

**THE ROLE OF LOCAL KNOWLEDGE AND ORGANIZATIONS  
IN SUSTAINABLE CONSERVATION OF BIODIVERSITY: A  
CASE STUDY OF UDZUNGWA MOUNTAINS, TANZANIA**

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## ABSTRACT

To some extent the conservation of biodiversity in Tanzania is currently vested on local communities. This strategy is clearly stipulated in the National Forest Policy of 1998. The success of this strategy depends largely on people's local knowledge, organizations and their underlying institutions. Local knowledge and organizations constitute essential component for attempts to facilitate local level engagement in conservation and utilization of natural resources. However local knowledge and organizations were neglected in the past until recently when their importance have been stressed in rural development and conservation of natural resources in particular. This study was conducted to identify different local knowledge systems, organizations and their underlying institutions in the management and conservation of Udzungwa Mountains National Park. Specifically the study sought to: assess changes occurred in the forest resource base over time, identify and assess the role of the existing local organizations (both internally and externally sponsored) and their underlying institutions in biodiversity conservation and to assess the state of conflict between externally and internally initiated organizations. Other specific objectives include identification of indigenous practices and their role in the conservation of biodiversity in Udzungwa Mountains National Park, identification of socio-economic factors including gender, which enable or constrain local people participation in biodiversity conservation and propose a model that will ensure sustainable conservation of biodiversity for Udzungwa Mountains National Park. The study was

carried under two phases. Phase one of the study involved Participatory Rural Appraisal techniques in two villages namely Msolwa and Sonjo. Participatory Rural Appraisal techniques were designed to quickly generate information about local conditions, livelihood and social formation around Udzungwa Mountains National Park. The second phase involved structured questionnaire surveys as the major tool for data collection. Questionnaire survey was done in four villages namely Msolwa, Sonjo, Ichonde and Kisawasawa. The sample size in each village was 5 percent of the total number of households. Other tools used were checklist and participant observation. Data collected by using Participatory Rural Appraisal techniques in phase one were analyzed with the help of the communities and the results were communicated back to them. The Statistical Package for Social Science was used to analyze quantitative data whereas Content and Structural-Functional Analysis were used for qualitative data. The study revealed the presence of various internally initiated organizations. These include village governments, village Community Conservation Committees, fire brigades, women groups, religious organizations, primary schools and cooperative unions. Ranking of these organizations by farmers indicated that village government, village Community Conservation Committee, fire brigades are more effective in decision making in joint management of natural resources in Udzungwa Mountains National Park. About 49 percent of respondents described the role of these organizations as being both tree planting and enforcement of rules and regulations. The study also identified two externally sponsored organizations, namely World Wildlife Fund and Tanzania National Parks. More than 85 percent of the respondents said that there is no conflict between externally and

internally sponsored organizations. Similarly more than 75 percent of the respondents participate in tree planting and that both men and women participate equally in tree planting. Pollarding, pruning and the use of ash against termites are some of the indigenous management practices pointed out by most respondents. The presence of traditional institutions such as *Bokela*, traditional healing and sacred groves in the Udzungwa Mountains National Park is the evidence that the resource base has been protected and conserved by the local people even before the advent of externally sponsored institutions. The study concludes by saying that local people could work and provide the means for sustainable management and conservation of Udzungwa Mountains National Park. The study recommends strengthening the present agroforestry program through joint ownership of tree nurseries, formation of agroforestry demonstration plots and more emphasis should be put on education and extension. The study also recommends carrying out inventory and identification of traditional medicines to ascertain their distribution for effective conservation. Carrying out effective ecological monitoring and evaluation are other recommendations of the study.

**DECLARATION**

I, Jonathan Stephen Mbwambo, do hereby declare to the Senate of the Sokoine University of Agriculture that this dissertation is my original work and has not been submitted for a degree award at any other university.

Signature ----- Jonathan -----

Date ----- 10-11-2000 -----

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## **Dedication**

To my beloved parents, Stephen Salehe and Joyce Leonard, who laid down the foundation for my education and to my wife for her tireless support.

