products. During focus group discussion it was reported that the collection and sales of indigenous *Allanblankia* seeds contributed to about 100,000/= per year of the household's income. The activity was being supported by UNILIVER Project which operated under TFCG. Communities were trained on the method for collecting and processing seeds (see Plate 5). Also, the project facilitated marketing of all the seeds collected by farmers**.** Since *Allanblankia* is a forest product with less input costs, reliability of the market made immediate response for many farmers to participate.

There was an attempt to domesticate *Allanblackia* spp through the establishment of *Allanblackia* nursery at Mlesa village and Kwamkoro forest Station (AGMP, 2007). The purpose was to reduce the collection of *Allamblackia* seeds from the Nature Reserve. However, the sustainability of this project was questionable due to dependence on UNILIVER as the only source of marketing. The study noted that training on the extraction of oil from the collected seeds could help increasing sustainability of the project.

Plate 5: *Allanblackia* seeds being dried on the ground at Mlesa village in Muheza District.

4.3.2.10 Vegetable garden

Vegetable garden was another income generating activity promoted by EUCAMP. The aim was to provide farmers with an alternative source of vegetables for domestic use and income generation. The main tool used to promote this activity was training on how to establish bio- intensive gardening (EUCAMP, 2002). Various vegetables such as amaranthus, cabbage, lettuce, Chinese, tomatoes and onions were found to be grown at the homesteads. The garden growers received support from EUCAMP. More than 45% of community in the study villages had adopted vegetable growing. It is estimated that a vegetable grower in Mlesa and Shebomeza villages can generate about 25 000/= per year.

4.3.2.11 Eco-tourism development

Eco-tourism was promoted by EUCAMP since 1997 as another alternative way of making use of the valuable biodiversity and catchment forests while supporting local livelihoods. Records at ANR show that from 1997 to August 2007, a total number of 10 544 tourists visited EUM. The number of tourists has been increasing from 295 in 1997 to 1082 in 2007. A total of 49 million Tshs was generated from eco-tourism activities of which 20% was accrued by village governments for social service development. Local communities had been serving tourists with cultural items and goods and some of the local people were employed as tour guides, which contribute substantially individual income (AGMP, 2007).

Eco-tourism in the study area is considered as a way forward to sustainable forest management, as it creates job opportunities and additional means for revenue generation to local community. However, it was observed that eco-tourism has not yet been well developed to attract more tourists. The development is constrained with inadequately of infrastructural facilities such as rest houses, picnic sites, and camping sites, reliable roads, marketing and networking. If these facilities are well developed, it is possible to attract

more tourists and to create adequate revenue to finance most of the conservation and development interventions in EUM.

4.3.3 Awareness of the existence of CDIs in the study area

The results in Table 9 show that 61.2% of the respondents were aware of the existence of CDIs in the villages, while the rest were not aware of the existence of CDIs projects in their localities. The results indicate further that majority of the respondents in Shebomeza, Mlesa and Shambagenda villages had some knowledge of the implemented programme/projects in their villages, but this was opposed to the interviewed respondents in Sakale village, who didn't have any knowledge of the existence of CDIs in their village.

However, these results imply that a larger number of the respondents were aware of the CDIs initiatives in their localities. This partly was an indication of community participation in the CDIs initiatives in the area; and that awareness was a key motive to successful people participation and implementation of CDIs. Understanding community awareness is imperative for acquiring views and opinions during discussions on the impact of CDIs on people's livelihoods and forest resource management.

Table 9: Response on awareness of CDIs existence

Awareness	**Village responses**				**Total**
	Sakale %(n=37)	Shembagenda %(n=29)	Mlesa %(n=27)	Shebomeza %(n=23)	% (N=116**)**
Yes	0.0	75.9	96.3	100.0	61.2
No	75.7	17.2	3.7	0.0	29.3
Not sure	24.3	6.9	0.0	0.0	9.5
Total	100.0	100.0	100.0	100.0	100.0

4.2.3 Stakeholder collaboration

It was reported that CDIs, particularly EUCAMP collaborated with other conservation institutions and stakeholders. The collaborators among others included the local community, ANR, District Councils (Muheza and Korongwe), Tanga Region Catchment Forest, Tanzania Forest Research Institute (TAFORI), Tanzania Forest Conservation Group (TFCG), Mlingano Soil Conservation, National Institute for Medical Research (NIMR) and production enterprise (e.g. Tea estate- EUTCO). To facilitate collaboration, a co-ordination committee was established. The committee served as a common platform for the development of EUM. Also, the committee defined interventions and priorities of the area and communicates the activities implemented by one stakeholder to others in order to avoid duplication of efforts and resources. The coordination committee is coordinated under the Ministry of Natural Resource and Tourism.

However, the key informants interviewed revealed of there being poor lines of communication (and irresponsibility) between District and EUCAMP/ANR, Local community and the projects (EUCAMP/ANR), and other development and research institutions. This led to over-compartmentalization whose outcome is duplication of efforts, negating responsibilities, and limiting alternatives/opportunities in the area. Hokkanen (2002) reveals that a major obstacle in reconciling environment activities with development is lack of clear line of communication between institutions or project implementing interventions in the rural area. There is need for all stakeholders to come together and identify their roles and responsibilities so as to come up with a strategy and assigning of responsibility to each stakeholder in favor of conservation and local community development as suggested in Figure 5.

Figure 5 suggests a schematic chart of the CDIs co-ordination committee which indicates how project activities could be linked directly to the National and Regional Policies. The Administrative responsibility of the catchments forest reserve (Amani Nature Reserve) lies in the FBD, which would allocate one person to Tanga Region Catchment office to facilitate all the necessary links in the area. The CDIs co-ordination committee should involve all the relevant stakeholders and actors to make the overall project management plan. This could facilitate a link with national supervisory group which consists of national financiers and international donors for strategic financing decisions.

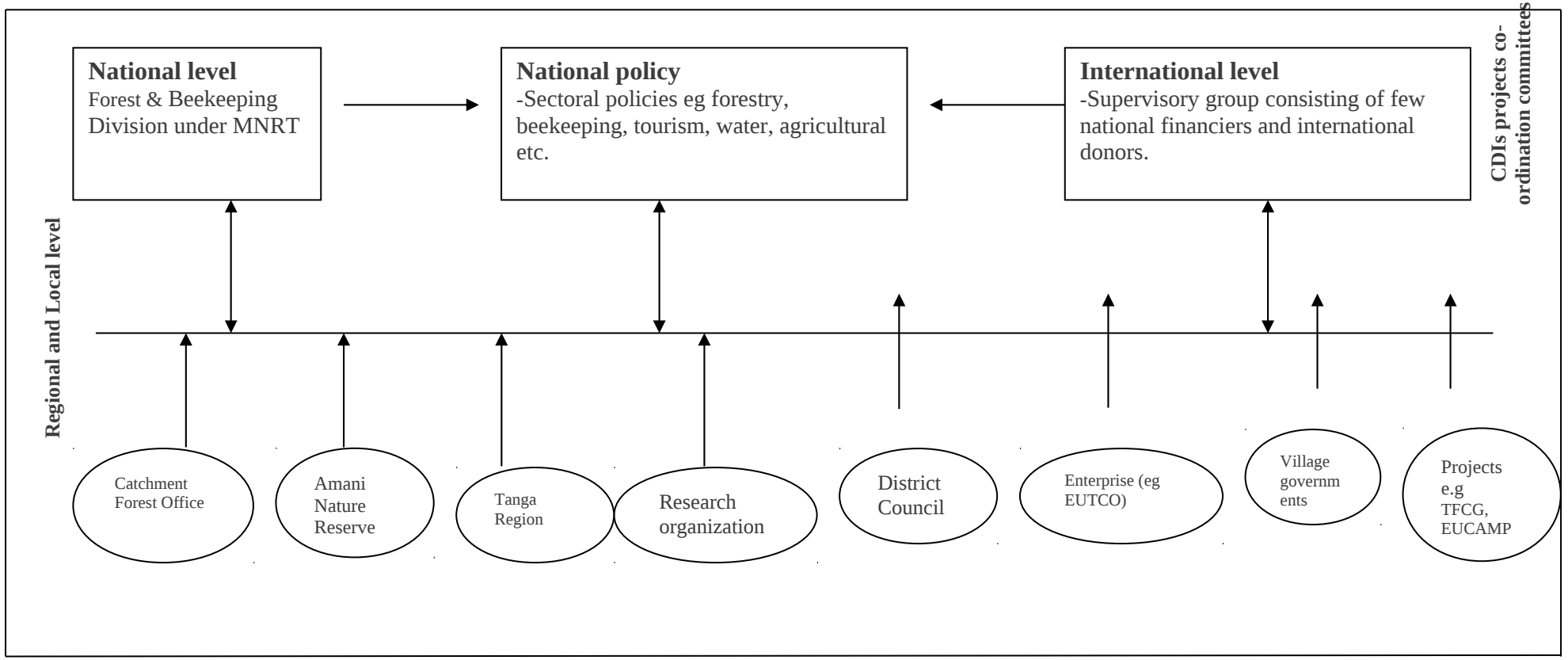

Figure 5: Schematic chart of the CDIs co-ordination committee

Source: Adopted from Hakkanen (2002) and own presentation

4.4 Impact of CDI's on Livelihood Strategies

This section presents the findings on the impact of CDIs on household livelihood strategies; household economy; land tenure and acquisition; linkage of livelihood strategies with CDIs activities; contribution of CDIs in livelihood improvement; negative impact of CDIs on livelihood strategies**;** and a linkage of livelihoods with forest resource management**.**

4.4.1 Household livelihood strategies

The household livelihood strategies in the study area like any part of Tanzania depend largely on agriculture and livestock keeping as the major livelihood strategies. The results in Table 10 indicate that about 45% of the respondents were engaged on agricultural farming, while 34.7% were involved in livestock keeping and 17.1% of the respondents were involved in petty business as livelihood strategies.

The study, revealed further that people in the study area, make important diversification as a strategy. Diversification from agriculture to off-farm activities is an important strategy for decreasing livelihood vulnerability and enhancing welfare. During the study survey, it was observed that agriculture was being diversified through cultivating different crops for both subsistence and cash. The crops cultivated for subsistence include maize, beans, yams, groundnuts, cassava and sweet potatoes. The cash crops include clove cardamom, aroma, tea, cinnamon, sugarcane and bananas. Also in the study area was kept livestock of different types such as dairy cattle, goat, sheep, and poultry (local chicken), which occupy a major role in risk management as well as being a source of household income.

Off –farm household activities for livelihood include small business such as kiosks, tailoring, and carpentry and food vendoring. There were also instances of people being

engaged in casual laborers for wage earning; almost half of the villagers in the study villages were employed as casual labor in Tea Estate. The Tea Estate influenced largely the economy and social life of the population in the study area.

Additionally, it was noted that people in Mlesa, Shebomeza and Shambagenda villages had more income generating activities initiated by CDIs than was the case in Sakale village. The income generating activities (IGAs) included fish farming, beekeeping, butterfly farming, collection and selling *Allanblackia* seeds and vegetables; all of which had a positive impact on household livelihood strategies. This is because the activities had influenced increase in income and diversifying income sources, strengthened peoples capacity to meet their own needs, and expanded optional and choice available to households as compare to households in Sakale village who relied on traditional livelihood strategies such as agricultural farming, livestock keeping and small business. These findings are supported by findings from Ellis (1998) and Sen (2002) who reported that rural people maintain their livelihood through a bundle of activities to achieve livelihood outcome. Households in the study area used multiple paths and a diverse range of economic activities to get out of livelihood vulnerability.

Table 10: Response on household livelihood strategies

Livelihood strategies	Village responses				Total (N=116)	Estimate of contribution of strategies to Hh income/months)
	Sakale (n=37)	Shembagenda (n=29)	Mlesa (n=27)	Shebomeza (n=23)		
Agricultural	44.6	52.4	38.2	41.9	44.6	45000
Livestock keeping	35.1	33.3	32.4	37.2	34.7	55000
Petty business	17.6	14.3	17.6	18.6	17.1	87000
Employment	2.7	0.0	0.0	0.0	1.0	4037.55
Brick making	0.0	0.0	8.8	2.3	2.1	-

Beekeeping	0.0	0.0	2.9	0.0	0.5	-
Total	38.3	21.8	17.6	22.3	100.0	

4.4.2 Household source of income

The results in Table 11 reveal that about 42% of the respondents earned their income from farming and livestock keeping, while 17.2% of the respondents earned their income from non-farm activities (i.e. either from petty business, casual labour, etc) and 3.6% of the respondents attained income through wage employments, whereas 33.6% of the respondents obtained their income through agriculture production and non-farming activities.

The study indicates further that in Sakale village where CDIs interventions were not implemented, the farmers depended largely on agricultural farming to enhance household income. This was contrast to Mlesa, Shebomeza and shambagenda villages which had CDIs interventions. The incomes in these villages were also partly contributed by income generating activities initiated by the programmes such as fish farming, vegetable gardening, beekeeping, butterfly farming, dairy cattle husbandry, spice cultivation and the collection and selling of A*llanblackia* seeds.

Table 11: Response on household source of income

Sources income	Village responses				Total % (N=116)
	Sakale %(n=37)	Shembagenda % (n=29)	Mlesa %(n=27)	Shebomeza %(n=23)	
Agricultural	46.0	41.4	37.0	43.5	42.0
Off-farming activities	16.2	24.1	11.1	17.4	17.2
Wage employment	10.8	3.5	0.0	0.0	3.6
Off farming + employment	2.7	0.0	0.0	0.0	0.69
Agricultural + off-farming	18.9	24.3	51.9	39.1	33.6
Agricultural + employment	5.4	6.7	0.0	0.0	3.0
Total	100.0	100.0	100.0	100.0	100.0

Deliberate efforts to boost people's income through environmental friendly activities in the study area were crucial for environmental sustainability and guarantee of the resulting environmental goods and services. More environmental friendly activities need to be initiated and others expanded. For instance, a project such as Butterfly farming is one of the most promising environmental friendly activities, which have already taken off as pilot projects in a few villages under Tanzania Forest Conservation Group (TFCG). During key informant interviews with TFCG field manager, it was revealed there were currently over 400 butterfly farmers in Amani Division. It was further reported that, depending on species each butterfly pupae was worth between USD 1 and 2.5. Allocating more funds for these activities would not only be an important conservation strategy but also a critical source of income for the local community in the study area.

Another activity cited as potential for income generation was livestock keeping initiated under Tanga Small Dairy Development Project (PSDDP). Currently, there were about 150 households under PSDDP in the study village. Each household owned an average of about 1 to 2 cattle. However, the number of households keeping cattle need to be increased for any significant income to be realized.

Experience has shown that lack of reliable sources of income force people to engage themselves in unauthorized activities. For example, illegal gold mining activities were reported in Sakale village as been undertaken in the upper catchments of Zigi River and along rivers and streams in the reserved forest (Plate 6). During focus group discussion, a significant number of villagers especially young men in Sakale village were reported as being involved in Gold mining along river banks. It was acknowledged that mining was relatively a more promising source of income than working as laborers in tea plantations.

Interestingly, these young men were of the opinion that since gold mining earns them a relatively higher income, the government should train them on how they could do mining in a sustainable manner, rather than evicting them from the area.

Plate 6: Illegal gold mining nearly water sources within East Usambaras Mountains.
Source: Mwayoka (2005)

4.4.3 Linkage of livelihood strategies with CDIs activities

Best practices such as farm forestry, soil and water conservation practices, implementation of alternative income generating activities for the purposes of reducing dependence on natural forests products, enhancing household income and production per area were the major emphasis of CDIs in the sample villages.

It was noted that EUCAMP and TFCG implemented activities in Mlesa, Shambagenda and Shebomeza villages. The sampled households linked agricultural farming with CDIs activities by 49.3%. For example, the EUCAMP introduced cash crops (clove, black pepper cinnamon etc), soil and water conservation practices. About 4% of the respondents agreed that people were employed by the project as casual labourers on various forest

operations in the forest reserve. About 45% of the respondents did not respond to the question, implying that no CDIs activities were implemented. This was evidenced at Sakale and Shambagenda villages (Table 12). It was also noted that Sakale village is situated relatively far (60 km) from Muheza District headquarters and was not easily accessible compared to the other villages, which were located 40 km from Muheza headquarters. Distance and inaccessibility was the plausible reason that compelled development agencies to exclude ntegrate Sakale village in the conservation and development projects.

In the villages where there were no interventions, the local communities had an opinion that development partners should scale up the project to support people's livelihoods and conservation of catchments forest especially the Zigi River catchments. Salafsky *et al.* (2002) pointed out that if a viable enterprise is linked to biodiversity of the protected area and generates benefits to stakeholders, then the stakeholders act to counter the threat to the resources. This poses a challenge to development partners in ensuring that local communities are empowered in contributing positively towards watershed management by providing incentives and or opportunities to the guardians/stewards of the environmental resources.

Table 12: Responses on linkage of livelihood strategies with CDIs activities

Activities	Village responses				Total (N=116)
	Sakale % (n=37)	Shembagenda % (n=29)	Mlesa %(n=27)	Shebomeza %(n=23)	
Agriculture farming	0.0	31	70.4	95.7	49.3
Livestock keeping	0.0	3.5	0.0	0.0	0.7
Butterfly farming	0.0	13.8	0.0	0.0	3.5
Beekeeping & fish farming	0.0	6.9	7.4	0.0	3.6
Casual labour	0.0	13.8	3.7	0.0	4.4
Not aware	100	31	18.5	4.3	44.5
Total	100.0	100.0	100.	100.0	100.

	0	0

4.4.4 Household economy

Table 13 shows average annual incomes of the respondents. Generally, the income range between Tsh. 150 000 to 300 000/= Tshs earned by 32% of the respondents per annum. About 27.8% of the respondents earn below Tsh. 150 000/= per annum, and about 21% of the respondents earn an average of between Tsh. 300 000/= and 500 000/= per annum; while 19% of the respondents earn an average of above Tsh. 500 000/= per annum.

In the villages where EUCAMP operates (i.e Mlesa and Shebomeza villages) the average income was higher than in villages with no CDIs intervention such as Sakale village. In Sakale villages, a bigger proportional of the households (37.8%) earned incomes below 150 000/= per annum. This is notwithstanding that, the income levels in the study area were relatively lower than the to Tanzania per capital income of Tsh. 257 000/= per annum (THDS, 2002). These results imply that people always strive to make ends meet. The common strategy is to carryout activities that have negative impact on environmental and natural resources as a means to supplement meagre incomes. Such activities may include unplanned utilization of forest products, wildlife capture and gold mining in the forest reserves.