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**ABBREVIATIONS**

<b>CBD</b>	=Convention of Biological Diversity
<b>CPR</b>	=Common Pool Resources
<b>FAO</b>	=Food and Agriculture Organization
<b>IUCN</b>	=International Union for Conservation of Nature and Natural Resources
<b>MNRT</b>	=Ministry of Natural Resources and Tourism
<b>NGOs</b>	=Non-Governmental Organizations
<b>NORAD</b>	=Norwegian Agency for Development
<b>PRA</b>	=Participatory Rural Appraisal
<b>UMNP</b>	=Udzungwa Mountains National Park
<b>UNCED</b>	=United Nations Conference on Environment and Development
<b>WRI</b>	=World Resource Institute
<b>WWF</b>	=World Wildlife Fund

## CHAPTER ONE

### 1. INTRODUCTION

#### 1.1 Background

##### 1.1.1 Overview

Tanzania which is located at  $2^{\circ}$ - $11^{\circ}$  S and  $29^{\circ}$ -  $40^{\circ}$  E is the largest country in East Africa covering about 942,800 Km<sup>2</sup> of which 60,000 km<sup>2</sup> is covered by water bodies (Kaiza-Boshe *et. al*, 1998). Based on the 1988 census, the population of Tanzania was 23.2 million with annual growth rate of 2.8 percent (United Republic of Tanzania, 1988). The current population is estimated to be more than 30 millions. The country's jurisdiction over biological resources includes 80km stretch of coastline and 200km marine exclusive economic zone (Kaiza-Boshe *et. al*, 1998). The expanse, coupled with physical features of a tremendous variety, superlative attributes and uniqueness, make Tanzania home to a great diversity of organisms, a good number of them occurring in great abundance. Tanzania is consequently one of the world's famous country in biodiversity, indeed it ranks very high in the number of species and in a number of taxa.

The Udzungwa Mountains like many other areas of great biodiversity potential in Tanzania forms one of the important areas for conservation. These mountains have long been recognized as a key site for conservation of biodiversity in Africa and some action for protecting the mountain forests have already been initiated (John *et.al*,

1993). Being one of the eastern arc forests, the Udzungwa mountains are marked by the large number of restricted species and genera many of which are currently known from just one site or a few sites (Collar and Stuart, 1988; Lovett, 1988; and Wasser, 1993, as cited by John *et al.*, 1993). It is also reported by Scharf *et al.*, (1982), Colar and Stuart (1988), Lovett and Wasser, (1993) and Lovett (1988); in John *et al.*, (1993) that these mountains together with other Eastern Arc Mountains namely North Pare, South Pare, West Usambara, East Usambara, Nguu, Uluguru, Ukaguru, Nguru and Rubeho Mountains (Figure 1) are characterized by high species richness and have high number of endemic species. Martin (1999) reported that the Eastern Arc Mountains form one of the 18 most important 'hot spot' areas for the conservation of plants in the world, and a globally important centre for endemism in birds, mammals, reptiles, amphibians, butterflies and other invertebrates.

### **1.1.2 What is Biological diversity?**

Biological diversity is defined as the variety of life forms (animals, plants and micro-organisms), communities/ecosystem and the ecological process in which these components are a part. Biological diversity is also considered as an umbrella term for the degree of nature's variety, including the number and frequency of ecosystems, species and genes in a given assemblage (Mwalyosi, 1993).

Ruth (1996); Richard (1993); and Winpenny (1991) consider biological diversity in three different categories: **Genetic diversity** which refers to the variability in genes both within and between species.; **Species diversity** as a concept of the variety of living organisms on earth and is measured by the total number of species in the world



### **1.1.3 Biodiversity conservation in Tanzania**

In 1992 the global community met in Rio de Janeiro to discuss global problems concerning environment and development. One of the end results of the United Nations Conference on Environment and Development (UNCED) was the adoption of the text for an international convention on the conservation of biological diversity, making it one of the most important of all international treaties (Timothy, 1997). Although the need for conservation of biological diversity is internationally recognized there is no common agreement on the most effective way of achieving long term conservation (Mwalyosi, 1993). This is because each country has its own specific problems and political ideology and therefore the path to conservation has to be country-specific.

In the Tanzanian context, conservation of biological resources is currently vested among the local communities. This strategy is clearly emphasized in article 4.3.1.1 (16) of 1998 National Forestry Policy which states that "Biodiversity conservation and management will be included in the management plans for all protection forests. Involvement of local communities and other stakeholders in conservation and management will be encouraged through joint management agreements". Support for community involvement is shown by many authors, e.g., Pennington, 1983; Harcourt *et al.*, 1986 and Newmark and Leonard, 1991. The main argument being to provide the local people with food, timber, fuel and other requirements and at the same time

enhancing the ecological capacity of the environment to provide these resources for the present and future generations.

Involvement of local communities in the conservation of biological diversity calls for the use of people's indigenous knowledge and organizations. To a large extent, environmental degradation and the loss of biodiversity results from a variety of factors, including and perhaps more importantly, the lack of recognition, understanding and use of indigenous knowledge, technology and practices (WRI *et al.*, 1992). It should be noted that the word management as used in this study entails a full range of management activities from the preservation of species, their genetic traits and the arrays of habitats, through restoration of ecosystems for human needs and distribution of benefits (Okeyo, 1997). Conservation on the other hand refers to the act of protecting and sustainably utilizing biodiversity (MNRT, 1998a).

#### **1.1.4 Indigenous Knowledge**

Local communities have for ages developed and maintained indigenous knowledge and practices for the management and conservation of biological resources on which they depend (Kamara, 1995). Indigenous knowledge is defined by Kajembe (1994) as sum of experiences and knowledge of a given ethnic group that forms the basis for decision making in the face of familiar problems. He further described it as that knowledge considered to be characteristic of a certain cultural group. Lugeye (1994) defined indigenous knowledge as a mixture of knowledge created endogenously

within a society and knowledge acquired from outside and integrated within the society. It is asserted by Lugeye (1994) that this knowledge is not static but is continuously changing and has an inherent capacity for absorbing relevant new knowledge from outside.

Kamara (1993) points out that indigenous knowledge and practices are empirical based on continuous observation by local communities and their close attachment to the natural resources. This knowledge is based on accurate, detailed and meaningful observations collected and passed over many generations (Chambers *et al.*, 1989). Since conservation of biological resources, especially insitu conservation calls for knowledge of the local ecological conditions of the biological resources in question, then indigenous knowledge is of paramount importance.

#### **1.1.5 Institutions**

FAO (1992) defines an institution as a set of rules that govern some activities of individuals or groups. Brinkerhoff and Goldsmith (1992) in Shijamabu (1997) referred to institutions as stable, valued, recurring patterns of behaviour and includes rules and procedures that shape how people act, status or legitimacy. Institutions are important to our social understanding and to integrating conservation and development because they represent both social entities which are enduring and a means by which the social, economic and political life of communities, regions and countries are integrated (Furze *et al.*, 1996). It is important to note that community involvement in conservation efforts is social process which entails a change in the institutional arrangement of the

society. Such changes are brought as a result of incorporation of both state and community interests in the conservation and management of the resource base.

## **1.2 Problem Statement and Justification**

The current environmental problems have brought to the mainstream of public policy and development planning the need for taking measures to promote the management and sustainable use of natural resources (Mugabe and Clark, 1998). While economic issues continue to dominate the development plans and practices of most countries, there is adequate evidence that ecological imperatives are beginning to receive policy and political attention at various levels of governance.

Formulation of policies and laws coupled with various institutional arrangements to address the problem of global and local environmental problems have been a strategy over the past 20 years (WRI *et al.*, 1992). Despite these efforts, environmental degradation, particularly the loss of the world's biological diversity continues. According to Mugabe and Clark (1998) the loss of biological diversity and environmental degradation threatens humanity's future by undermining the socio-economic base of most societies. The management and sustainable use of biological diversity are, therefore, issues of public policy and political concern.

Since colonial period in Tanzania, protection of forest reserves has been done by the state using the Forest Ordinance administered by the Forestry Division. This ordinance does not permit either entry into or free access to products from the forest reserves by

the general public. All protection activities and operations were done by forestry employed staff and the public is involved only under special arrangements. Protection and management of the Udzungwa forest reserve followed more or less similar patterns; but effective protection of 267,000ha of Udzungwa mountain forests under this strategy calls for a very big manpower requirement, which in turn puts a heavy wage allocation on the national budget (Sabuni, 1998). At the same time the mechanism denies the poor adjacent communities accessibility to utilization of their natural heritage (Sabuni, 2000). Lack of sufficient manpower and lack of sufficient capital combined with the socio-economic pressure from the local communities puts the forest reserve even more vulnerable to destruction now than ever before.