Table 13: Household average annual income

Annual income (Tshs)	Village responses				Total
	Sakale %(n=37)	Shembagenda %(n=29)	Mlesa %(n=27)	Shebomeza %(n=23)	%(N=116)
< 150,000	37.83	31.04	7.41	34.78	27.76
150000 - 300,000	29.73	34.49	33.33	30.43	32.0
300,000 - 500,000	16.22	13.79	33.33	21.74	21.27
> 500,000	16.22	20.68	25.93	13.05	18.97
Total	100.00	100.00	100.00	100.00	100.00

4.4.4 Influence of CDIs on land tenure and acquisition

The results revealed that about 94% (n= 109) owned land for different purposes, while six percent (n=7) did not own land. The land size in the study area as shown in Table 14 ranged from 0 to 5 acres (70.2%), while 5.8% own land between 11 to 20 acres. The average land holding per household was 4.4 acres ranging from 1 acre to 20 acres. The reesults revealed that, majority of the farmers owned small parcel of land, while fewer farmers hold large parcels of land as big as 20 acres. Further, it was reported that land is acquired through inheritance, buying, renting, borrowing and application through village government.

During the study survey, it was noted that there was shift in strategies before (1998) and after CDIs interventions. Those who had small parcels of land practiced crop rotation and intercropping as strategies to overcome land shortage. Those with small parcels of land borrowed or rented land from neighbours who had more land for a price or in kind. Discussions with Sakale villagers revealed that many people who faced shortage of land borrowed land from the neighbourhood villages in Korogwe District for farming during rain seasons.

Land shortage implies reduced size of land for cultivating subsistence crops on which most families depend and reduce the economic potential of the people. The expansion of ANR (after CDIs intervention in 1999) to some villages like Mlesa and shebomeza was among the reasons cited for land shortage. Jambiya and Sosovele (2001) confirmed that loss of land on the village adjacent the nature reserve was a critical problem, with serious repercussion to the affected households, particularly where the population pressure is high. Land is a basic productive resource its shortage prevents rural community from engaging in long-term investment such as tree planting as introduced by EUCAMP in the study area.

Insecurity of land tenure leads to poor land development and disincentive for long term investments (Mariki, 2002) as could be seen in subsection 4.4.5 below.

Table 14: Response on land holding

Land size (acres)	Village Responses				Total % (N=116)
	Sakale %(n=37)	Shembagenda % (n=29)	Mlesa %(n=27)	Shebomeza %(n=23)	
< 5 acres	81.1	75.9	62.9	60.9	70.2
Between 6-10	16.2	20.7	33.3	26.1	24.0
Between 11-20<	2.7	3.5	3.8	13.0	5.8
Total	100.0	100.0	100.0	100.0	100.0

4.4.5 Negative impact of CDIs to local community livelihoods

Table 15 shows responses on the negative impacts of the implementation of CDIs to community livelihoods after interventions from 1998 to 2007. About 20% of the households reported a significant decline of income due to scarcity of land, loss of tree crops and restrictions on accessing timber and collecting non timber forest products. Whereas 23.9% of the respondents realized the scarcity of land for farming agricultural crops, 38.2% of household did not respond, meaning that there was no any influence of CDIs on livelihoods. The study revealed that Mlesa and Shebomeza villages were relatively more affected than was Sakale village which had no project interventions.

Among the causes of the decline of income and land shortage in the study area, particularly in the villages where EUCAMP was implemented were the establishments of ANR, and the strict regulations on forest use and this had much effect on the utilization of forest resources, particularly timber harvesting. During focus group discussion and key informant interviews with the village leaders in Mlesa and Shebomeza village, one of the participants reported that,

> "*The conservation had changed the livelihood strategies in the villages, logging and pit sawing were banned even in general land. The chairman of Shebomeza village claimed that, the villages had serious problems in accessing timber for house construction (and other domestic uses) even from general lands and blamed that the regulations of forest use since CDIs intervention are too strict*".

ANR, through General Management Plan (1998) had made agreements with the adjacent villages, to allow the local people to collect certain products such as firewood, traditional medicine and mushroom from the forest reserve. However, some of the forest products such as rope extraction, timber, poles and withies, honey and wild animal hunting, fodder /grass, butterfly and gold mining were restricted from free collection/harvesting except with permission from the forest authority. The National Forest Act No.14 of 2002 reserved certain valuable natural tree species (e.g. *milicia excelsa*, *cephalosphaera usambarensis*, *Newtonia buchananii*, *Ocotea usambarensis*) that cannot be harvested in any location including public land without a permit or a licence.

Gombya –Ssembajjwe and Banana (2000) reported that in places where farmers were required to obtain permits to cut or prune their own agroforestry trees or transporting tree products has discouraged tree planting and retaining trees in their own farm fields. The same was reported during field study that people in Mlesa and Shebomeza villages, have started cutting regenerant natural tree species growing in their farms, arguing that it was not benefiting to retain trees in farms with no user rights.

Other villagers interviewed admitted that they had a problem with animals such as baboons and blue monkeys from the forest reserves, who caused destruction to crops. Farmers spent about eight hours per day in the farm just to scare the destructive animals. Woodcock

(2002) reported that there is an increase in destructive animals now as opposed to the past due to an increase in forest covers because CDIs intervention. In the study villages, some people were discontent with the bans to kill baboons and other destructive animals in the forest while they keep on destroying the crops.

This problem was also observed in earlier studies (see Kessy, 1998; Jambiya and Sosovele, 2001; Mashamba and Lemack, 2001) but the problem has not been addressed so far. However, most farmers support the conservation efforts of ANR and its contribution to their livelihoods (as presented in subsection 4.4.6 below), although their livelihoods were affected negatively by its establishment.

Table 15: Response on negative impact of CDIs to people's livelihoods

Negative impact (1998 to 2007)	Village Responses				Total % (N=116)
	Sakale %(n=37)	Shembagenda %(n=29)	Mlesa %(n=27)	Shebomeza % (n=23)	
Income decline	0.0	24.1	14.8	39.1	19.5
Food insecurity	0.0	6.9	18.5	8.7	8.5
Scarcity of land for farming	0.0	20.7	40.0	34.8	23.9
Unemployment	0.0	3.5	7.4	0.0	2.7
income decline + food insecurity + unemployment	0.0	3.5	7.6	17.4	7.1
Not aware	100.0	41.4	11.61	0.0	38.2
Total	100.0	100.0	100.0	100.0	100.0

4.4.6 Contribution of CDIs on livelihood improvement

Understanding on how livelihood strategies have changed over time after development intervention is crucial for assessing the impact of intervention. The respondents were asked to rate the performance of CDIs towards people's livelihood improvement. The results in Table 16 shows that 42.4% of the respondents confirmed that interventions had improved their livelihoods and 16.3% of the respondents reported low improvement in their

livelihoods even with CDIs in place. Whereas 16.3% of the respondents had not observed any livelihoods improvement, 25% of them were not aware. But most of those who were not aware came from Sakale village where there were no interventions.

The study revealed further that in villages where CDIs (EUCAMP) were implemented, many activities relevant for the conservation and promotion of alternatives in forest utilization, reported to have their livelihoods improved through various income generating activities such as beekeeping, fish farming, vegetable gardening, selling and collection of *Allanblakia* seeds, dairy cattle keeping, butterfly farming and farming exotic tree species. These results are similar to those reported by Pandey (2005) revealing that a considerable increase of income generating activities to farmers as an intervention is a tangible economic gain and is a positive impact of CDIs projects. Box 1 Summaries the contribution of CDIs activities to livelihood improvement in the study area.

Table 16: Response on livelihoods improvement after implementation of CDIs

Variables	Village Responses				Total
	Sakale %(n=37)	Shembagenda %(n=29)	Mlesa %(n=27)	Shebomeza %(n=23)	%(N=116)
High improvement	0.0	41.4	63.0	65.2	42.4
Low improvement	0.0	13.8	29.6	21.7	16.3
No improvement	0.0	44.8	7.4	13.1	16.3
Not aware	100.0	0.0	0.0	0.0	25.0
Total	100.0	100.0	100.0	100.0	100.0

Box 1: Contribution of CDIs to people's livelihoods improvement

CDIs	Livelihood strategies	Target groups	Livelihood contribution
EUCAMP/ANR (2002 to 2007)	Eco-cultural tourism development	Village members (youth, men & women)	-12 Local guides trained, received 60% of guiding fee (average of 80,000 Tsh per guide per month). -Village Government receiving 20% of revenue accrued from tourists entering the reserve (Average of 400,000 TSh per year per village). -Individual people get direct pay of 10,000/= per head for the cultural tourism. -Individual community member sale foods staff and handcraft to tourist.
UWAMA under TSDDP	Diary Cow farming through zero grazing	Village community members (youth, men & women)	-More than 300 people supported diary cow farming with average earning of 65,000 Tsh per month from sale of milk. -Improved agricultural production through organic manure -Improve food security and nutrition status
EUCAMP 1999 /02	Beekeeping and apiary	Village community member (youth & men)	- 200 people engaged in modern beekeeping activity. They were supplied with 1 modern beehive as to motivate them to make 3 modern beehives.
EUCAMP 1999 /02	Fish farming	Village community members (youth, women& men)	-About 65 individual's fish ponds exist planted with fast growing Tilapia species. Each pond with an average yield of 35 kg of fish in every three moths. -Improved food security and nutrition status
TFCG 2003 to 2007	Butterfly farming	Village community members (youth, women & men)	-Started as research, now with more than 300 people engaged in butterfly farming each with average earning of 45,000 Tsh per month
EUCAMP 1999/02	Bio-intensive garden	Village community members (youth & women)	-32 Women groups formed each with 4-10 individuals having both individual and group production vegetable gardens. -Improved household food security and income
EUCAMP (1999/02) TFCG (2003 to 2007)	Bio-energy and efficient use of wood fuel	Village community members (women)	Efficient stoves introduced and adopted in 18 buffer zone villages including Mlesa, Shebomeza and Shembagenda village. The range of adoption per village is 40-6%. This reduced time spent for firewood collection and increased production time.
ANR 2006 to 2008	Construction of modern houses	All households	-57 simple modern houses constructed and thousands of bricks ready made. Villages of Mlesa, Shebomeza & Shembagenda supplied with one brick making machine.
EUCADP 1998/02	Spice and fruit garden	Farmers (men &women)	- Clove being the leading crop with average yield of 230,000/= / annum/person with more than 4000 people engaged in cultivation. Hence increased household source of income.
UNILIVER 2004 to 2007	Change wild fruits to commercial crop and its domestication	Village community members (men, women & youth)	- Wild picking of *Allanblackia stuhilmanii* seeds with average about 45% people engaged in the activities. -Average earning of 100,000/= per individual within 3 months of collection per year.
EUCAMP 1999/02	Farm forestry	Village community members	On average each household planted 12 trees per annum (2005). This led to self support and hence reduce dependency to the forest reserve and water sources

4.4.7 Linkage of people's livelihoods and forest resources

4.4.7.1 Forest resource utilization

The study revealed that majority of the households (86.2%) used forest products to support households needs. About 14% of the households do not use forest products (Fig. 6). The study further observed that, 99% of households in the study villages used forest resources in their household. Those who responded "No" 13.8% were afraid of being recorded, because they encroached in the forest reserve for collecting firewood, hunting wild animal, collecting fodder for livestock and timber logging.

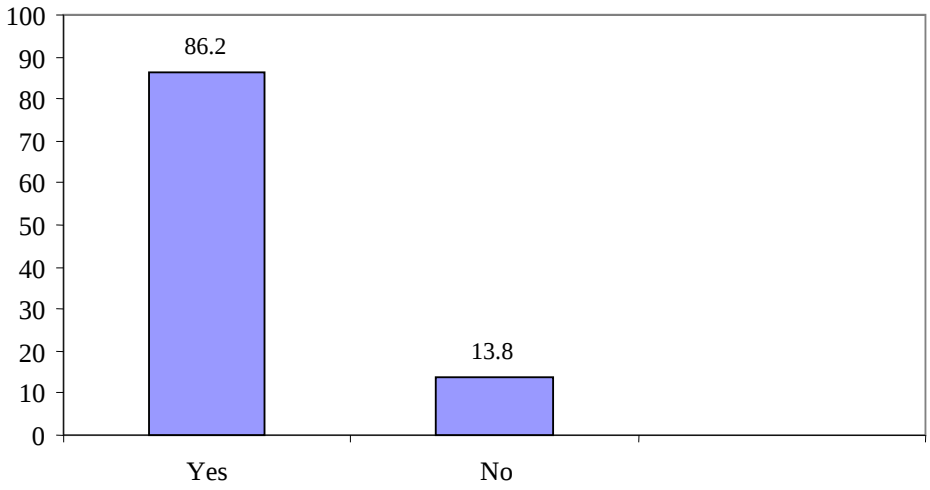

Figure 6: Responses on forest resources utilizations

In a separate study Inversen (1991) and Kessy (1998) noted that People around Amani Nature Reserve depend on the forest for subsistence. The results from multiple responses revealed that about 21% of the households used firewood, while 19.6% fetched water from the forest, 16.5% obtained building materials (Poles) from the forest and 14.0% obtained traditional medicines (Table 17). Those forest products were harvested either from the farms or from forest reserves (either illegally or through special arrangement by forest authority). It was further noted that communities adjacent to the forest reserve (Mlesa and Shambagenda) were not collecting forest products frequently because of the stringent rules.

Some households (55%) domesticated vegetable species as a way avoiding accessing the forest resources, few vegetables, around their homesteads were utilized as adaptive strategies.

Although the local people were allowed to collect dead wood twice per week, the villagers demanded to collect various products from the reserve. This indicated that the supply of forest products from the farmland was not enough to meet household's demands. Further, the establishment of farm forestry to the adjacent village did not reduce pressure toward the nature reserve. Also the constant removal of deadwood from the reserve can be detrimental to the forest ecosystem, as a dead wood is a living ground for several organisms and plays an important role in nutrient cycle of the forest. Therefore, for proper management practices and ensuring ecological sustainability, searching and developing alternative sources of forest products are crucial for ecosystem conservation and at the same time supporting the community.

Table 17: Forest product utilized by households

Forest products	Village multiple responses				Total % (N =116)
	Sakale %(n =37)	Shembagenda %(n =29)	Mlesa %(n= 27)	Shebomeza %(n= 23)	
Collecting honey	5.3	2.4	0.0	4.8	3.4
Building materials	17.5	15.7	17.5	14.5	16.5
Firewood	21.1	19.3	20.6	21.0	20.5
Traditional medicine	12.3	13.3	17.5	14.5	14.0
Hunting wild animal	4.4	8.7	7.9	4.8	6.2
Thatching material	8.8	10.8	7.9	11.3	9.6
Water	21.1	19.3	20.6	16.1	19.6
Fodder for livestock	9.6	10.8	7.9	12.3	10.2
Total	35.4	25.8	19.6	19.3	100.0

4.4.7.2 Importance of forest resources to people's livelihoods

It was deemed necessary to find out on how the local community established a link between their livelihoods and the forest adjacent to them in terms of water catchments,

climate amelioration, and provision of forest products for community use and biodiversity conservation. About 47% of the respondents admitted that the conservation was very important to them, whereas 42.1% of the respondents agreed that the conservation of the forest was important to their livelihoods and 8.1% of the respondents reported that the forest was moderately important to their livelihoods. While about 2% of the respondents were not sure whether or not the forest conservation had any importance to their livelihoods (Table 18).

Those who said they had benefited from the forest mentioned various goods and services such as fresh water, firewood, reliable rain, fruits, traditional medicine, honey, mushroom collection and grass/hay collection for their livestock. They also recognized that such benefits were available due to better natural resources management, and they said that they felt to have an obligation to participate in the management of those resources. However, they expressed their concerns that they received less of these benefits compared to other people particularly those who use water down-stream.

While those who felt they were less benefiting, blamed restrictions imposed by the forest management authority-ANR an accessing resources in the reserve. Before the establishment of the ANR (1997), people used to go into the forest to gather various forest-based products freely and felt that it was their right, but after ANR establishment they were allowed to go into the forest reserve to collect just deadwoods for firewood only on Wednesdays and Saturdays.

Table 18: Responses on the importance of forests resource to local community

Importance of forest	Village responses				Total % (N=116)
	Sakale %(n=37)	Shembagenda %(n=29)	Mlesa %(n=27)	Shebomeza %(n=23)	
Very important	37.8	51.7	51.9	47.8	47.3
Important	37.8	34.5	48.1	47.8	42.1
Moderate	16.2	13.8	0.0	4.4	8.6
Not important	2.0	0.0	0.0	0.0	2.0
Tota1	100.0	100.0	100.0	100.0	100.0

4.5 Impact of CDIs on the status of forest resources management

This section presents findings of the study inventory conducted in 2007 after CDIs interventions and compares it with inventory carried out by Kessy and Temu in 1998 before CDIs interventions in Kwamkoro Forest Reserve (KFR). The impact was assessed on Variation of tree diameter class with distance; Quantity and distribution of coppicing trees with distance; Quantity and distribution of dead tree stumps with distance; Distribution of debarked trees and the number of wild animal traps encountered. The **i**mpact on **t**ree stocking, basal area, volume, tree density and richness i.e Shannon-Winner index of diversity (H') and Importance Value Index (IVI) were also assessed.

4.5.1 Distribution of trees diameter class

The results in figure 7a shows that trees of small diameter increase with an increase in distance from the forest edge up to around 1000 m, which was different compared with that reported by Kessy and Temu in 1998 before CDIs interventions. The trees of small diameter class decrease with an increase in distance from the forest edge up to 1000 m (Fig.7b). The difference in trends of distributions of trees diameter class suggests that the forest was still disturbed regardless of CDIs interventions e.g. EUCAMP. Evidence of disturbance was observed during field study. For example, old roads used for commercial timber logging were observed and has been useful routes for local community to pass through inside the forest for illegal collection of forest products. Further, it was observed

that substantial amounts of the small diameter class trees were coppicing trees suggesting that as the CDIs struggle to restore the ecological system of the forest through conservation interventions, human disturbance in terms of collection of forest products such as building materials pose a threat to the regenerating trees.