To help check out the obvious threats to the Udzungwa forests and save the vital biodiversity, effective and sustainable management and conservation strategy is inevitable now than later (Sabuni, 1998). One of the recently undertaken strategy is the conversion of the eastern part of the Udzungwa Mountains Forest Reserve into a National Park. This National Park forms the first component of the eastern Arc mountains to be given realistic protection. However like other national parks in Tanzania, people living around the newly established Udzungwa Mountains National Park are given special permission to collect deadwood, medicinal plants, and thatching grasses. This arrangement is based on the following scenario; first, local communities have been living with the resource base over a long time and have been using and protecting it through various traditional management systems, organizations and institutions. Secondly, local people are no longer seen as adversaries but partners in

the conservation and management of natural resources. To deny them access to these resources is to deny their basic human rights to the resource they purportedly owned. It is therefore important to take into account the local management systems in both planning and implementation stage. This is important because indigenous management systems have practical validity in themselves, without having to 'scientize' them by forcing them into technical framework used by scientists (Kajembe, 1994). Instead, they should be entry points in participatory conservation efforts.

However little is known on various indigenous management systems, organizations and the underlying institutions that are locally used to conserve and manage natural resources in the Udzungwa Mountains Forest Reserve. The study sought to assess the role of various knowledge systems, organizations and institutions in the conservation of biological resources in UMNP.

### **1.3 Objectives**

#### **1.3.1 Overall Objective**

The overall objective of this study was to identify different local knowledge systems, organizations and institutions around Udzungwa Forest reserve and assess their role in the conservation of biological diversity.

#### **1.3. 2 Specific Objectives**

Specifically the study is intended to:

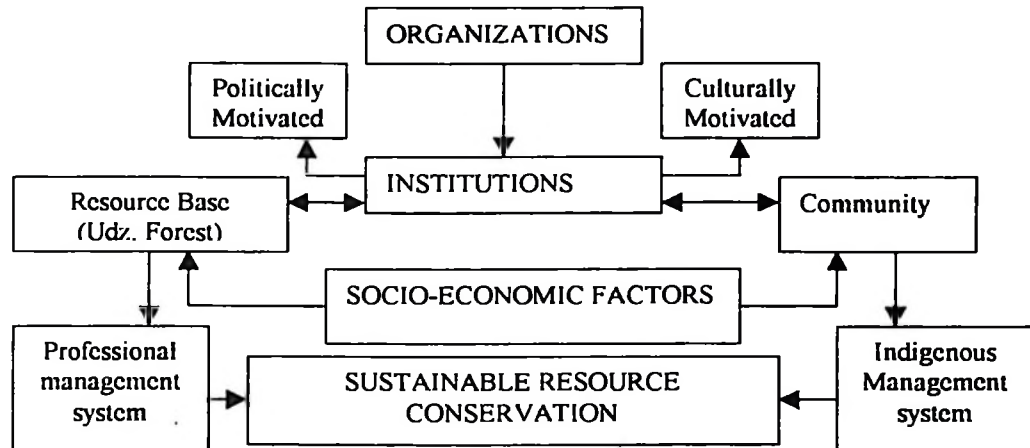
- i. Assess changes occurred in the forest resource base over time.

- ii. Identify and assess the role of the existing local organizations (both internally and externally sponsored) and their underlying institutions in biodiversity conservation.
- iii. Assess the state of conflict between externally and internally initiated organizations.
- iv. Identify indigenous practices and their role in the conservation of biodiversity in Udzungwa Mountain forest.
- v. Identify socio-economic factors including gender, which enable or constrain local people participation in biodiversity conservation.
- vi. Propose a model that will ensure sustainable conservation of biodiversity in Udzungwa forest reserve.

#### **1.4 Conceptual Framework**

Conceptual framework prevents fragmentation of knowledge into diverse segments of unconnected statements. Katani (1999) argues that a framework binds facts together, and provides guidance towards realistic collection of data and information.

Research performed without the guidance of a conceptual framework is usually sterile for the reason that the researcher doesn't know quite well what data to collect and when he/she has them, he/she cannot put them to use (Kajembe, 1994). Figure 2 presents the framework which reflect the generalization of the issues under the study.



**Fig. 2: Conceptual Framework**

In this study, sustainable resource conservation of biological diversity may be realized when indigenous and professional management systems are reconciled. The reconciliation of both indigenous and professional management systems call for equal partnership with the surrounding communities. The surrounding communities and the resource base are mediated by both politically and culturally motivated institutions. Politically motivated institutions include state rules and regulations whereas culturally motivated institutions include norms, taboos and customs that regulate behaviour with regard to conservation and utilization of the resource base. Both the community and resource base are influenced by various socio-economic factors that determine the development of strategies for effective conservation of the resource base.

### 1.5 Research questions

The study was underlined by the following research questions:

- i. What institutional arrangements have so far been experienced in the conservation of Udzungwa Mountains and what impact do they have in conservation of biological resource?
- ii. What are the local organizations and what role do they play in conservation of UMNP?
- iii. Is there any conflict between internally and externally initiated organizations and how are these conflicts resolved for sustainable conservation of UMNP?
- iv. What are the indigenous management practices and how are they related to biodiversity conservation?
- v. What are the socio-economic factors enabling or constraining local communities to participate in conservation of biodiversity?
- vi. How can indigenous and professional management system be reconciled to bring sustainable biodiversity conservation?

#### **1.6 Delimitation**

- i. Local people in this study are only those living close to the Udzungwa Mountains National Park with notable cooperation with the Community Conservation Services of the Udzungwa Mountains National Park.
- ii. Quantitative variables in both PRA and questionnaire survey are not based on the scientific standards, they are based on estimates and memories of the respondents.
- iii. Udzungwa Mountains Forest Reserves is a collection of several reserves falling between Iringa and Morogoro regions. Due to financial and time constraints, only

Udzungwa Mountains National Park representing one fifth of the entire area was covered by the study.

## CHAPTER TWO

### 2.0. LITERATURE REVIEW

#### 2.1 Evolution of Biodiversity Conservation in Tanzania

Conservation of biodiversity in Tanzania has its roots in the colonial period when the approach towards conservation was fundamentally aesthetic and preservationist (Mwalyosi, 1993). Prior to colonialism, societies in then Tanganyika had a system of governance that protected community biological and other resources and allocation and utilization was foreseen by tribal rules and regulations. Tribal rules and regulations regulated land uses and enforced cultivation regulations (Chamberlain *et al.*, 1998). Examples of such rules include those which enhance productivity or protection of trees and shrubs against abusive harvesting and browsing. FAO (1990) describes those rules as "fairness ethics" and don't require formal enforcement since they were embodied in the moral cultures of all the people. Otieno (2000) argues further that some of those rules were so fundamental, that they appeared to be taken for granted as inviolable and were widely respected by all the people. The author points out further that these fundamental rules were "first come first serve" rights of historical precedence and right of continual occupancy.

In the early 1900s the potential of forest and wildlife in Tanzania led the colonial administrators to introduce protected area system based on western knowledge and values (Ntiadou-Baidu, 1995). Some of these protectionistic management strategies started as early as 1903 when the German colonial power appointed full time

professional foresters and enacted the forest conservation ordinance in the following year to protect the forest against any human interference (Neumann, 1997). The colonial period as argued by WRI, *et al.*, (1992); McNeely (1995) and Furze *et al.*, (1996) fought to protect the interests of the colonial legacy whose conservation efforts had the desire to preserve game population and forest reserves for products needed by colonial powers, revenue generation and protection of watersheds. Little or no efforts were put on the conservation of areas with the greatest number of endemic and rare species or those combining both endemism and species richness (Mwalyosi, 1993). Example of these sites in Tanzania include the montane and lowland forests, montane grasslands, Itigi thickets, much of the area around Lake Rukwa and the whole coastal and marine zone; including mangroves and coral reefs (Mwalyosi, 1993).

Priorities for biodiversity conservation projects in Tanzania under colonial and even after independence were characterized by marginalisation of the local people who had the stake of the existing biological resources. Examples include indigenous Maasai who were evicted from Serengeti and Ngorongoro Crater in 1951 and 1975 respectively (Mwalyosi, 1990). Similar experiences were noted in forestry whereby the creed for scientific forestry enforced state claims on the forestlands and the management adopted by the state had little concern over the importance of forest products and services to the local population (Otieno, 2000). The basic assumptions underlying this forest management strategy include:

- i. Forests can play many and diverse roles in producing raw materials and providing environmental services. These various roles have to be carefully

balanced in multipurpose forest management systems.