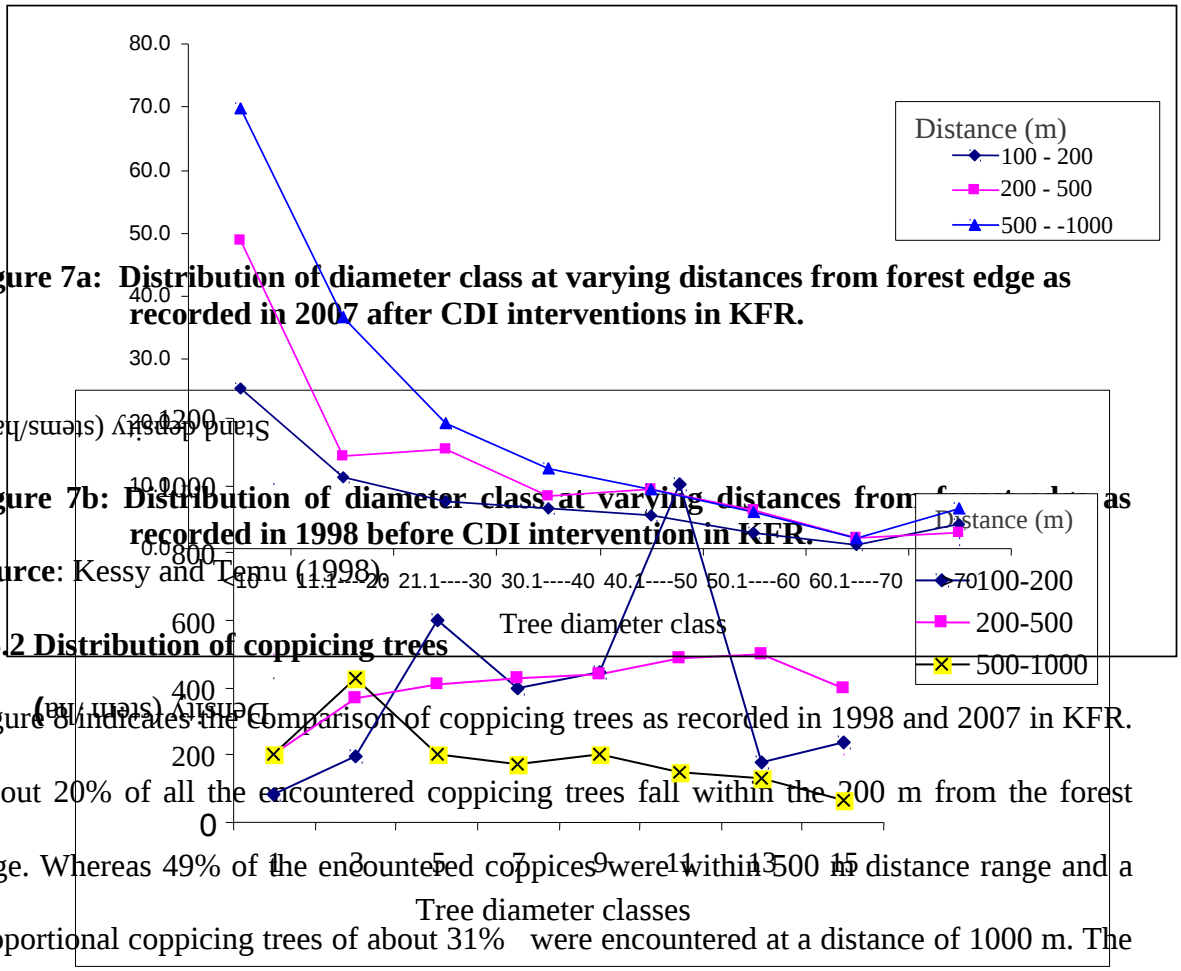

Figure 7a: Distribution of diameter class at varying distances from forest edge as recorded in 2007 after CDI interventions in KFR.

Figure 7b: Distribution of diameter class at varying distances from forest edge as recorded in 1998 before CDI intervention in KFR.

Source: Kessy and Temu (1998)

4.5.2 Distribution of coppicing trees

Figure 8 indicates the comparison of coppicing trees as recorded in 1998 and 2007 in KFR. About 20% of all the encountered coppicing trees fall within the 200 m from the forest edge. Whereas 49% of the encountered coppices were within 500 m distance range and a proportional coppicing trees of about 31% were encountered at a distance of 1000 m. The results recorded in 2005 show different trends of coppicing trees compared with (50%) of coppicing trees observed at 200 m from the forest edge recorded by Kessy and Temu in 1998 before CDIs interventions. The differences in trends suggest that, there is an increase of pressure on forest resources toward the deeper forest; this is a plausible indication of the reduction of forest products in the forest reserves adjacent to the community where CDIs was under implementation.

Reports from ANR authority indicate that the local community was only allowed to collect dead firewood in the local use zone within the reserves (50 m from forest edge) twice per

week and the collector usually was not allowed to carry any working tools (machetes) with them. However, during field study it was observed that the collection of firewood was conducted even on unallowable days without supervision and involved cutting down of live trees. In some areas such as Bom bom, Sedunda and Kihuhwi and areas close to Shebomeza and Mlesa villages where CDIs was implemented, trees cut for firewood and building poles were observed even beyond 600 m inside the forest reserve.

Owen (1992) observed that some villages had developed practices of illegally collecting fresh branches from tea estate forest in order to dry them at home and later use them as firewood at a time of acute firewood scarcity. Illegal collection and cutting down of trees of good quality in deeper forest (500-1000 m) for firewood, building pole and timber logging were the most plausible evidence of different trends of coppicing trees observed in 2007 and 1998 record. It was evident from the field study that the local people utilized some endemic species (e.g. *Cephalosphaera usambarensis*, *Mesogyne insginis, Anisophyllea abtusifolia)* for firewood, construction poles, medicines etc. This kind of utilization tends to threaten such species and the forest ecosystem. Had pressure being decreased through CDIs interventions, such illegal harvesting forest products within the forest reserve could be reduced and people would be encouraged to utilize tree grown in their field farms.

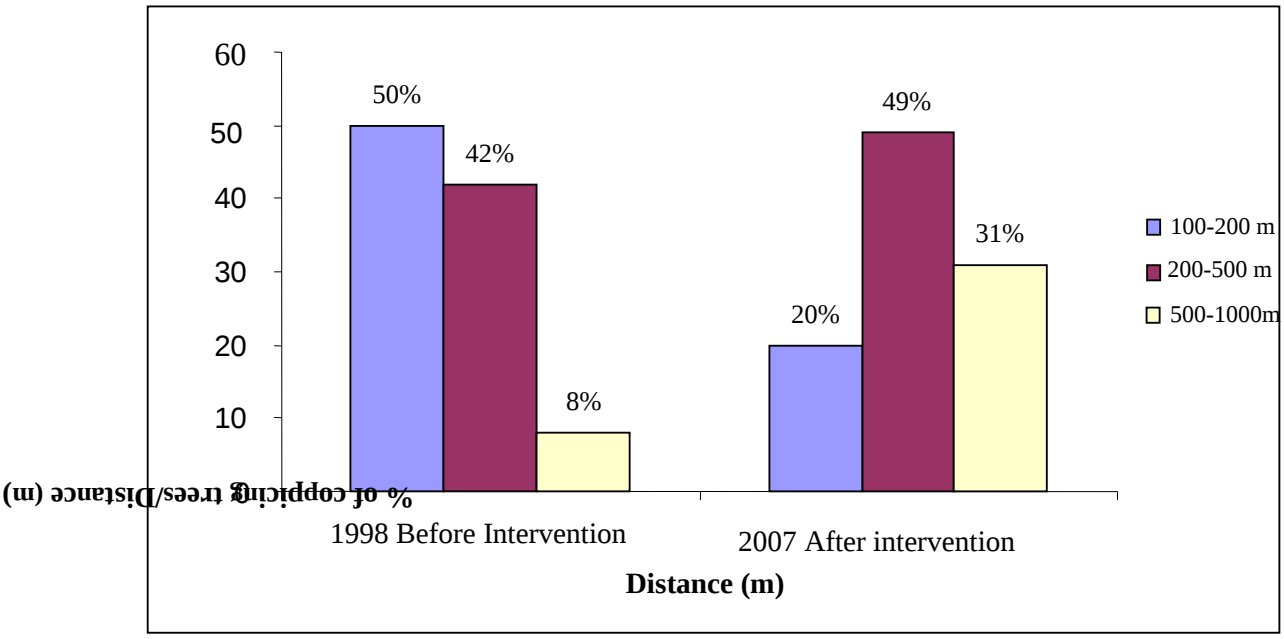

Figure 8: Comparison of distribution of coppicing trees at varying distances between year 1998 and 2007 in KFR.

Source: Kessy and Temu 1998, and Own field data (2007).

4.5.3 Distribution of dead stumps

Figure 9 illustrates the comparison of distribution of dead tree stumps at varying distances as observed before CDIs intervention in 1998 and after CDIs interventions in 2007. The results revealed that, the number of dead stumps before interventions (Kessy and Temu, 1998) was observed to be higher (596) at 200 m distance compared to (236) at 200 m distance range after interventions.

The results indicate further that the number of dead stumps decreased after CDI intervention (2007) compared to the number of dead stumps observed before CDIs interventions. The plausible cause of increased number of dead stumps before interventions was due to timber logging for commercial purpose done by Sikh Sawmill Company in 1980s and 1990s. However, during field study, signs of illegal pit sawing operation inside the forest reserve were observed. This was evident when new sawn timber slabs was found at 600 m distance from the forest edge. This suggests that there is still human disturbance

going on toward the forest reserves regardless of ANR law enforcements, environmental awareness, and introduction of farm forestry to the adjacent villages implemented by CDIs.

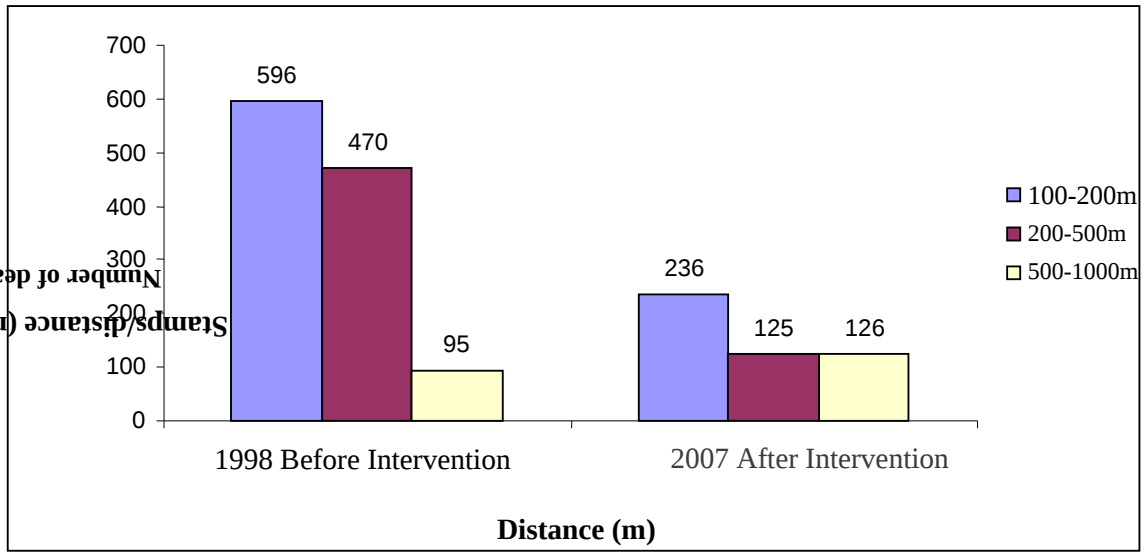

Figure 9: Comparison of distribution of dead tree stumps at varying distance between year 1998 and 2007 in KFR.
Source: Kessy and Temu (1998), and Own field data (2007).

4.5.4 Debarked trees and wildlife traps

Debarked trees and wildlife traps were also used in the comparison of the results record recorded in 1998 before CDIs intervention with those in 2007 after CDIs interventions as disturbance indicator in different distances from the forest edge.

The field observation conducted in 2007 indicates that, most encountered debarked trees were the ones with medicinal values. Species debarked were *Metadenibolia bobonica, Terminalia sambesiaca, Stereospermum kunthianum, Antidesma membreanaceum and zanha golungensis.* These species were encountered within 200 m distance from the forest edge. *Anickia kumeriae, Carvalhoa campanulata , Cynometra sp., Myrianthus holstii and Cythea maniana* were encountered within 500 m distance from the forest edge. No debarked tree was observed within 1000 m distance range. The study conducted by Kessy and Temu in 1998 observed similarly trend as the debarked trees for medicinal purposes

increased with an increase of distances from the forest edge. The plausible reason for the continuing trends of debarking trees despite CDIs that support development of social service in the villages could be the attached values or beliefs on tradition medicine and the dispersed health services that necessitate people to travel long distance to seek for the services; this encouraged the local community to look for alternatives.

During field observation, nine traps were observed, six were found within 200 m, and three within 500 m from the forest edge. A study conducted by Kessy and Temu in 1998 before CDIs interventions recorded a total of seven traps. Out of these two were found at about 500 m from the forest edge, while five were found beyond 600 m deeper in the forest. This implies that illegal wild animal hunting by traps have not been contained by CDIs initiative to the forests adjacent to the community. Informal discussion with the local community revealed the most preferred wild animal species for hunting as being Bush pig (*Potamochoerus porcus*), Red duiker (*Cephalophus natalensis*), Bushbuck (*Tragelaphus scriptus*), Banded mongoose (*Mungos mungo*), Rock dassie, and Cane rats (*Thryonomys swynderianus*).

During field observation, it was noted that wood snares and wood ropes, and pits traps were the techniques used for animal capture. Animal trapping was found to be practised by using withies sized trees and in most cases the immature ones were used. This increased the threats to the juvenile trees species in the reserves. Other studies in East Usambara revealed that trapping wild animal such as vermin and food security were found to be common practices to the community adjacent to the forest reserves. For instance, Woodcock (2002) reported that certain community members in Kwatango village had earlier organized themselves to combat vermin and hunting them for food once a week. This implies that hunting for bush meat for protein source has not be reduced, despite the

CDIs interventions such as the introduction of fish farming and livestock keeping as alternative sources of protein.

4.5.5 Impact of CDIs on tree stocking, basal area and volume

4.5.5.1 Tree stocking

The results in Table 19 shows an average of stocking level of about 333 ± 45(SE) stems per hectare as observed in 2007 after CDIs interventions as compared to 504 ± 135 of stems per hectare as observed by Kessy and Temu in 1998 before CDIs interventions. The difference of stems per hectare for the two periods was statistically significant ($t=3.043$; $p= 0.0006$). Other studies conducted in Montane rainforests reported an average stocking levels of about 650 stems per hectare for the East Usambara forests (AFIMP 1988). Luoga *et al.* (2005) estimated a tree density of 714 stems per hectare in South Kilimanjoro Catchment Forest Reserves. The low stocking level in this study might be attributed to a small sample which covers only 2750 hectares out of 8380 ha of ANR.

However, the results in Figure 10 shows increasing trends of stocking density with an increase in distance from the forest edge (Appendix 3). The low stocking level in the outer of the forest (100 m) implies that there were unsustainable collections of forest resources deeper toward the forest reserve (1000 m). Visual observation during survey revealed a lot of remnants of branches, stumps, foot tracks in the forest reserves, which indicate the intensity of disturbances in the forest reserves. The continued trend of low stocking levels suggests that the forest is gradually continue to undergo disturbances, which impede the forest from recovering despite the CDIs development initiatives to the adjacent forest community.

Table 19: Comparison of stocking parameters in 1998 and 2007 in Kwamkoro Forest Reserve

Stocking	1998 Before Interventions	20007 After Intervention	t -value	P(T<=t)
N	504 ± 135.12(SE)	333.12± 45.2(SE)	3.043	0.0006**
G	42.096± 6.973(SE)	22.526± 4.78(SE)	0.35	0.8169 ns
V	546.337±87.88(SE)	533.23±215.04(SE)	1.06	0.467ns

Source: Kessy and Temu (1998) and Own field data (2007)

N= number of stems per hectare (N/ha.), G= Basal area (m^2/ha), V= Volume (m^3/ha), SE = Standard error; ** = Significance at 0.05 level, and NS= Non significance at o.o5 level

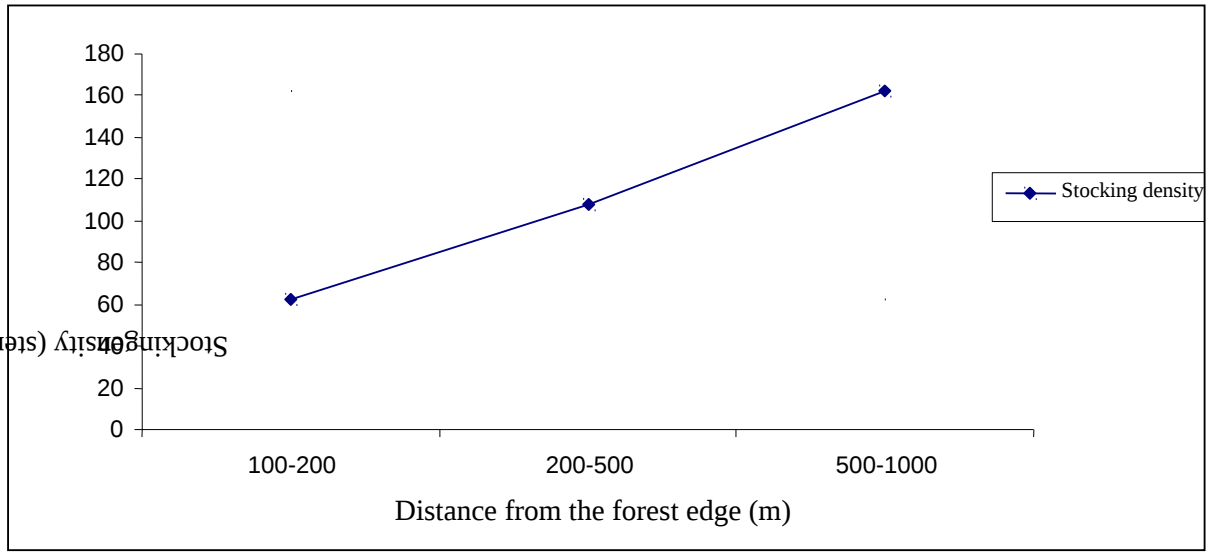

Figure 10: Distribution of stocking density at varying distance from the forest edge in KFR.

4.5.5.2 Basal area

The results in Table 19 shows an estimate of an average basal area of 22.526± 4.78(SE) m^2/ha in 2007 observed after CDIs interventions which is lower compared to the basal area of 42.096± 6.973(SE) recorded by Kessy and Temu in 1998 before CDI s interventions in KFR. However, the difference is not statistically significant at (p>0.05). The recorded basal area in 2007 was lower than is the case in other studies conducted in EUM. For instance, AFIMP (1988) and Maliondo *et al.* (2000) documented about 51m^2/ha and

42m^2/ha respectively in the EUM forests, while Malimbwi and Mgeni (1991) reported a value of 51m^2/ha in Amani Nature Reserve.

Figure 11 and Appendix 3 and 4 indicate the distribution of basal area with distances. The figure shows basal areas as increasing with the increase of distance from the forest edge. Of 200 m, 500 m and 1000 m from the forest edge were 5.6 m^2/ha, 6.6 m^2/ha and 10.4 m^2/ha respectively. This was evident during the study where by most of the small tree species with small diameter were observed to dominate in the forest, and which reflects regeneration from past exploitation done by timber merchants and the current illegal logging of timber. Therefore, this study suggests that there was still human disturbance going on in KFR, even with CDIs interventions, which cause negative impact to forest resources.

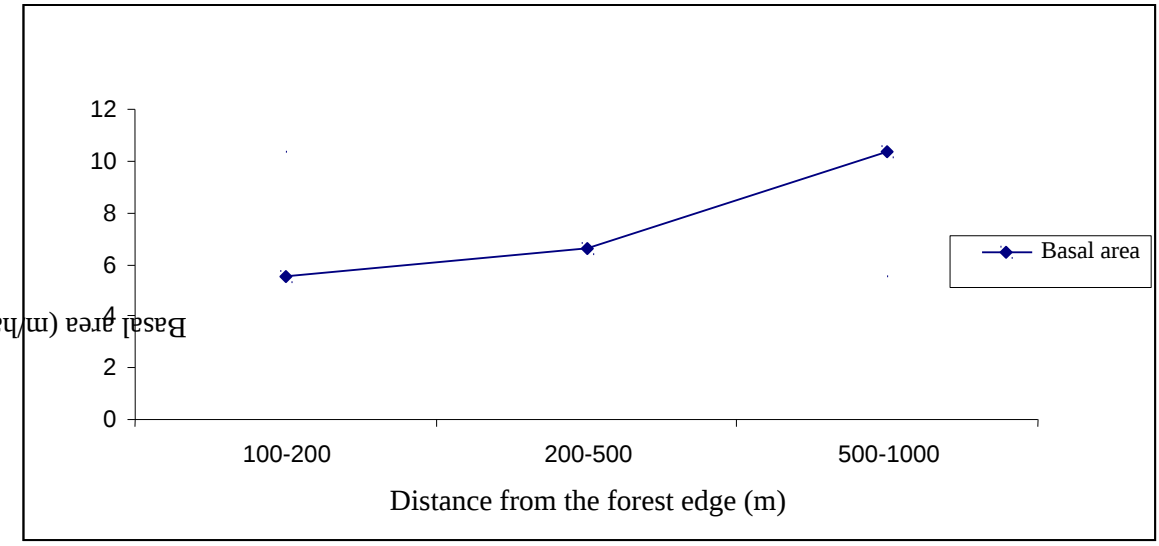

Figure 11: Distribution of Basal area at varying distance from the forest edge, KFR.

4.5.5.3 Wood volume

The results in Table 3 indicate an average of wood volume of 533.23 ± 215.04(SE) m^3/ha recorded in 2005 after CDIs interventions being lower than the wood volume of 546.337±87.88 (SE) m^3 /ha recorded by Kessy and Temu in 1998 before CDIs

interventions. The difference is not statistically significant ($p>0.05$). The plausible reason of low wood volume in 2007 could be that, most tree species were dominated by trees with small diameter which contributed to small basal area and consequently wood volume. The variation of volume and distances as shown in Figure 12 indicates increase of wood volume with an increase in distance; this implies that the outer of the forest edge (200 m) experiences unsustainable forest resources utilization which reduced wood volume despite the CDIs intervention and government efforts to protect and upgrade the forest to being nature reserve.

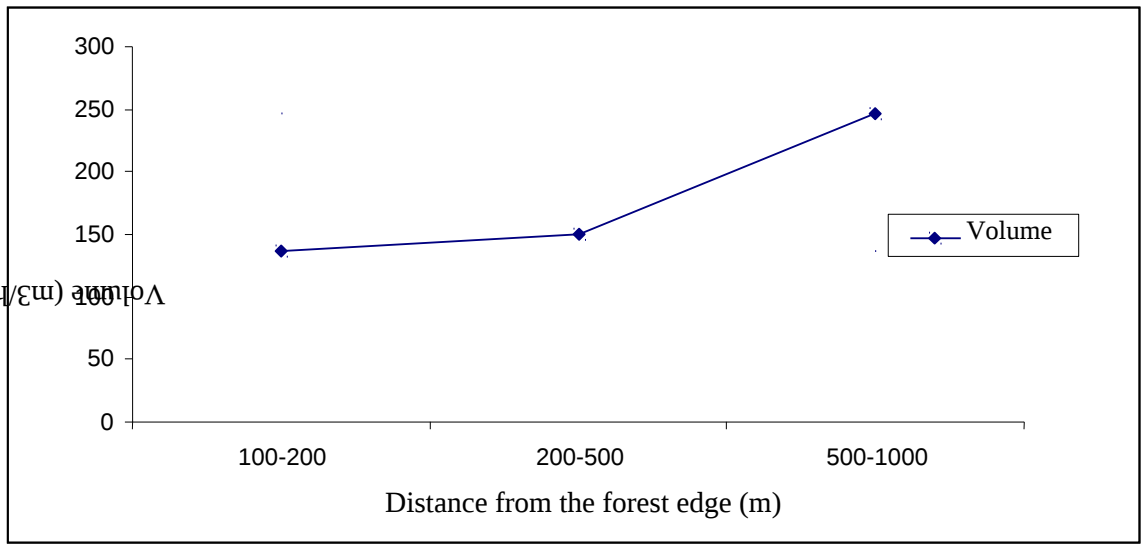

Figure 12: Distribution of Volume at varying distance from the forest edge, KFR.

4.5.6 Impact of CDIs on trees diversity and richness

4. 5. 6.1 Shannon –wiener index of diversity

The Shannon –wiener value (H′) of this study was 3.5 (Appendix 4). This value was higher than the one observed by Kessy and Temu in 1998 of 3.37 before CDIs intervention. The greater the values of Shannon-wiener index the higher the species diversity (Philip, 1992). These results suggest that there is high species diversity found after CDIs intervention than before interventions. The high diversity observed after interventions shows a high

re-growth rate of the forest after disturbance. The H′ value was also higher compared to H′ value reported by Munishi *et al*. (2004) of 2.93 and 3.31 in East Usambara and Uluguru mountains respectively.

The plausible cause of high species diversity may be explained by disturbances in the forest under study. According to field observation, the disturbance noted were firewood collection, pole cutting for household construction, traditional medicines gathering, timber logging and mining, which opened the forest canopy, creating favorable conditions for emergence of new species or re-growth of suppressed species. Consequently, the emerging species in the exploited area are likely to cause changes in species composition and structure of the ecosystem, hence increasing the Shannon-wiener index.

Seydack (2000) reported that the disturbances caused by pole harvesting have a major influence on the forest that can alter the balance of species. Munishi (1996) argues that regeneration of different trees species in mountain forests tend to be suppressed by gaps formed by larges falling tree due to dense growth of climbers and strangers of different types, thereby changing the canopy structure and tree species composition from the original vegetation. Therefore, CDIs intervention has enhanced tree species diversity, suggesting that the forest composition was changing as new species were recruited due to human disturbance.

4.5.6.2 Important value indices

Important Value Index (IVI) is presented in Appendix 4. The highest values of IVI were observed for *Maesopsi eminii* (48.72) *Allambackia stulhminii* (25.14) *Cephalosphaera usambarensis* (24.95), *Sorindeia madagascariensis* (22.92), *Alchornea hirtella* (17.08) and *Myrianthus holstii* (11.94). While the lowest values of IVI were observed for *Bussia sp*.

(0.18), *Antidesma membronoceum* (0.17) *Ficus lutea* (0.17), *Keetia venosa* (0.17), *Rytigynia stulhmanii* (0.1710), *Rinorea ferruginea* (0.1706) and *Polysphaeria multiflora* (0.1702). The species with the highest IVI in relation to others implies that they are abundant in the study forest.

According to Philip (1992), the important value Index shows the overall picture of ecological importance of a species with respect to the community structure because its composite index is based on the summation of percentage of value of the relative frequency, relative density and relative dominance. These results suggest that CDIs intervention have increased the abundance of species in the KFR, supported by equally distribution of the IVI in all distance ranges from the forest edge to 1000 m within the forest reserve.

4.6 Socio-economic factors influencing CDIs

This section discusses the findings on socio-economic factors influencing CDIs in the study area. Stakeholder participation, promotion of income generating activities, employment and source of income, improved forest resource protection and management and balancing conservation with community development were the factors identified to influence achievement of CDIs. Whereas inadequate resources and material support, lack of capital and access to financial services, inadequate extension services and inadequate reliable markets for produce were the factors constraining CDIs implementation.

4.6.1 Contributing factors to the achievement of CDIs

Table 20 shows regression results of socio-economic factors influencing the achievement of CDIs. The log-likelihood ratio of the logistic regression model was found to fit very well to the data as shown by the significance value of 0.003 for a constant. The Model Chi-

square 35.4 was highly significant (p<0.001) implying that the independent variables affected the outcome or dependent variables. The –2 log likelihood value of 115.1 also indicated that the model fitted the data reasonably.

The overall percentage of correct predictions was 77.6%, which shows better goodness of fit. Stakeholder participation, employment and a source of income, and balancing conservation with community developments show to have significantly influenced the achievement of CDIs implementations at (p<0.05 and <0.01) significance level. Whereas, the promotion of income generating activity and forest protection and managements shows to have no significant influence on the achievement of CDIs.

Table 20: Regression analysis on the factors influencing achievement of CDIs

Variable	β	S.E.	Wald	df	Sig.	Odds Ratio (Expβ)
Promotion of IGA	0.86	0.41	3.00	1	0.08ns	2.36
Forest protection and management	0.51	0.52	0.95	1	0.32ns	1.67
Stakeholders participation	1.34	0.56	5.71	1	0.02*	3.82
Employment and source of income	1.25	0.51	6.01	1	0.01**	3.48
Balance conservation with community development	-1.27	0.41	9.89	1	0.00**	0.28
Constant	3.32	1.13	8.64	1	0.003	0.03

Note: Model Chi-square= 35.4 (p<0.001); -2LL = 115.11; Overall percentage = 75.3, R-Square =77.6, β= Regression coefficient; SE= Standard error of the estimate; Sig= significance level; number of cases =116, Wald= $\beta/(SE)^2$; df= degree of freedom; Exp (β)= odds ratio. * = Statistically significant at 0.05, ** = Statistically significant at 0.01,*** = Statistically significant at 0.001level of significance and NS = non- significant at 0.05 and 0.01 level of significance.

4.6.1.1 Employment and source of income

Table 20 indicates a positive regression coefficient (β=1.25) of employment and source of income on the achievement of CDIs implementations. The creation of employment and source of income depict statistical significance on the CDIs achievements at (p<0.01). The positive relationships signify that an increase in one unit change of employment and source

of income, increases odds ratio of achievement of CDIs implementation by a factor of 3.48. This indicates that an increase in CDIs activities generated more employment, consequently diversified the income source to the local communities. This had been confirmed by the existence of production (EUTCO) and supportive institution (i.e. TFCG ANR, EUCAMP) that contributed to employment and diversification of income sources in the study area.

The results in Table 21 revealed that about 24.7% of the respondents agreed that the project and the institutions have increased employment and contributed to household income sources in their villages. For instance, during the survey, it was reported that almost 50% of people from the study villages engaged themselves in tea plucking (casual labour) as source of income, while others were employed by ANR as tour guides, watchmen and hotel attendants. Other people were engaged in income generating activities initiated by EUCAMP, and earned substantial incomes from such employment. This has added value to household incomes, which catered for household obligations and some amount tricked down to investment on non –farm economic activities. Other studies conducted in EUM (Kessy, 1998; Jambiya and Sosovele, 2001; Vihemaki, 2005) ranked projects and production institutions as the major employer of the residents and immigrants.

4.6.1.2 Balancing conservation –with community development

Table 20 shows the balancing conservation with community developments as having negative regression (β =-1.27) and odds ratio of 0.28. This indicates that for every unit change in this variable, there is a decrease in the odds ratio of CDIs implementation by a factor of 0.28. The increase in conservation and community development is statistically highly significant at ($p<0.001$). This implies that people's adoption of activities implemented by CDIs and that are geared at conserving natural resources and supporting

community development services, enhanced the linkage between conservation and community developments. The results in Table 21 shows that about 6.3% of the respondents recognize that balancing conservation with developments was among the factors which contributed to CDIs achievement.

During field study it was reported that CDIs supported villages' development social service. For instance, EUCAMP/ANR have entered into agreement with the villages surrounding ANR including Mlesa and Shebomeza that the villages have to receive 20% share of revenues generated from tourism, research and other activities conducted by ANR. Apart from the money accrued to individual's community after selling *Allanblackia* seeds, UNILIVER projects also provides five percent of its sales to respective villages where the product was collected to support community development services. Ranth and Jain (2005) revealed that benefit sharing act as a motivating factor for people's participation and token appreciation for the peoples efforts in conservation. Nurse and Kabamba (1999) argued that cost and benefit sharing, motivation and incentive have been acknowledged by local community as the basis for successful implementation of CDIs activities.

4.6.1.3 Stakeholder participation

The results in Table 20 show that stakeholders' participation has a positive regression coefficient (β=1.34), 3.82 odds ratio and significantly at ($p=<0.05$). It means that an increase in one unit change of stakeholder participation increases the odds ratio of CDIs implementation by a factor of 3.82. The logical explanation of the positive relationship is that involving stakeholders in project planning and decision making toward project implementation, increased the willingness of people to adopt income generating activities initiated by CDIs, consequently achieving the anticipated project objectives.

The results in Table 21 show that about 25% of the respondents confirmed that awareness raising and stakeholder participation influenced the achievement of CDIs in the study area. The strategies of stakeholder participation in the study area were taken as the whole procedure and mechanism that enabled stakeholders' role and responsibility on the implementation of project activities. For instance EUCAMP/ANR had entered into an agreement with the adjacent villages, including Mlesa, Shebomeza and Shambagenda whereby the rights and responsibilities of each party concerned in the ANR were defined. Literature (Sayer and Campbell, 2004) reveal that success of CDIs project requires involvement of all significant stakeholders and these must help to determine appropriate measures of success, maintain stable and fair tenure and governance arrangements.

4.6.1.4 Promotion of income generating activity

The results in Table 20 show further that the promotion of income generating activities has a positive regression coefficients ($\beta=0.86$), odds ratio of 2.36 and its non- significantly at ($p>0.05$). This means that change of one unit of an income generating activities, increase the odd ratio of CDIs implementation by a factor of 2.36. The plausible explanation for positive regression coefficients is that the presence of CDIs in the study area have initiated income generating activities, which were adopted and implemented by the local communities. This was confirmed by 24% of the respondents who revealed that the achievement of CDIs was contributed by the promotion of income generating activities and the alternative or wise use of natural resources such as energy saving stoves, butterfly farming and fish farming (Table 21).

In the study villages, income generating activities had been initiated and implemented by the community as livelihood strategies; and some of which are natural resource based with significant and direct positive impact on forest conservation and biodiversity. Newmark

(2002) concluded that projects support conservation effort through promoting development of the local people through income generating activities. Chinguwo (2000) points out that in Tanzania, a number of NGOs, donor agencies and Governmental institutions are involved in introducing alternative income generating activities to the forest adjacent community in an attempt to improve their livelihoods and enhance management of natural resources.

4.6.1.5 Forest resources protection and management

Table 20 shows that forest resources protection and management indicated a positive regression coefficient (β= 0.51), odd ratio of 1.67 and its non- significance at ($p>0.05$). This means that an increase in one household involved in forest protection and management increases the odd ratio of CDIs implementation by a factor of 1.67. The logical interpretation could be an increase in forest resources protection and managements decreases the unsustainable forest products use by the adjacent forest communities. Restriction and law enforcement imposed by projects/ANR authority on unsustainable utilization of natural resource products has enhanced the improvement of forest and water resources. This was confirmed by 20.5% of the respondents who agreed that the restrictions and regulations put in place facilitated forest protection and ensured sustainable utilization (Table 21). The forest resource improvement indicator as perceived by the respondents was the reliability of rainfall and water availability in the streams and rivers, which have an influence on crop production.

Table 21: Response on contributing factors to the achievement of CDIs

Variable	Villages multiple responses			Total % (N=116)
	Shembagenda %(n=29)	Mlesa %(n=27)	Shebomeza %(n=23)	
Promotion IGA	28.0	23.1	21.0	23.7
Forest protection & management	20.0	19.2	22.6	20.5
Stakeholder participation	22.0	25.6	25.8	24.7
Employment & source of income	22.0	25.6	25.8	24.7
Balance conservation with				

community development	8.0	6.4	4.8	6.3
Total	26.3	41.1	32.6	100.0

4.6.2 Correlation analysis

Pearson Correlation coefficient was used to depict the relationship between CDIs activities and the income, land size, forest improvement, and livelihood improvement. The results in Table 22 show that the number of activities implemented by CDIs were significance ($P<0.01$) correlated with the land size, total annual income, forest improvement and livelihood strategies.

Table 22: Pearson correlation coefficient analysis

Variable	Number of activities supported by EUCAMP
Land size	0.321(**) 0.000 116
Occupation of respondents	0.658 -0.048 0.658
Annually total income	0.253(**) 0.006 116
Livelihoods improvement after implementation of CDI's	-0.423(**) 0.000
Improvement forest in terms of water catchments, climate amelioration, provision of forest product and biodiversity conservations	-0.339(**) 0.002 79

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

The Land size was significance correlated with the activities implemented by CDIs ($r = 0.321$; $P < 0.01$). The correlation coefficients show a positive sign indicating that the people with relatively large land size implemented more activities than those with the small parcel of land. The an average land size in the study area were 4.44 ha/ household, farmers with limited land probable avail it only for agricultural crops and are normally

undecided to involve themselves in longer term investment like tree planting. However, it was observed that people with the small parcel of land have adapted crops integration, renting and borrowing as strategies on overcome land shortage.