- ii. Forests ~~do~~ not only exert their positive influences locally, but may also influence conditions in some distant regions (e.g., watershed influences). Thus forest management should incorporate regional interests.
- iii. The production cycle in forest normally takes many years and thus long-term sustained forests production and protection can best be assured by government organizations.

These assumptions were the basis for colonialists to insist on the so called proper management which could be realized only through the creation of legally gazetted forest reserves which were to be managed by professional forest officers.

It can be argued that the externally enforced exclusion of local communities from wildlife and forest reserves and alienation of people from the management of protected areas during colonial and during the post independence period did not promote good relations and did not encourage local support for conservation. This situation naturally generated antagonism and often resulted into conflicts between the surrounding communities and wildlife/forest officers. This led to extensive habitat destruction, degradation and severe depletion of wildlife and forest reserves with serious negative consequences in biodiversity conservation (Mwalyosi, 1993).

However, the second half of 1970s was marked by the need for rural development and it became increasingly clear that the classical and often still colonial approach, in

effect did not contribute much towards rural development (Westoby, 1978; Dargavel, *et al.*, 1985). It became increasingly acknowledged that if forests and other biological resources are to contribute significantly to rural development, a change in approach was needed (FAO, 1978). The new outlook was enhanced by a change in thinking of the very concept of rural development where emphasis was directed not only towards economic growth but also towards proper distribution of the wealth and the need to fulfil the basic human needs (Wiersum, 1989). These changes in thinking on rural development were accompanied by greater loss of forests and biodiversity. This loss did not only affect the livelihood of many rural people, but also brought many undesirable environmental effects (Postel and Heise, 1988).

In mid 1980s and early 1990s the concept of rural development again shifted its vision towards sustainable development which is defined by WCED (1987) as the development that meet the needs of the present without compromising the ability of the future generations to meet their needs. This re-orientation is emphasized by article I of the Global Biodiversity Convention which insist on the conservation of biodiversity, sustainable use of its components and fair and equitable sharing of the benefits arising from the resource itself (WCED, 1987).

Within this re-orientation the protected areas and forest reserves were viewed as part and parcel of the surrounding communities. To make this possible, WRI *et al.*, (1992) suggested that local people must be involved in the planning and management of the protected areas. To support the need for community involvement, article 3.1 (C) and

4.3.1.1 (16) of the Wildlife Policy of Tanzania and National Forest Policy respectively states clearly that it is the determination of the Tanzanian government to involve local communities in biodiversity conservation (MNRT, 1998).

The call for sustainable biodiversity conservation through community participation as said earlier will be effective if efforts are taken to reinforce, encourage and further develop local practices and traditional institutions that are already consistent with biodiversity conservation (WWF *et al.*, 1993). This is probably the most important strategy at which biodiversity conservation policy must operate (Swanson and Barbier, 1992).

## **2.2 Sustainable Conservation and Use of Biological Resources**

The Convention of Biological Diversity (CBD), adopted at Rio summit in 1992 and now ratified by 169 countries, has had a major impact on biodiversity as a global concern (Sayer and Iremonger, 1999). A major landmark was the publication of the Global Biodiversity Assessment Document (Heywood and Watson, 1995), which provide comprehensive account of the status of the world's biodiversity and other issues confronting its conservation.

Sustainable conservation and use of biological resources come out of the general concept of sustainable development. This concept has been a global discourse since a Brundtland commission's report in 1987, followed by the 1992 United Nations Conference for Environment and Development in Rio de Janeiro (Lema, 1997).

According to Brundtland report, sustainable development means attainment of economic growth without degrading the environment. United Nations Environmental Program suggests that an action is sustainable if it improves the prospects that future generations will enjoy the same level of welfare enjoyed today (Lema, 1997). Similarly, Goodland and Ledec (1986) defined sustainable development as a pattern of social and structural economic transformations (i.e. development) which optimizes the economic and other societal benefits available in the present without jeopardizing the likely potential for similar benefits in the future.

Sustainable uses of biological resources is concerned with overall resource management, maintaining the ecological integrity of the resource base and keeping future options open (Mgeni, 1993). Sustainable conservation of the existing biological resources involves maintaining indefinitely without unacceptable impairment of the productive and renewable capacities as well as the species and ecological diversity of the ecosystems. The acceptable thresholds of impairment, is determined by the choice and decision made by individuals, institutions and nations (Lema, 1997). The decision is based on human understanding of both ecological principles and socio-economic imperatives (Mgeni, 1993).