The household income show a positive significance correlation coefficient ($r = 0.253$; $P< 0.01$) with the CDIs activities. This implies that the CDIs project implementation increases diversity of an income source and employment creation through income generating activities. Some activities such as butterfly farming, and dairy cattle milk production have contributed to the household income. The money accrued from activities assist community to accumulate valued asset in household such as to purchase land, livestock, farms equipment and handling social service i.e. health, education.

The results show further a negative significance correlation coefficient ($r = -0.423$; $P<0.01$) of livelihood improvement with the CDIs activities. This implies that increases in intervention through income generating opportunity have not adequately improved people's livelihoods, the plausible cause among others may be shortage of farming land due to expansion of ANR and limited access to forest products which is important for people's livelihood security.

The study also reveals that forest restoration show a negative significance correlation coefficient ($r = -0. 339$; $P< 0.01$) with the activities implemented by CDIs, implying that an increase in intervention through income generating opportunity, extension services and farm forestry have not reduced pressure toward in the forest reserves. This correlation is justified through results from inventory study that notes illegal collection of the forest product in the forest reserve; especial firewood and building material which hinder forest restoration.

4.6.3 Factors constraining CDIs implementation

Table 23 shows regression results of socio-economic factors constraining CDIs implementation. The goodness of fit of the logistic regression model was found to fit by significance value of 0.007 for a constant. The Model Chi-square 40.4 was highly significant at ($p<0.001$) implying that the independent variables affected the outcome or the dependent variables. The –2 log likelihood value of 113.89 also indicated that the model fitted the data reasonably. The overall percentage of correct predictions was 81%, which shows better goodness of fit. Inadequate extension services, inadequate resources and material support and unreliable markets for the produce are statistically significant, while lack of capital and access to financial service show no significance.

Table 23: Regression analysis on factors constraining CDIs implementation

Variable	β	S.E.	Wald	df	Sig.	Odds Ratio (Expβ)
Lack of capital & access to financial service	-0.21	0.53	0.15	1	0.69 ns	0.811
inadequate resources & material support	1.63	0.54	9.03	1	0.00***	5.089
Inadequate extension service	1.51	0.55	7.65	1	0.001***	4.538
Inadequate reliable markets	0.96	0.48	3.99	1	0.04*	2.616
Constant	1.33	0.49	7.38	1	0.007	0.26

Note: Model Chi-square= 40.4 ($p<0.001$); -2LL = 113.89; Overall percentage = 81, R-Square =84.6, β= Regression coefficient; SE= Standard error of the estimate; n= number of cases, Sig = significance level; Wald= $\beta/(SE)^2$; df= degree of freedom; Exp (β)= odds ratio, * - statistical significance at 0.05, ** = Statistically significant at 0.01, *** =Statistically significant at 0.001 and NS = statistically non- significant at 0.05 and 0.01 level of significance

4.6.2.1 Inadequate resources and material support

Table 23 shows that inadequate resources and material support indicate a high significance at ($p<0.01$), a positive regression coefficient ($\beta=1.63$) and an odd ratio of 5.09. This implies that an increase in one unit change of resource and material increases the odd ratio of constraint to CDIs implementation by a factor of 5.09. The plausible explanation could

be poor provision of resources (financing) and inadequate working equipment as increasing shortfalls on the projects to accomplish its planned objectives.

The results in Table 24 show that about 17.9% of the respondents mentioned inadequate resources and material support as the constraints that made the projects failed to accomplish the implemented activities. It was revealed that projects were funded by donor agencies under limited period of time (just 3 or 5 years) while the initiative required long term facilitation (e.g farm forestry and soil and water conservation). After the project had stopped funding the government had the responsibility to continue channelling resources to facilitate implementation of such initiative. Unfortunately, the local community received less support from the government as a result innovations initiated by project were neglected by farmers because they were poorly facilitated.

4.6.2.2 Lack of capital and access to financial services

Table 23 shows lack of capital and financial services as statistically not-significant at ($p>0.05$), negative regression coefficient ($\beta= -0.21$) and odd ratio of 0.81. This means that the increase in one unit change of capital and access to financial service decreases the odds ratio of CDIs implementation by a factor of 0.81. The negative regression coefficient signifies that as households were increasingly becoming limited to capital and access to financial services, they failed to implement and invest on the activities initiated by CDIs hence poor implementation rate of the CDIs objectives.

The results in Table 24 show that 10.7% of the respondents agreed that lack of capital and access to financial services were among the factors constraining the community from adopting the CDIs implemented technology. For instance, people from Mlesa, Shebomeza and Shabagenda villages and who were engaged in wood stove making, bio-intensive

gardening, fish farming, beekeeping, butterfly farming and tree nursery articulated that those projects needed input and equipment which required more capital in their investment, and there was no financial institution which was ready to provide soft loan credit. This was evidenced by low adoption rate of farmers to CDIs implemented activities.

According to Washa (2001) lack of capital and financial service is the major hindrance to smallholder farmers in implementing income generating opportunity initiated by projects. Washa, (*ibid*) reported further that local communities in the rural areas depend on their saving, which take a long period to accumulate and sometimes the savings cater for other household obligations such as food, health and education. Lack of access to financial service in the study area hindered many people from adopting income generation activities initiated by the projects.

4.6.2.3 Inadequate extension services

Table 23 indicates that inadequately of extension services has a positive regression coefficient (β=1.51) and odds ratio of 4.54, and it is statistically significance at ($p<0.01$) as constraint facing CDIs implementation. This implies that an increase in one unit change of extension services increases the odds ratio of constraint to CDIs implementation by a factor of 4.54. The plausible explanation could be, inadequate provision of extension services was the hindrance to the project, because farmers were not facilitated and motivated to acquire knowledge and skills to practises CDIs initiated technology.

The results in Table 24 revealed that 15.5% of the respondents claimed that the project had inadequate human resources to render extension services. People expressed their concerns on the inadequately of technical skills in implementing income generating activities, farm forestry and soil and water conservation practices. It was reported by one participant in

Shebomeza village that since he constructed his fish pond, he had never been visited by any extension officer (fishery officer) and he did not know where he could get fingerlings. The same was also observed in Misalai ward where extension services were inadequate as five villages in the ward were being served by only one agricultural extension officer.

Lack of adequate skills on how to run enterprises and inadequate extension services have been mentioned by MNRT (2004) which reported that groups and individuals that practise beekeeping at village level lack training and education, extension services and access to capital. Inadequate technical skills in the study area contributed to poor performance of some income generating activities such as fish farming, beekeeping and soil and water conservation practices.

4.6.2.4 Inadequate reliable markets

Table 23 shows that inadequate reliable markets indicate positive regression coefficient (ß= 0.96), Odds ratio of 2.62 and it is statistically significant at ($p<0.05$) as a constraint facing CDIs implementation. This implies that an increase in one unit of unreliable market increases the odds ratio of constrain of CDIs implementations by a factor of 2.62. Positive regression coefficient signifies that inadequate reliable markets increased the limitation to the households in adopting CDIs interventions. The results in Table 24 revealed that 29.8% of the respondents pointed out the unreliable markets as a factor in the study area. This caused them to travel long distances to access markets and services. For instance, farmers from Sakale village had to travel 10 km to Amani centre where social services were available, while sometime they had to travel to Muheza town, which is about 60 km away.

Lack of market and social services had been a crucial constraint facing farmers engaged in butterfly farming. Sometime, the farmers had to release their butterflies in the wild due to

lack of market. According to Amani butterfly field manager, a total of six markets were located in USA, UK, France, Germany, Switzerland, and Belgium but only 45% were regularly. Those engaged in collecting and selling *Allanblakia* seeds claimed to have only one market controlled by UNILIVER project. The unreliability of markets situation in the study area gave a very low return.

These findings are supported by the findings from Bird *et al.* (2002) who argued that returns to investment are likely to be lower in remote rural areas partly because markets do not function well; they are 'thinner' - more interlocked, with smaller marketable surpluses, higher transactions costs, and possibly offering lower prices. Therefore, provision of communication infrastructure in the area would probably lead to market development where goods from the urban areas could be sold the community at lower prices and vice verse.

Table 24: Responses on factors constraining CDIs implementation

Variable	Villages multiple responses			Total % (N=116)
	Shembagenda %(n=29)	Mlesa %(n=27)	Shebomeza %(n=23)	
Lack of capital & access to financial service	0.0	15.6	6.7	10.7
Inadequate of resources &material support	22.2	13.3	23.3	17.9
Inadequate extension service	44.4	15.6	6.7	15.5
Less support from government	11.1	26.7	30.0	26.2
Inadequate reliable market	22.2	28.9	33.3	29.8
Total	10.7	53.6	35.7	100.0

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study concludes that EUCAMP was a major CDIs implemented in the study area. Soil and water conservation, farm forestry (agro forestry), butter fly farming, fish farming, bee keeping, energy saving stove, collection and selling *Allanblackia stulhminii* seeds, bio-intensive gardening, zero grazing dairy cattle, spice cultivation and ecotourism development were the main activities implemented by CDIs.

The study further demonstrated that local communities in the study area pursue diverse range of livelihood strategies. Agriculture, livestock keeping and small business were identified as the major household livelihood strategies. Moreover, it was noted that people in Mlesa, Shabomeza and Shembagenda villages had more income generating activities initiated by CDIs as compared to Sakale village which had no CDIs implemented. CDIs project initiative showed a relative positive impact on livelihoods specifically on the increase of household source of income, reduced women's workloads through time saving for collecting firewood, employment generation, development of social service through income accrued from the project, adoption of new technology and food security through soil improvement and reliable rainfall.

However, despite profound positive impact, the study revealed that CDIs interventions have increased hardships and have jeopardised people's livelihoods through reduced land for farming, crop damage caused by wild animals, restricted access to timber and other non

tree forest products. Mlesa and Shebomeza villages were found to be more affected than other villages due to the establishment and expansion of ANR which were facilitated by CDIs. The study noted that lack of alternative income sources, because of lack of interventions has driven people in Sakale village into invading streams, river beds and water catchments of Zigi River for unauthorized gold mining, with negative impacts on the environment resources.

The study concludes further that curently the level of CDIs intervention and enforcement in ANR have little impact on reducing pressure toward forest resources utilization in the foret reserves. Illegal collection of forest products especial firewood and building material is still high in the forest reserve. The inventory study has shown that encountered coppicing trees and dead stumps were harvested for building material. The areas most affected by the collection of building materials, such as the forest edge, have the stocking level in terms of stem per hectare and Basal area being lower and regeneration being continuously disturbed.

The Correction analysis (r) revealed that livelihoods improvement and forest resources restoration shows a negative significant correlation coefficient with activities implemented by CDIs, meaning that CDIs interventions have not adequately improved people's livelihoods or reduced pressure toward forest resources utilization.

Additionally, the study revealed that inadequate resources and material support, lack of capital and access to financial service, inadequate extension service and inadequate reliable markets for the produce were among the factors constraining CDIs implementation.

5.2 Recommendations

Based on the above conclusion, the following recommendations can be drawn;

i. More sources of CDIs based income generating activities need to be secured by ANR and development partners. Contemporary sources of income such as butterfly farming and dairy cattle need to be intensified and extended to other villages such as Sakale.

ii. The Government and other development partners need to put in place a mechanism which will lead into sharing of benefit and cost of conservation between the upland community and the down stream user since the current benefit is inadequate e.g. local communities ensure a continuous flow of clean water in Tanga Municipal, for paddy irrigation and hydro electric power generation. Some benefits derived from this water should flow back to the upstream communities to support their livelihoods.

iii. Local Government Authority (Muheza District) should continue promoting tree planting exercise outside ANR, which may serve as alternatives for different forest products. Villagers should be encouraged to use bricks as construction materials instead of poles and improving farming systems to minimize the rate of encroachments.

iv. The ecological integrity of the forest reserve (ANR) must be maintained on the long-term basis by regularly assessing and monitoring its status to evaluate the extent and nature of changes that are taking place.

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APPENDICES

Appendix 1: Household questionnaires

PART A. IDENTIFICATION VARIABLE

1. Questionnaire No……
2. Date of interview ……
3. Name of the respondent……..
4. Name of village ……..
5. Sub village……..
6. Name of ward …….....
7. Name of division…….
8. District ……..

PART B. GENERAL CHARACTERISTIC OF RESPONDENTS

9. Age of respondent […….yrs]

10. Gender
    a) Male [….]
    b) Female [….]

11. Marital status
    a) Single [….]
    b) Married [….]
    c) Divorced [….]
    d) Widowed [….]
    e) Separated

12. Family size (i.e. number of people in the household) [……..]

13. Education level of respondents (Years)
    a) No formal education [….]
    b) Primary school level [….]
    c) Secondary and high school level [….]
    d) Diploma [….]
    e) Degree [….]

4. Ethnicity, are you native of this area?

a) Yes […..]
b) No […..]
c) If No, where do you come from……..
d) Tribe …….

15. Reason for moving to the village

……

PART C. MAIN ACTIVITIES OF CDIS

16. Do you have any information on the program /project encouraging improvement of well being and forest conservation?

1. Yes […]
2. No […]
3. Not sure […]

17. If yes, which program/project?

……
……

18. The following is/are the main activity of the program/project mentioned above?

a) Promote Food security […]
b) Facilitate income generating activities […]
c) Promoting awareness on environment conservation and forest protection […]
d) Implementing policy and act (eg.forest policy) […]
e) Promoting land use plan and conflict resolution […]
f) Creating employment in the village […]

Others (mention…….

19. To your opinion, are activities performed by Conservation development interventions improve livelihoods and forest resources? Yes […] No […]

Give reason for the answer given above (19)……
……..

PART C. IMPACT CDIS ON LIVELIHOOD STRATEGIES

20. Which of the following is your main occupation(s) (tick from the list)

a. Agriculture […….]
b. Livestock keeping […….]
c. Fishing […….]
d. Hunting […….]
e. Lumbering […….]
f. Petty business […….]
g. Wage Employment […….]
h. Brick making […….]
i. Beekeeping […….]
j. Casual labour […….]

21. Which of those linked to Conservation Development Interventions available to your village (mention)……
……

22. What main crops do your cultivate?

No.	Crops

23. Do you notes decline of crops production per acre for the past 5 year or more?

a) Yes […]
b) No […..]

If yes give reason

……

24. Do food produced is enough to household for period of …

a) Secure for all year around […….]
b) Seasonally food insecure […….]
c) Food insecure most of the year […….]

25. Where do you get food in time of hardships/food shortage?

……

……

26. Do you own land for different purpose?

a) Yes [….]
b) No [….]

27. If the answer (Q.26) is yes what size is it? […….Acres]

28. How did you acquire the land you own?

a) Bought […..]
b) Rented […..]
c) Inherited […..]
d) Allocated by village government […..]
e) Self allocation […..]

29. Is the land owned enough for agricultural/livestock/settlement/forest?

a) Yes […….]
b) No […….]

If no, where do you get other land (mention).....?

30. What is your annual total household income (estimate, Tshs?)

a) Below 150, 000.00 [……]
b) Between 150, 000.00 and Tshs.300, 000.00 [……]
c) Between 300, 000.00 and Tshs.500, 000 .00 [……]
d) Above 500, 000.00 [……]

31. What are the main sources of income mentioned above?

a) Farming (agricultural) [……]
b) Non farming activities(petty business, casual labour…) [……]
c) Wage Employment [……]
d) Others mention……...

32. Do you own any of the following items in your household?
a) Electricity […..]
b) Radio […..]
c) Television […..]
d) Land line telephone or cell phone […..]
e) Bicycle […..]
f) Motorbike […..]
g) Fridge […..]
h) Car […..]

33 Were these items obtained before or after implementation of CDI's?
a. Before [……..]
b. After […….]

34. How do your rate livelihoods after implementation of CDI's
a. High improvement [……..]
b. Less improvement [……..]
c. No improvement [……..]

35. What can you tell about the success of CDI's in terms of improving peoples livelihoods strategies …….

36. What can you tell about the failure of CDI's in terms of improving peoples livelihoods strategies……..

37. How community have been affected by implementation of CDI's
a. Income decline […….]
b. Food insecurity […….]
c. Land use conflict […….]

d. Water use conflict […….]
e. Scarcity of land for farming […….]
f. Scarcity of land for grazing […….]
g. Scarcity of firewood […….]
h. Unemployment […….]
i. Displacement of people […….]

38. What conservation and development interventions have been done in terms of improving people's livelihood strategies?

a) Fish farming [….]
b) Beekeeping [….]
c) Energy saving stoves [….]
d) Commercial tree nurseries [….]
e) Land for agriculture [….]
f) Land for Livestock keeping [….]
g) Market for products [….]
h) Offering soft loan credit [….]

39. To what extent has each of the above served to improve your livelihoods strategies

a) Low [….]
b) Medium [….]
c) High [….]

40. Comment on the best way CDI's can do to improve people's livelihood needs in the village?.....
…….

PART D. IMPACT OF CDIS ON THE STATUS OF FOREST RESOURCE MANAGEMENT

41 Do you have any forest adjacent to the village?

a) Yes […….]

b) No […….]

42. If the answer above is yes, what is the status of the forest?

……

…….

43. How important is the forest to you and the village in terms of water catchments, climate amelioration, provide forest products and biodiversity conservation

a) Very important […...]
b) Important [……]
c) Moderate [……]
d) Not important [……]

44. Do you use forest products to supplement the family food and income?

a) Yes […..]
b) No […..]

45. If the answer above is yes, what type of product among those listed below?

a. Collecting honey [……..]
b. Building materials [……..]
c. Firewood [……..]
d. Timber [……..]
e. Fruits [……..]
f. Traditional medicine [……..]
g. Hunting/wild animals [……..]
h. Thatching materials [……..]
i. Honey [……..]
j. Charcoal [……..]
k. Water [……..]
l. Fodder for livestock [……..]

46. There is any restrict in terms of access and uses of the forest product?

a) Yes […..]
b) No […..]

47. If the answer above is yes, who enforce the restriction (mention?)

……

……

48. Can you tell the availability of forest product after the implementation of CDI's?

a. More available forest product […….]
b. Less/ Scarcity of forest products […….]
c. No change in availability […….]

49. Can you rank the problem of environmental degradation /deforestation after implementation of CDI's?

a. Highly […….]
b. Medium […….]
c. Low […….]
d. No change […….]

50. To your opinion, what has been done by CDI's to promote forest restoration, protection and conservation in your village? ……

……

51. Comment on what the best way the CDI's can do to improve forest resources, meanwhile meeting people livelihood needs ?……

……

……

PART F. SOCIO-ECONOMIC FACTORS INFLUENCING CDIS

52. What factors contribute on the success of the conservation development interventions on improving the people's livelihoods and forest resources?

a) Create income generating activities to poor people [……..]
b) Forest resource restored and sustainable used [……..]
c) Involve all stakeholders in decision making [……..]
d) Increase employment in the village [……..]
e) Balance conservation -with- community development […….]

53. What factor contributes on the failure of CDI's on improving the people's livelihood and forest resources? (Tick from the list)

a) Inadequate support from stakeholder (local community) [……]
b) Inadequate of resources and equipment (fund) to implement activities […]
c) Inadequate of human resources [……]
d) Less of support from the government [……]
e) Focus on conservation than solving community livelihood needs [……]
f) Low awareness from community on issue of conservation [……]

54. Is there any policy influencing livelihoods and forest resources in your area?

a) Yes [….]
b) No [….]
c) None [….]

55. If yes, mention them …….

56. Does that policy, law/institutional have any impact to community livelihood and forest management?

a) Yes […….]
b) No […….]

57. Give reason(s) for the answer given Q.56 above

……
……
……. ……. ……

Appendix 2: Checklist for focus group discussion and key informant

Check list for focus group discussion

Group members (2 members from each group – gender sensitive):

- Members of the Village government
- Members of the Village Natural Resources Committee
- Prominent people in the village (preferably old people)
- Youth
- Representative of project/program working in the village

Guiding questions

1. Livelihood strategies in the village
2. Main Conservation Development Interventions in the village?
3. Objective of the Conservation Development Intervention?
4. Achievement of Conservation Development Intervention activities toward improvement of local livelihood and forest resource conservation?
5. Constraint imposed to local community from conservation development interventions
6. How do you compare people livelihoods and forest resource before and after conservation development interventions
7. Issue policy and institution change
8. Comment on how conservation development intervention can harmonize improving both people's livelihood and forest resources.

Checklist for Key Informants

Village Government Officials

1. Village population, social services
2. Main livelihood activities of the villagers
3. Main sources of income for the villagers.
4. Is there any conservation and development intervention in the village?
5. What does it do in the village –main objective

6. How do you compare people livelihoods and forest resource before and after conservation development interventions
7. Issue policy and institution change
8. How do you perceive the presence of conservation and development intervention?
9. Does the development intervention contributed on the improvement peoples livelihood in the village, in which way?
10. The conservation development intervention has caused any problem to local communities and forest resources.
11. What should be done so that development intervention can contribute to local livelihoods?

District officers

1. District socio-economic profile
2. Main conservation development interventions in Muheza district, when commenced and mention their activities
3. The main objective
4. Mail livelihood strategies of the local community
5. Type and management status of forest resources in the district
6. How does the local communities livelihood and forest resources are influenced by conservation development interventions
7. how do you compare people livelihoods and forest resources before and after Conservation development intervention
8. Does the project face problem during implementation
9. Does policies and institution change have any influence on livelihoods and forest resources use and management?
10. How does project perceived by local community

Project, program officer

1. Conservation Development intervention background, objectives, activities and achievement.
2. What factors are perceived as the main achievement
3. Does the project achieved to link communities livelihood needs and forest resource conservation
4. Does the project face problem on implementing its activities? Why?
5. How does the project perceived by local community?
6. Does of policies and institution change have any influence on the program/projects

Appendix 3: List of tree species identified in KFR, East Usambara, Tanzania.

Spp Code	Botanical Name	Local Name	SPP code	Botanical name	Local Name
1	*Aisoddeopsis schumanii*	***Mkaranga –mwitu/Moambeyu***	43	*Morinda asterocepa*	
2	*Albizia gumifera*	Mshai	44	*Myrianthus holstii*	Mkonde
3	*Alchornea hirtella*	*Zasa*	45	*Newtonia buchananii*	Mnyasa/Mshashita
4	*Allambackia stulhminii*	*Msambu*	46	*Ocotea usambarensis*	Maase
5	*Allophylus meliodorus*		47	*Oxanthus speciosa*	Mkahawapori
6	*Anickia kumerieae*	*N'gwaka*	48	*Parinari excelsa*	Muua/Muula
7	*Anisophylea obtusifolia*	Msala	49	*Pirer capensis*	Ngoko
8	*Anthocleista grandflora*	*Mpumu*	50	*Placodiscus amaniensis*	
9	*Antidesma membronoceum*	*Muindi/Mlindi*	51	*Polycias fulva*	*Fumbati*
10	*Aoranthe pendulflora*	*Samaka*	52	*Polysphaeria multiflora*	
11	*Beilschmedia kweo*	*Mfimbo*	53	*Pouteria adolfifriederici*	
12	*Bersama abysinica*	Mbamba	54	*Quasia undulata*	*Banko*
13	*Blighia unijugata*	Mzindanguuwe	55	*Rauvolfia caffra*	Msesewe
14	*Bussia sp*		56	*Rawsonia lusida*	Kigwandi
15	*Celtis africana*		57	*Rinorea ferruginea*	
16	*Cephalosphaera usambarensis*	*Mtambara*	58	*Rytigynia stulhmanii*	Ntwavuha
17	*Chrisophyllum perpulchrum*	*Kuti*	59	*Schefflerodendron Usambarense*	Msase
18	*Coffea zanguebarica*	Mkahawa	60	*Shirakiopsis ellipticum*	
19	*Cola greenwayii*	*Muungu*	61	*Sorindeia madagascariensis*	Mkwingwina
20	*Cramespora triflora*		62	*Spathodea campanulata*	
21	*Cynometra brachyrrachis*		63	*Strombosia schefleri*	Msangana,/Sangana
22	*Cythea maniana*		64	*Suregada zanzibariensis*	*Mdimu*
23	*Dasylepsis integra*	*Kigwandi*	65	*Syncepalm msoo*	
24	*Drypetes usambarense*	Kisengeti	66	*Syncepalm cerasiferum*	Mohoyo
25	*Englerodendron usambarense*	*Mzumba/Mkwe*	67	*Syzgium guinense*	Mshihwi
26	*Ficus sycomorus*	Mkuyu/Msasa	68	*Tabernaemontana pachysphon*	Muamba/Mbeewe
27	*Ficus lutea*	Msasa	69	*Tarenna nigrescens*	Msahaghasha chole
28	*Funtumia africana*	*Kiimboti*	70	*Tricalysia myritiflora*	Saani,Uhako wa ngoto
29	*Greenwayodendreon suavelons*	Mwati	71	*Trichilia emetica*	Mngoimazi
30	*Harungana madagascariensis*	Mkutu	72	*Trichillia dregeana*	
31	*Isobelinia scheffler*	*Mbarika/mtoa magasa*	73	*Trilepsium madagascariense*	

32	*keetia venosa*		74	*Turraea holstii*	
33	*Lasianthus kilimandischaricus*		75	*Uvariodendron usambarense*	Msofi
34	*Leptaulus holstii*		76	*Whitefiedia ollongata*	
35	*Leptonychia usambarensi*		77	*Xymalos monospora*	Mzikozoko/Kidimudimu
36	*Macaranga capensis*	Mkumba	78	*Xylopia ethiopica*	Muawia
37	*Maesopsi eminii*	***Mhesi***	79	*Zenkerela grotei*	
38	*Magnistipula butayei*	Mlawia			
39	*Maranthes goetzeniana*	Fuzu,Mng'nga.Ng'anga			
40	*Mesogyne insgnis*	Mkuhe			
41	*Mimusops kummei*				
42	*Mimusops aedificatoria*				

Appendix 4: Stand density, Basal area, Volume and Species richness and Diversity

Spp Code	Botanical Name	Total N	G	V	Frq.	Rel. Freq	Rel. Dom.	Rel. Den	IVI	H'
37	*Maesopsi eminii*	45.3	4.8452	99.4654	160	13.6054	21.5052	13.6054	48.7161	0.2714
4	*Allambackia stulhminii*	20.9	2.8288	68.8623	74	6.2925	12.5555	6.2925	25.1405	0.1740
16	*Cephalosphaera usambarensis*	24.6	2.2878	58.8338	87	7.3980	10.1543	7.3980	24.9502	0.1926
61	*Sorindeia madagascariensis*	35.4	0.3744	5.3611	125	10.6293	1.6617	10.6293	22.9202	0.2383
3	*Alchornea hirtella*	26.9	0.2089	4.4834	95	8.0782	0.9273	8.0782	17.0838	0.2032
44	*Myrianthus holstii*	14.4	0.7349	13.6510	51	4.3367	3.2619	4.3367	11.9354	0.1361
77	*Xymalos monospora*	10.8	0.4321	7.8222	38	3.2313	1.9180	3.2313	8.3806	0.1109
54	*Quasia undulata*	7.6	0.8394	20.5106	27	2.2959	3.7255	2.2959	8.3173	0.0866
68	*Tabernaemontana pachysphon*	12.2	0.0858	0.9451	43	3.6565	0.3808	3.6565	7.6937	0.1210
40	*Mesogyne insgnis*	11.9	0.0786	0.9353	42	3.5714	0.3488	3.5714	7.4916	0.1190
45	*Newtonia buchananii*	4.2	1.0516	27.8919	15	1.2755	4.6674	1.2755	7.2184	0.0556
39	*Maranthes goetzeniana*	2.8	1.1121	33.6192	10	0.8503	4.9362	0.8503	6.6369	0.0405
60	*Shirakiopsis ellipticum*	3.1	0.9766	26.7531	11	0.9354	4.3346	0.9354	6.2054	0.0437
36	*Macaranga capensis*	8.2	0.2480	3.7211	29	2.4660	1.1005	2.4660	6.0325	0.0913
25	*Englerodendron usambarense*	7.4	0.1866	3.6628	26	2.2109	0.8281	2.2109	5.2499	0.0843
49	*Parinari excelsa*	5.4	0.4535	11.2124	19	1.6156	2.0128	1.6156	5.2441	0.0667
65	*Syncepalm msoo*	3.7	0.6207	17.9074	13	1.1054	2.7550	1.1054	4.9659	0.049

										8
43	*Morinda asterocepa*	4.2	0.3512	6.9396	15	1.2755	1.5589	1.2755	4.1099	0.0556
17	*Chrisophyllum perpulchrum*	3.7	0.4144	9.1818	13	1.1054	1.8391	1.1054	4.0500	0.0498
46	*Ocotea usambarensis*	0.3	0.8022	33.8437	1	0.0850	3.5606	0.0850	3.7307	0.0060
29	*Greenwayodendreon suavelons*	4.8	0.1206	1.8945	17	1.4456	0.5351	1.4456	3.4263	0.0612
63	*Strombosia schefler*	3.7	0.2041	3.8929	13	1.1054	0.9060	1.1054	3.1169	0.0498
24	*Drypetes usambarense*	2.8	0.2952	6.9790	10	0.8503	1.3101	0.8503	3.0108	0.0405
7	*Anisophylea obtusifolia*	3.4	0.1626	2.9077	12	1.0204	0.7218	1.0204	2.7626	0.0468
66	*Syncepalm cerasifera*	3.1	0.1414	3.1687	11	0.9354	0.6275	0.9354	2.4983	0.0437
28	*Funtumia africana*	2.8	0.1608	3.1402	10	0.8503	0.7139	0.8503	2.4146	0.0405
22	*Cythea maniana*	3.7	0.0354	0.3673	13	1.1054	0.1571	1.1054	2.3680	0.0498
1	*Aisoddeopsis schumanii*	3.4	0.0204	0.1967	12	1.0204	0.0904	1.0204	2.1312	0.0468
8	*Anthocleista grandflora*	2.8	0.0926	2.0162	10	0.8503	0.4110	0.8503	2.1117	0.0405
31	*Isobelinia scheffler*	1.7	0.2443	6.1425	6	0.5102	1.0843	0.5102	2.1047	0.0269
11	*Beilschmedia kweo*	2.0	0.1848	4.4172	7	0.5952	0.8202	0.5952	2.0107	0.0305
51	*Polycias fulva*	2.3	0.1296	2.1721	8	0.6803	0.5754	0.6803	1.9359	0.0339
35	*Leptonychia usambarensi*	2.5	0.0291	0.3313	9	0.7653	0.1292	0.7653	1.6598	0.0373
71	*Trichilia emetica*	0.8	0.2486	7.4990	3	0.2551	1.1033	0.2551	1.6135	0.0152
21	*Cynometra brachyrrachis*	1.7	0.1243	2.4344	6	0.5102	0.5518	0.5102	1.5722	0.0269
41	*Mimusops kummei*	2.3	0.0421	0.6132	8	0.6803	0.1867	0.6803	1.5473	0.0339
10	*Aoranthe pendulflora*	1.4	0.1336	3.2300	5	0.4252	0.5930	0.4252	1.4433	0.023

										2
19	*Cola grenwayii*	2.3	0.0115	0.1288	8	0.6803	0.0512	0.6803	1.4117	0.0339
73	*Trilepsium madagascariense*	1.4	0.1077	2.0908	5	0.4252	0.4778	0.4252	1.3281	0.0232
75	*Uvariodendron usambarense*	2.0	0.0158	0.1695	7	0.5952	0.0701	0.5952	1.2605	0.0305
2	*Albizia gumifera*	1.7	0.0396	0.6941	6	0.5102	0.1756	0.5102	1.1960	0.0269
30	*Harungana madagascariensis*	1.4	0.0698	1.1339	5	0.4252	0.3099	0.4252	1.1603	0.0232
6	*Anickia kumerieae*	1.7	0.0241	0.3719	6	0.5102	0.1071	0.5102	1.1275	0.0269
76	*Whitefiedia ollongata*	1.7	0.0029	0.0247	6	0.5102	0.0130	0.5102	1.0334	0.0269
34	*Leptaulus holstii*	1.7	0.0015	0.0089	6	0.5102	0.0068	0.5102	1.0272	0.0269
59	*Schefflerodendron Usambarense*	1.4	0.0321	0.4419	5	0.4252	0.1426	0.4252	0.9929	0.0232
12	*Bersama abysinica*	1.1	0.0456	0.7559	4	0.3401	0.2023	0.3401	0.8826	0.0193
38	*Magnistipula butayei*	0.8	0.0773	1.4059	3	0.2551	0.3431	0.2551	0.8533	0.0152
42	*Mimusops aedificatoria*	1.1	0.0347	0.5057	4	0.3401	0.1540	0.3401	0.8343	0.0193
72	*Trichillia dregeana*	0.6	0.1039	2.2263	2	0.1701	0.4613	0.1701	0.8015	0.0108
78	*Xylopia ethiopica*	0.3	0.1290	3.4555	1	0.0850	0.5727	0.0850	0.7428	0.0060
69	*Tarenna nigrescens*	1.1	0.0092	0.1097	4	0.3401	0.0410	0.3401	0.7212	0.0193
64	*Suregada zanzibariensis*	1.1	0.0089	0.0977	4	0.3401	0.0393	0.3401	0.7196	0.0193
79	*Zenkerela grotei*	0.8	0.0229	0.3569	3	0.2551	0.1015	0.2551	0.6117	0.0152
13	*Blighia unijugata*	0.8	0.0195	0.2966	3	0.2551	0.0864	0.2551	0.5966	0.0152
56	*Rawsonia lusida*	0.8	0.0112	0.1397	3	0.2551	0.0497	0.2551	0.5599	0.0152
62	*Spathodea campanulata*	0.8	0.0053	0.0536	3	0.2551	0.0235	0.2551	0.5337	0.015

20	*Cramespora triflora*	0.8	0.0010	0.0068	3	0.2551	0.0046	0.2551	0.5148	2 0.0152
33	*Lasianthus kilimandischaricus*	0.8	0.0009	0.0053	3	0.2551	0.0038	0.2551	0.5140	0.0152
67	*Syzgium guinense*	0.8	0.0006	0.0032	3	0.2551	0.0026	0.2551	0.5128	0.0152
47	*Oxanthus speciosa*	0.6	0.0076	0.0978	2	0.1701	0.0336	0.1701	0.3737	0.0108
18	*Coffea zanguebarica*	0.6	0.0012	0.0083	2	0.1701	0.0051	0.1701	0.3453	0.0108
23	*Dasylepsis integra*	0.6	0.0006	0.0035	2	0.1701	0.0026	0.1701	0.3428	0.0108
26	*Ficus sycomorus*	0.3	0.0313	0.5882	1	0.0850	0.1387	0.0850	0.3088	0.0060
50	*Placodiscus amaniensis*	0.3	0.0246	0.4372	1	0.0850	0.1094	0.0850	0.2794	0.0060
55	*Rauvolfia caffra*	0.3	0.0121	0.1792	1	0.0850	0.0535	0.0850	0.2236	0.0060
5	*Allophylus meliodorus*	0.3	0.0063	0.0792	1	0.0850	0.0278	0.0850	0.1979	0.0060
74	*Turraea holstii*	0.3	0.0025	0.0245	1	0.0850	0.0109	0.0850	0.1809	0.0060
14	*Bussia sp*	0.3	0.0004	0.0022	1	0.0850	0.0016	0.0850	0.1716	0.0060
9	*Antidesma membronoceum*	0.3	0.0003	0.0019	1	0.0850	0.0014	0.0850	0.1715	0.0060
27	*Ficus lutea*	0.3	0.0003	0.0017	1	0.0850	0.0013	0.0850	0.1713	0.0060
32	*keetia venosa*	0.3	0.0002	0.0011	1	0.0850	0.0009	0.0850	0.1710	0.0060
49	*Pirer capensis*	0.3	0.0002	0.0011	1	0.0850	0.0009	0.0850	0.1710	0.0060
58	*Rytigynia stulhmanii*	0.3	0.0001	0.0007	1	0.0850	0.0006	0.0850	0.1707	0.0060
57	*Rinorea ferruginea*	0.3	0.0001	0.0006	1	0.0850	0.0005	0.0850	0.1706	0.0060
52	*Polysphaeria multiflora*	0.3	0.0000	0.0001	1	0.0850	0.0001	0.0850	0.1702	0.0060
Grand		**333**	**22.53**	**533.02**	**1176**	**100**	**100.000**	**100**	**300.000**	**3.445**

Total

Appendix 5: Distribution of stand parameter with distance

Distance	Spp code	N	G	V	Frq.	Rel. Freq	Rel. Dom.	Rel. Den	IVI	H'
100-200	37	3.1	0.387293	8.014766	11	10.476	11.821	10.476	32.774	0.236
100-200	16	1.7	0.596965	17.711102	6	5.714	18.221	5.714	29.650	0.164
100-200	60	1.1	0.575456	16.472781	4	3.810	17.565	3.810	25.184	0.124
100-200	54	1.7	0.412468	11.637709	6	5.714	12.590	5.714	24.019	0.164
100-200	44	2.5	0.169987	3.231702	9	8.571	5.189	8.571	22.331	0.211
100-200	40	2.8	0.013586	0.140624	10	9.524	0.415	9.524	19.462	0.224
100-200	77	2.3	0.116422	1.940168	8	7.619	3.554	7.619	18.792	0.196
100-200	65	0.8	0.414655	13.891309	3	2.857	12.657	2.857	18.371	0.102
100-200	61	2.3	0.017629	0.216755	8	7.619	0.538	7.619	15.776	0.196
100-200	43	1.4	0.064261	0.991954	5	4.762	1.961	4.762	11.485	0.145
100-200	4	1.1	0.119429	2.342686	4	3.810	3.645	3.810	11.264	0.124
100-200	45	0.3	0.196356	5.837248	1	0.952	5.993	0.952	7.898	0.044
100-200	68	1.1	0.006204	0.065675	4	3.810	0.189	3.810	7.808	0.124
100-200	3	0.8	0.003656	0.037416	3	2.857	0.112	2.857	5.826	0.102
100-200	48	0.8	0.001078	0.007411	3	2.857	0.033	2.857	5.747	0.102
100-200	66	0.6	0.004406	0.048056	2	1.905	0.134	1.905	3.944	0.075
100-200	76	0.6	0.000374	0.001974	2	1.905	0.011	1.905	3.821	0.075
100-200	38	0.3	0.035556	0.691040	1	0.952	1.085	0.952	2.990	0.044
100-200	2	0.3	0.032768	0.624062	1	0.952	1.000	0.952	2.905	0.044
100-200	73	0.3	0.030422	0.568782	1	0.952	0.929	0.952	2.833	0.044
100-200	29	0.3	0.021356	0.365633	1	0.952	0.652	0.952	2.557	0.044
100-200	13	0.3	0.016806	0.271087	1	0.952	0.513	0.952	2.418	0.044
100-200	36	0.3	0.015724	0.249470	1	0.952	0.480	0.952	2.385	0.044
100-200	7	0.3	0.010272	0.146606	1	0.952	0.314	0.952	2.218	0.044
100-200	71	0.3	0.004802	0.056725	1	0.952	0.147	0.952	2.051	0.044
100-200	35	0.3	0.004672	0.054817	1	0.952	0.143	0.952	2.047	0.044
100-200	10	0.3	0.001422	0.012414	1	0.952	0.043	0.952	1.948	0.044
100-200	63	0.3	0.001089	0.008893	1	0.952	0.033	0.952	1.938	0.044
100-200	70	0.3	0.000338	0.002064	1	0.952	0.010	0.952	1.915	0.044
100-200	21	0.3	0.000272	0.001575	1	0.952	0.008	0.952	1.913	0.044
100-200	75	0.3	0.000228	0.001259	1	0.952	0.007	0.952	1.912	0.044

Distance	Spp code	N	G	V	Frq.	Rel. Freq	Rel. Dom.	Rel. Den	IVI	H'
100-200	8	0.3	0.000139	0.000680	1	0.952	0.004	0.952	1.909	0.044
100-200	62	0.3	0.000089	0.000389	1	0.952	0.003	0.952	1.907	0.044
100-200	4	4.2	0.655092	15.086237	15	12.821	28.725	12.821	54.366	0.263
100-200	61	6.5	0.111541	1.926882	23	19.658	4.891	19.658	44.207	0.320
100-200	16	3.1	0.254986	5.215358	11	9.402	11.181	9.402	29.984	0.222
100-200	37	2.0	0.298825	6.929035	7	5.983	13.103	5.983	25.069	0.168
100-200	45	0.8	0.290192	7.283127	3	2.564	12.725	2.564	17.853	0.094
100-200	44	2.0	0.026966	0.348387	7	5.983	1.182	5.983	13.148	0.168
100-200	39	0.6	0.213556	6.049029	2	1.709	9.364	1.709	12.783	0.070
100-200	54	1.4	0.078141	1.382699	5	4.274	3.426	4.274	11.973	0.135
100-200	75	1.1	0.013617	0.150928	4	3.419	0.597	3.419	7.435	0.115
100-200	68	1.1	0.008460	0.089022	4	3.419	0.371	3.419	7.209	0.115
100-200	40	1.1	0.002024	0.015786	4	3.419	0.089	3.419	6.926	0.115
100-200	77	0.8	0.031150	0.563694	3	2.564	1.366	2.564	6.494	0.094
100-200	29	0.8	0.028990	0.487792	3	2.564	1.271	2.564	6.399	0.094
100-200	17	0.8	0.022717	0.351214	3	2.564	0.996	2.564	6.124	0.094
100-200	6	0.8	0.002494	0.021177	3	2.564	0.109	2.564	5.238	0.094
100-200	7	0.6	0.037729	0.737334	2	1.709	1.654	1.709	5.073	0.070
100-200	28	0.6	0.037494	0.735676	2	1.709	1.644	1.709	5.063	0.070
100-200	11	0.6	0.025078	0.444457	2	1.709	1.100	1.709	4.518	0.070
100-200	73	0.3	0.054450	1.176591	1	0.855	2.388	0.855	4.097	0.041
100-200	3	0.6	0.001028	0.007068	2	1.709	0.045	1.709	3.464	0.070
100-200	51	0.3	0.030422	0.568782	1	0.855	1.334	0.855	3.043	0.041
100-200	60	0.3	0.025689	0.460505	1	0.855	1.126	0.855	2.836	0.041
100-200	36	0.3	0.020000	0.336885	1	0.855	0.877	0.855	2.586	0.041
100-200	5	0.3	0.006272	0.079178	1	0.855	0.275	0.855	1.984	0.041
100-200	62	0.3	0.002006	0.019067	1	0.855	0.088	0.855	1.797	0.041
100-200	48	0.3	0.000800	0.006052	1	0.855	0.035	0.855	1.744	0.041
100-200	56	0.3	0.000228	0.001259	1	0.855	0.010	0.855	1.719	0.041
100-200	13	0.3	0.000200	0.001072	1	0.855	0.009	0.855	1.718	0.041
100-200	47	0.3	0.000200	0.001072	1	0.855	0.009	0.855	1.718	0.041
100-200	67	0.3	0.000118	0.000552	1	0.855	0.005	0.855	1.715	0.041
100-200	24	0.3	0.000089	0.000389	1	0.855	0.004	0.855	1.713	0.041

Distance	Spp code	N	G	V	Frq.	Rel. Freq	Rel. Dom.	Rel. Den	IVI	H'
		62.8	**5.556729**	**136.121137**	**222**	**200.000**	**200.000**	**200.000**	**600.000**	
200-500	16	5.9	0.986894	26.837577	21	18.919	37.011	18.919	74.849	0.315
200-500	37	2.8	0.332127	6.649697	10	9.009	12.456	9.009	30.474	0.217
200-500	3	3.7	0.006804	0.052474	13	11.712	0.255	11.712	23.679	0.251
200-500	40	2.8	0.015272	0.147972	10	9.009	0.573	9.009	18.591	0.217
200-500	44	2.0	0.107656	1.879875	7	6.306	4.037	6.306	16.650	0.174
200-500	4	1.4	0.135061	2.752324	5	4.505	5.065	4.505	14.074	0.140
200-500	71	0.6	0.243778	7.442298	2	1.802	9.142	1.802	12.746	0.072
200-500	68	1.7	0.008540	0.076880	6	5.405	0.320	5.405	11.131	0.158
200-500	61	1.7	0.004039	0.032402	6	5.405	0.151	5.405	10.962	0.158
200-500	54	0.6	0.127278	3.124829	2	1.802	4.773	1.802	8.377	0.072
200-500	53	0.3	0.142934	3.926483	1	0.901	5.360	0.901	7.162	0.042
200-500	24	0.3	0.142222	3.902075	1	0.901	5.334	0.901	7.135	0.042
200-500	17	0.6	0.082450	1.926758	2	1.802	3.092	1.802	6.696	0.072
200-500	8	0.3	0.080000	1.902276	1	0.901	3.000	0.901	4.802	0.042
200-500	43	0.3	0.072708	1.688261	1	0.901	2.727	0.901	4.528	0.042
200-500	72	0.3	0.058939	1.298931	1	0.901	2.210	0.901	4.012	0.042
200-500	28	0.6	0.007574	0.091095	2	1.802	0.284	1.802	3.888	0.072
200-500	7	0.6	0.001356	0.009890	2	1.802	0.051	1.802	3.654	0.072
200-500	20	0.6	0.000362	0.001895	2	1.802	0.014	1.802	3.617	0.072
200-500	26	0.3	0.031250	0.588172	1	0.901	1.172	0.901	2.974	0.042
200-500	29	0.3	0.017422	0.283564	1	0.901	0.653	0.901	2.455	0.042
200-500	73	0.3	0.017422	0.283564	1	0.901	0.653	0.901	2.455	0.042
200-500	21	0.3	0.014450	0.224498	1	0.901	0.542	0.901	2.344	0.042
200-500	71	0.3	0.007200	0.094067	1	0.901	0.270	0.901	2.072	0.042
200-500	63	0.3	0.006422	0.081553	1	0.901	0.241	0.901	2.043	0.042
200-500	35	0.3	0.004050	0.045858	1	0.901	0.152	0.901	1.954	0.042
200-500	36	0.3	0.003362	0.036345	1	0.901	0.126	0.901	1.928	0.042
200-500	22	0.3	0.002689	0.027497	1	0.901	0.101	0.901	1.903	0.042
200-500	13	0.3	0.002450	0.024481	1	0.901	0.092	0.901	1.894	0.042
200-500	48	0.3	0.001494	0.013203	1	0.901	0.056	0.901	1.858	0.042
200-500	66	0.3	0.000968	0.007678	1	0.901	0.036	0.901	1.838	0.042
200-500	77	0.3	0.000800	0.006052	1	0.901	0.030	0.901	1.832	0.042

Distance	Spp code	N	G	V	Frq.	Rel. Freq	Rel. Dom.	Rel. Den	IVI	H'
200-500	70	0.3	0.000257	0.001465	1	0.901	0.010	0.901	1.811	0.042
200-500	58	0.3	0.000139	0.000680	1	0.901	0.005	0.901	1.807	0.042
200-500	75	0.3	0.000139	0.000680	1	0.901	0.005	0.901	1.807	0.042
200-500	37	6.5	0.691439	13.613075	23	15.972	34.236	15.972	66.181	0.293
200-500	61	5.1	0.029441	0.323764	18	12.500	1.458	12.500	26.458	0.260
200-500	16	3.4	0.118395	2.297220	12	8.333	5.862	8.333	22.529	0.207
200-500	4	1.4	0.295514	8.735303	5	3.472	14.632	3.472	21.577	0.117
200-500	3	4.2	0.008527	0.069751	15	10.417	0.422	10.417	21.256	0.236
200-500	44	2.8	0.142901	2.812089	10	6.944	7.076	6.944	20.965	0.185
200-500	39	0.8	0.149120	3.548350	3	2.083	7.384	2.083	11.550	0.081
200-500	36	1.7	0.058238	0.949165	6	4.167	2.884	4.167	11.217	0.132
200-500	65	0.8	0.098909	1.981777	3	2.083	4.897	2.083	9.064	0.081
200-500	28	0.8	0.094682	1.970651	3	2.083	4.688	2.083	8.855	0.081
200-500	10	0.6	0.116921	3.015056	2	1.389	5.789	1.389	8.567	0.059
200-500	77	1.4	0.016237	0.230881	5	3.472	0.804	3.472	7.748	0.117
200-500	68	1.4	0.009744	0.103879	5	3.472	0.482	3.472	7.427	0.117
200-500	48	1.4	0.009524	0.100098	5	3.472	0.472	3.472	7.416	0.117
200-500	54	0.8	0.026210	0.459890	3	2.083	1.298	2.083	5.464	0.081
200-500	51	0.8	0.022619	0.307040	3	2.083	1.120	2.083	5.287	0.081
200-500	40	0.8	0.005236	0.051350	3	2.083	0.259	2.083	4.426	0.081
200-500	17	0.3	0.060552	1.343473	1	0.694	2.998	0.694	4.387	0.035
200-500	1	0.6	0.002182	0.017848	2	1.389	0.108	1.389	2.886	0.059
200-500	2	0.6	0.002076	0.017948	2	1.389	0.103	1.389	2.881	0.059
200-500	29	0.3	0.016200	0.258944	1	0.694	0.802	0.694	2.191	0.035
200-500	7	0.3	0.015022	0.235653	1	0.694	0.744	0.694	2.133	0.035
200-500	24	0.3	0.015022	0.235653	1	0.694	0.744	0.694	2.133	0.035
200-500	77	0.3	0.004050	0.045858	1	0.694	0.201	0.694	1.589	0.035
200-500	35	0.3	0.002222	0.021673	1	0.694	0.110	0.694	1.499	0.035
200-500	60	0.3	0.002134	0.020607	1	0.694	0.106	0.694	1.495	0.035
200-500	8	0.3	0.002091	0.020085	1	0.694	0.104	0.694	1.492	0.035
200-500	69	0.3	0.001089	0.008893	1	0.694	0.054	0.694	1.443	0.035
200-500	19	0.3	0.001028	0.008272	1	0.694	0.051	0.694	1.440	0.035
200-500	34	0.3	0.000200	0.001072	1	0.694	0.010	0.694	1.399	0.035

Distance	Spp code	N	G	V	Frq.	Rel. Freq	Rel. Dom.	Rel. Den	IVI	H'
200-500	6	0.3	0.000139	0.000680	1	0.694	0.007	0.694	1.396	0.035
200-500	76	0.3	0.000139	0.000680	1	0.694	0.007	0.694	1.396	0.035
200-500	33	0.3	0.000118	0.000552	1	0.694	0.006	0.694	1.395	0.035
200-500	37	9.9	0.844563	16.082421	35	27.778	43.728	27.778	99.284	0.356
200-500	3	4.5	0.008892	0.066051	16	12.698	0.460	12.698	25.857	0.262
200-500	39	0.6	0.412278	13.045269	2	1.587	21.346	1.587	24.521	0.066
200-500	16	3.4	0.096700	1.880062	12	9.524	5.007	9.524	24.054	0.224
200-500	4	1.7	0.241246	5.592203	6	4.762	12.491	4.762	22.015	0.145
200-500	61	3.4	0.017847	0.196033	12	9.524	0.924	9.524	19.972	0.224
200-500	36	2.0	0.056853	0.776255	7	5.556	2.944	5.556	14.055	0.161
200-500	65	0.8	0.044923	0.852761	3	2.381	2.326	2.381	7.088	0.089
200-500	19	0.8	0.002952	0.026413	3	2.381	0.153	2.381	4.915	0.089
200-500	44	0.6	0.021027	0.305246	2	1.587	1.089	1.587	4.263	0.066
200-500	31	0.3	0.046006	0.953315	1	0.794	2.382	0.794	3.969	0.038
200-500	43	0.6	0.011953	0.151846	2	1.587	0.619	1.587	3.793	0.066
200-500	7	0.3	0.038272	0.757586	1	0.794	1.982	0.794	3.569	0.038
200-500	45	0.6	0.004189	0.046538	2	1.587	0.217	1.587	3.391	0.066
200-500	68	0.6	0.003644	0.034087	2	1.587	0.189	1.587	3.363	0.066
200-500	40	0.6	0.003389	0.033676	2	1.587	0.175	1.587	3.350	0.066
200-500	35	0.6	0.000987	0.007036	2	1.587	0.051	1.587	3.226	0.066
200-500	63	0.6	0.000237	0.001119	2	1.587	0.012	1.587	3.187	0.066
200-500	1	0.6	0.001682	0.012887	2	1.389	0.083	1.389	2.861	0.059
200-500	51	0.3	0.020672	0.351082	1	0.794	1.070	0.794	2.658	0.038
200-500	38	0.3	0.016806	0.271087	1	0.794	0.870	0.794	2.457	0.038
200-500	17	0.3	0.010756	0.155269	1	0.794	0.557	0.794	2.144	0.038
200-500	24	0.3	0.008022	0.107666	1	0.794	0.415	0.794	2.003	0.038
200-500	2	0.3	0.004356	0.050218	1	0.794	0.226	0.794	1.813	0.038
200-500	54	0.3	0.003200	0.034172	1	0.794	0.166	0.794	1.753	0.038
200-500	77	0.3	0.003200	0.034172	1	0.794	0.166	0.794	1.753	0.038
200-500	56	0.3	0.002939	0.030726	1	0.794	0.152	0.794	1.739	0.038
200-500	76	0.3	0.002134	0.020607	1	0.794	0.111	0.794	1.698	0.038
200-500	8	0.3	0.001800	0.016659	1	0.794	0.093	0.794	1.680	0.038
200-500	29	0.3	0.000556	0.003838	1	0.794	0.029	0.794	1.616	0.038

Distance	Spp code	N	G	V	Frq.	Rel. Freq	Rel. Dom.	Rel. Den	IVI	H'
200-500	33	0.3	0.000512	0.003466	1	0.794	0.027	0.794	1.614	0.038
200-500	27	0.3	0.000288	0.001690	1	0.794	0.015	0.794	1.602	0.038
200-500	66	0.3	0.000200	0.001072	1	0.794	0.010	0.794	1.598	0.038
		107.9	**6.6**	**150.2**	**381.0**	**300.0**	**300.0**	**300.0**	**900.0**	
500-1000	37	7.1	0.484869	8.554606	25	24.038	24.908	24.038	72.985	0.343
500-1000	3	3.4	0.152369	3.996064	12	11.538	7.827	11.538	30.904	0.249
500-1000	4	1.7	0.339125	8.359583	6	5.769	17.421	5.769	28.960	0.165
500-1000	16	2.0	0.154212	3.623273	7	6.731	7.922	6.731	21.384	0.182
500-1000	60	0.6	0.282756	7.836851	2	1.923	14.525	1.923	18.372	0.076
500-1000	45	0.6	0.207022	5.364248	2	1.923	10.635	1.923	14.481	0.076
500-1000	61	1.4	0.011512	0.156399	5	4.808	0.591	4.808	10.207	0.146
500-1000	36	1.1	0.022444	0.291084	4	3.846	1.153	3.846	8.845	0.125
500-1000	41	1.1	0.002767	0.022752	4	3.846	0.142	3.846	7.834	0.125
500-1000	44	0.8	0.034504	0.549344	3	2.885	1.773	2.885	7.542	0.102
500-1000	25	0.3	0.100651	2.533982	1	0.962	5.171	0.962	7.094	0.045
500-1000	40	0.8	0.007228	0.073972	3	2.885	0.371	2.885	6.141	0.102
500-1000	29	0.8	0.000364	0.001726	3	2.885	0.019	2.885	5.788	0.102
500-1000	59	0.6	0.014017	0.214279	2	1.923	0.720	1.923	4.566	0.076
500-1000	24	0.6	0.013711	0.177761	2	1.923	0.704	1.923	4.551	0.076
500-1000	68	0.6	0.011070	0.159370	2	1.923	0.569	1.923	4.415	0.076
500-1000	31	0.6	0.007339	0.094746	2	1.923	0.377	1.923	4.223	0.076
500-1000	1	0.6	0.004139	0.041562	2	1.923	0.213	1.923	4.059	0.076
500-1000	64	0.6	0.003244	0.031336	2	1.923	0.167	1.923	4.013	0.076
500-1000	54	0.3	0.038828	0.771337	1	0.962	1.995	0.962	3.918	0.045
500-1000	28	0.3	0.019867	0.334087	1	0.962	1.021	0.962	2.944	0.045
500-1000	39	0.3	0.009339	0.130165	1	0.962	0.480	0.962	2.403	0.045
500-1000	47	0.3	0.007361	0.096699	1	0.962	0.378	0.962	2.301	0.045
500-1000	10	0.3	0.006806	0.087676	1	0.962	0.350	0.962	2.273	0.045
500-1000	11	0.3	0.005202	0.062685	1	0.962	0.267	0.962	2.190	0.045
500-1000	7	0.3	0.002404	0.023903	1	0.962	0.123	0.962	2.047	0.045
500-1000	6	0.3	0.001494	0.013203	1	0.962	0.077	0.962	2.000	0.045
500-1000	20	0.3	0.000672	0.004870	1	0.962	0.035	0.962	1.958	0.045
500-1000	14	0.3	0.000356	0.002198	1	0.962	0.018	0.962	1.941	0.045

Distance	Spp code	N	G	V	Frq.	Rel. Freq	Rel. Dom.	Rel. Den	IVI	H'
500-1000	66	0.3	0.000356	0.002198	1	0.962	0.018	0.962	1.941	0.045
500-1000	76	0.3	0.000200	0.001072	1	0.962	0.010	0.962	1.933	0.045
500-1000	19	0.3	0.000139	0.000680	1	0.962	0.007	0.962	1.930	0.045
500-1000	69	0.3	0.000139	0.000680	1	0.962	0.007	0.962	1.930	0.045
500-1000	63	0.3	0.000128	0.000614	1	0.962	0.007	0.962	1.930	0.045
500-1000	37	4.2	0.588392	12.328242	15	14.019	31.650	14.019	59.687	0.275
500-1000	16	3.7	0.035591	0.484108	13	12.150	1.914	12.150	26.214	0.256
500-1000	4	2.3	0.161855	3.887351	8	7.477	8.706	7.477	23.659	0.194
500-1000	61	3.1	0.022422	0.245503	11	10.280	1.206	10.280	21.767	0.234
500-1000	39	0.3	0.320000	10.741523	1	0.935	17.213	0.935	19.082	0.044
500-1000	44	1.4	0.144032	3.021452	5	4.673	7.748	4.673	17.093	0.143
500-1000	77	1.1	0.097789	2.150166	4	3.738	5.260	3.738	12.737	0.123
500-1000	54	1.4	0.031264	0.488120	5	4.673	1.682	4.673	11.028	0.143
500-1000	36	1.4	0.029830	0.387113	5	4.673	1.605	4.673	10.950	0.143
500-1000	40	1.4	0.027871	0.437086	5	4.673	1.499	4.673	10.845	0.143
500-1000	8	1.4	0.006351	0.054847	5	4.673	0.342	4.673	9.687	0.143
500-1000	78	0.3	0.129032	3.455517	1	0.935	6.941	0.935	8.810	0.044
500-1000	17	0.6	0.089000	2.154831	2	1.869	4.787	1.869	8.526	0.074
500-1000	21	0.6	0.047006	0.946434	2	1.869	2.528	1.869	6.267	0.074
500-1000	48	0.6	0.025828	0.461184	2	1.869	1.389	1.869	5.128	0.074
500-1000	60	0.6	0.015820	0.214533	2	1.869	0.851	1.869	4.589	0.074
500-1000	45	0.6	0.007878	0.102304	2	1.869	0.424	1.869	4.162	0.074
500-1000	65	0.3	0.041089	0.827833	1	0.935	2.210	0.935	4.079	0.044
500-1000	1	0.6	0.003362	0.034995	2	1.869	0.181	1.869	3.919	0.074
500-1000	3	0.6	0.000442	0.002431	2	1.869	0.024	1.869	3.762	0.074
500-1000	6	0.3	0.020000	0.336885	1	0.935	1.076	0.935	2.945	0.044
500-1000	62	0.3	0.003200	0.034172	1	0.935	0.172	0.935	2.041	0.044
500-1000	35	0.3	0.002888	0.030063	1	0.935	0.155	0.935	2.025	0.044
500-1000	22	0.3	0.002222	0.021673	1	0.935	0.120	0.935	1.989	0.044
500-1000	75	0.3	0.001800	0.016659	1	0.935	0.097	0.935	1.966	0.044
500-1000	66	0.3	0.001422	0.012414	1	0.935	0.077	0.935	1.946	0.044
500-1000	69	0.3	0.000800	0.006052	1	0.935	0.043	0.935	1.912	0.044
500-1000	70	0.3	0.000556	0.003838	1	0.935	0.030	0.935	1.899	0.044

Distance	Spp code	N	G	V	Frq.	Rel. Freq	Rel. Dom.	Rel. Den	IVI	H'
500-1000	9	0.3	0.000321	0.001934	1	0.935	0.017	0.935	1.886	0.044
500-1000	68	0.3	0.000272	0.001575	1	0.935	0.015	0.935	1.884	0.044
500-1000	24	0.3	0.000200	0.001072	1	0.935	0.011	0.935	1.880	0.044
500-1000	32	0.3	0.000200	0.001072	1	0.935	0.011	0.935	1.880	0.044
500-1000	19	0.3	0.000174	0.000902	1	0.935	0.009	0.935	1.879	0.044
500-1000	2	0.3	0.000162	0.000824	1	0.935	0.009	0.935	1.878	0.044
500-1000	37	4.2	0.442104	9.300204	15	13.761	20.970	13.761	48.493	0.273
500-1000	4	2.0	0.575010	15.988932	7	6.422	27.274	6.422	40.118	0.176
500-1000	61	2.8	0.032692	0.434519	10	9.174	1.551	9.174	19.899	0.219
500-1000	25	2.5	0.008237	0.081577	9	8.257	0.391	8.257	16.904	0.206
500-1000	48	0.6	0.274422	7.471492	2	1.835	13.017	1.835	16.686	0.073
500-1000	77	2.3	0.020672	0.240952	8	7.339	0.981	7.339	15.659	0.192
500-1000	43	1.4	0.126450	2.543452	5	4.587	5.998	4.587	15.172	0.141
500-1000	63	1.1	0.102528	2.012057	4	3.670	4.863	3.670	12.203	0.121
500-1000	45	0.6	0.144800	3.364449	2	1.835	6.868	1.835	10.538	0.073
500-1000	22	1.4	0.013249	0.138387	5	4.587	0.628	4.587	9.803	0.141
500-1000	68	1.4	0.003380	0.025373	5	4.587	0.160	4.587	9.335	0.141
500-1000	3	1.4	0.002567	0.018287	5	4.587	0.122	4.587	9.296	0.141
500-1000	16	0.8	0.043667	0.782991	3	2.752	2.071	2.752	7.576	0.099
500-1000	30	0.8	0.041117	0.671613	3	2.752	1.950	2.752	7.455	0.099
500-1000	12	0.8	0.037983	0.655207	3	2.752	1.802	2.752	7.306	0.099
500-1000	44	0.8	0.003561	0.030422	3	2.752	0.169	2.752	5.673	0.099
500-1000	24	0.3	0.080000	1.902276	1	0.917	3.795	0.917	5.629	0.043
500-1000	51	0.6	0.035792	0.605538	2	1.835	1.698	1.835	5.367	0.073
500-1000	17	0.3	0.055112	1.194481	1	0.917	2.614	0.917	4.449	0.043
500-1000	40	0.6	0.001450	0.011637	2	1.835	0.069	1.835	3.739	0.073
500-1000	65	0.6	0.000472	0.002647	2	1.835	0.022	1.835	3.692	0.073
500-1000	67	0.6	0.000472	0.002647	2	1.835	0.022	1.835	3.692	0.073
500-1000	15	0.3	0.033282	0.636309	1	0.917	1.579	0.917	3.414	0.043
500-1000	41	0.3	0.011756	0.173499	1	0.917	0.558	0.917	2.392	0.043
500-1000	21	0.3	0.010756	0.155269	1	0.917	0.510	0.917	2.345	0.043
500-1000	74	0.3	0.002450	0.024481	1	0.917	0.116	0.917	1.951	0.043
500-1000	1	0.3	0.002222	0.021673	1	0.917	0.105	0.917	1.940	0.043

Distance	Spp code	N	G	V	Frq.	Rel. Freq	Rel. Dom.	Rel. Den	IVI	H'
500-1000	42	0.3	0.000800	0.006052	1	0.917	0.038	0.917	1.873	0.043
500-1000	29	0.3	0.000624	0.004439	1	0.917	0.030	0.917	1.864	0.043
500-1000	33	0.3	0.000228	0.001259	1	0.917	0.011	0.917	1.846	0.043
500-1000	19	0.3	0.000200	0.001072	1	0.917	0.009	0.917	1.844	0.043
500-1000	49	0.3	0.000200	0.001072	1	0.917	0.009	0.917	1.844	0.043
500-1000	37	4.0	0.546040	12.572230	14	10.294	17.914	10.294	38.502	0.234
500-1000	46	0.3	0.802222	33.843703	1	0.735	26.319	0.735	27.789	0.036
500-1000	3	5.1	0.020953	0.208649	18	13.235	0.687	13.235	27.158	0.268
500-1000	61	4.0	0.062138	0.818794	14	10.294	2.039	10.294	22.627	0.234
500-1000	4	2.8	0.225906	4.854727	10	7.353	7.411	7.353	22.117	0.192
500-1000	25	2.5	0.048333	0.678391	9	6.618	1.586	6.618	14.821	0.180
500-1000	11	1.1	0.154513	3.910096	4	2.941	5.069	2.941	10.952	0.104
500-1000	68	2.0	0.016974	0.203618	7	5.147	0.557	5.147	10.851	0.153
500-1000	44	1.4	0.084299	1.472462	5	3.676	2.766	3.676	10.119	0.121
500-1000	66	1.1	0.128763	3.033522	4	2.941	4.224	2.941	10.107	0.104
500-1000	45	0.6	0.196356	5.837249	2	1.471	6.442	1.471	9.383	0.062
500-1000	53	0.3	0.188089	5.532002	1	0.735	6.171	0.735	7.641	0.036
500-1000	22	1.1	0.010944	0.112663	4	2.941	0.359	2.941	6.241	0.104
500-1000	54	0.8	0.042782	0.733281	3	2.206	1.404	2.206	5.815	0.084
500-1000	77	0.6	0.061632	1.272737	2	1.471	2.022	1.471	4.963	0.062
500-1000	63	0.6	0.050706	0.954555	2	1.471	1.664	1.471	4.605	0.062
500-1000	40	0.8	0.002524	0.023189	3	2.206	0.083	2.206	4.495	0.084
500-1000	24	0.6	0.035899	0.652105	2	1.471	1.178	1.471	4.119	0.062
500-1000	48	0.6	0.035458	0.646128	2	1.471	1.163	1.471	4.104	0.062
500-1000	17	0.3	0.078144	1.847334	1	0.735	2.564	0.735	4.034	0.036
500-1000	31	0.6	0.029649	0.527802	2	1.471	0.973	1.471	3.914	0.062
500-1000	41	0.6	0.026456	0.408058	2	1.471	0.868	1.471	3.809	0.062
500-1000	7	0.6	0.025152	0.386829	2	1.471	0.825	1.471	3.766	0.062
500-1000	29	0.6	0.014891	0.204381	2	1.471	0.489	1.471	3.430	0.062
500-1000	21	0.3	0.051842	1.106645	1	0.735	1.701	0.735	3.171	0.036
500-1000	73	0.6	0.005356	0.061859	2	1.471	0.176	1.471	3.117	0.062
500-1000	28	0.6	0.001228	0.008708	2	1.471	0.040	1.471	2.981	0.062
500-1000	18	0.6	0.001156	0.008250	2	1.471	0.038	1.471	2.979	0.062

Distance	Spp code	N	G	V	Frq.	Rel. Freq	Rel. Dom.	Rel. Den	IVI	H'
500-1000	23	0.6	0.000593	0.003509	2	1.471	0.019	1.471	2.961	0.062
500-1000	72	0.3	0.045000	0.927367	1	0.735	1.476	0.735	2.947	0.036
500-1000	65	0.3	0.020672	0.351082	1	0.735	0.678	0.735	2.149	0.036
500-1000	56	0.3	0.008022	0.107666	1	0.735	0.263	0.735	1.734	0.036
500-1000	59	0.3	0.007200	0.094067	1	0.735	0.236	0.735	1.707	0.036
500-1000	19	0.3	0.007041	0.091478	1	0.735	0.231	0.735	1.702	0.036
500-1000	35	0.3	0.004802	0.056725	1	0.735	0.158	0.735	1.628	0.036
500-1000	1	0.3	0.002939	0.030726	1	0.735	0.096	0.735	1.567	0.036
500-1000	36	0.3	0.001644	0.014871	1	0.735	0.054	0.735	1.525	0.036
500-1000	79	0.3	0.001606	0.014443	1	0.735	0.053	0.735	1.523	0.036
500-1000	34	0.3	0.000139	0.000680	1	0.735	0.005	0.735	1.475	0.036
500-1000	52	0.3	0.000022	0.000069	1	0.735	0.001	0.735	1.471	0.036
500-1000	61	5.1	0.065128	1.010068	18	15.385	4.671	15.385	35.440	0.288
500-1000	37	1.4	0.229589	5.421127	5	4.274	16.467	4.274	25.014	0.135
500-1000	4	2.3	0.080583	1.262911	8	6.838	5.780	6.838	19.455	0.183
500-1000	3	2.5	0.003692	0.025250	9	7.692	0.265	7.692	15.649	0.197
500-1000	77	1.4	0.080191	1.337532	5	4.274	5.752	4.274	14.299	0.135
500-1000	25	2.0	0.029353	0.368837	7	5.983	2.105	5.983	14.071	0.168
500-1000	31	0.3	0.161312	4.566658	1	0.855	11.570	0.855	13.279	0.041
500-1000	68	2.0	0.017498	0.185621	7	5.983	1.255	5.983	13.221	0.168
500-1000	48	0.8	0.104897	2.506800	3	2.564	7.524	2.564	12.652	0.094
500-1000	43	0.6	0.075850	1.564044	2	1.709	5.440	1.709	8.859	0.070
500-1000	29	1.1	0.020168	0.284157	4	3.419	1.447	3.419	8.284	0.115
500-1000	36	0.8	0.039856	0.679913	3	2.564	2.859	2.564	7.987	0.094
500-1000	42	0.8	0.033907	0.499646	3	2.564	2.432	2.564	7.560	0.094
500-1000	54	0.3	0.079202	1.878611	1	0.855	5.681	0.855	7.390	0.041
500-1000	60	0.3	0.074756	1.747848	1	0.855	5.362	0.855	7.071	0.041
500-1000	34	1.1	0.001184	0.007110	4	3.419	0.085	3.419	6.923	0.115
500-1000	63	0.6	0.043027	0.834065	2	1.709	3.086	1.709	6.505	0.070
500-1000	7	0.6	0.032410	0.609887	2	1.709	2.325	1.709	5.743	0.070
500-1000	30	0.6	0.028716	0.462332	2	1.709	2.060	1.709	5.478	0.070
500-1000	79	0.6	0.021270	0.342437	2	1.709	1.526	1.709	4.944	0.070
500-1000	17	0.6	0.015628	0.208395	2	1.709	1.121	1.709	4.540	0.070

Distance	Spp code	N	G	V	Frq.	Rel. Freq	Rel. Dom.	Rel. Den	IVI	H'
500-1000	59	0.6	0.010903	0.133582	2	1.709	0.782	1.709	4.201	0.070
500-1000	35	0.6	0.009494	0.115174	2	1.709	0.681	1.709	4.100	0.070
500-1000	22	0.6	0.006301	0.067071	2	1.709	0.452	1.709	3.871	0.070
500-1000	64	0.6	0.005611	0.066327	2	1.709	0.402	1.709	3.821	0.070
500-1000	1	0.6	0.003841	0.037039	2	1.709	0.275	1.709	3.694	0.070
500-1000	38	0.3	0.024939	0.443778	1	0.855	1.789	0.855	3.498	0.041
500-1000	50	0.3	0.024642	0.437191	1	0.855	1.767	0.855	3.477	0.041
500-1000	16	0.6	0.000400	0.002143	2	1.709	0.029	1.709	3.447	0.070
500-1000	51	0.3	0.020134	0.339696	1	0.855	1.444	0.855	3.153	0.041
500-1000	55	0.3	0.012064	0.179206	1	0.855	0.865	0.855	2.575	0.041
500-1000	10	0.3	0.008450	0.114882	1	0.855	0.606	0.855	2.315	0.041
500-1000	39	0.3	0.007854	0.104858	1	0.855	0.563	0.855	2.273	0.041
500-1000	12	0.3	0.007606	0.100729	1	0.855	0.545	0.855	2.255	0.041
500-1000	66	0.3	0.005270	0.063714	1	0.855	0.378	0.855	2.087	0.041
500-1000	45	0.3	0.004802	0.056725	1	0.855	0.344	0.855	2.054	0.041
500-1000	8	0.3	0.002222	0.021673	1	0.855	0.159	0.855	1.869	0.041
500-1000	41	0.3	0.001089	0.008893	1	0.855	0.078	0.855	1.788	0.041
500-1000	2	0.3	0.000200	0.001072	1	0.855	0.014	0.855	1.724	0.041
500-1000	57	0.3	0.000118	0.000552	1	0.855	0.008	0.855	1.718	0.041
500-1000	76	0.3	0.000089	0.000389	1	0.855	0.006	0.855	1.716	0.041
		162.2	10.356284	246.724569	573	500.000	500.000	500.000	1500.000	