It is important to note that economic conditions and policies have a profound effect on the ability of the people to use biological resources sustainably, to conserve them and share their benefits. Most of the underlying causes of biodiversity loss are found in national and international policies that undervalue natural resources, create incentive

to overexploitation and widen the gap between the poorest and the richest both within societies and between countries (Miller, *et al.*, 1995).

Some of the most effective tools for enhancing the sustainable use and conservation as emphasized by Miller *et al.*; (1995); McNeely *et al.*, (1995) and Furze *et al.*, (1996) entails involvement and participation of local people. Without local participation and support, many conservation and sustainable use efforts tend to fail. Arguing on the role of local participation, Furze *et al.*, (1996) had this to say " there is plenty of evidence to suggest that local people integration into decision making, protected area management and, more generally, the development process itself, means there are opportunities for sustainability. To ignore the local level participation is to ignore the rich source of knowledge from the local people".

### **2.3 Participation in biodiversity conservation**

Community participation has been defined in a variety of ways in the literature. According to Paul (1987), community participation is the process whereby people act in groups to influence the direction and outcome of development programme that will affect them. WWF *et al.*, (1993) considers participation as the deliberate action of the people and government to respond jointly in the formulation, planning, and implementation of a strategy to satisfy particular needs. Brown and Wyckoff-Baird (1992) provided a broader definition which state that participation is a continuum, from limited input into decision making and control, to extensive input into decision making and ultimately stewardship of the resources.

In this study, the definition provided by Okeyo (1997) has been adopted. Okeyo (1997) defined participation as "making known the local wishes, generating development ideas, providing local knowledge and investing local resources, promoting partnership from different perspectives and with different intentions". Thus, community participation in practice is a social process whereby specific groups with shared needs living in a definite geographical area actively identify their needs, take decisions and establish mechanisms to meet these needs

Traditionally, both international and national conservation efforts tended to rely on strict protection through the establishment of national parks and other protected areas. Communities surrounding protected areas, however, have often borne the costs and rarely received the benefits associated with neighbouring protected areas and hence have usually had little vested interest in the protection of biological resources in those areas (WWF, *et al.*, 1993). As a result, encroachment and illegal exploitation was high and beyond government ability to control. This reality calls for community involvement, as these are indispensable partners in resource conservation as they have been living and caring biological resources over years before professional interventions.

The rationale for community participation as argued by Okeyo (1997) includes:

- The principle of securing the consent of the public without denying the existence of "public interest". It emphasizes a group based politics, group interaction, conflict resolution and accommodation as a way to formulate sound decisions.

- Participation is seen as a means to alter the power structure because, "community participation is categorically a term of peoples power".

It is important to note that community participation in protected areas conservation has to be meaningful. For participation to be meaningful, local involvement and consultation must mean a partnership of equals (Furze *et al.*, 1996). The same author goes on saying that the goal for the development process, the protected area management functions and the community functions must be to instigate a partnership that is based on mutual cooperation. To have local people participate in a consultation process, for example, and then dismiss their views is not meaningful participation. It does however, set up or perpetuate antagonism between those involved in the conservation and development process.

However, one of the main challenges in engendering participation in conservation efforts is the fact that local people often view conservation as antithetical to development (Gartland, 1992). Efforts to involve local people in the conservation of biological diversity will not succeed in the long term unless local people perceive those efforts as serving their economic and cultural interest (Brown and Wickoff-Baird, 1992). Cultural interest includes, among others, indigenous knowledge and local management systems.

#### **2.4 The Role of Indigenous Knowledge in Biodiversity Management**

Lack of recognition, understanding and use of indigenous knowledge, technology and practices, among other factors, have contributed to environmental degradation and loss

of biodiversity in Africa. Cunningham (1994) points out clearly that indigenous knowledge systems and practices were developed to adapt to and manipulate land, flora and fauna and that this knowledge constituted an invaluable resource that should be used in conjunction with the scientific management systems.

However, until recently, indigenous knowledge has been under attack for being backward, static and a hindrance to modernization (Katani, 1999). This attitude has undermined the capacity of the local people to innovate and lowered the status of grassroots innovators, especially women, whose contribution to technological advancement has traditionally been undervalued (Fernandez, 1994). Matose and Mukamuri (1994) as cited by Katani (1999) reported that local people had, and still have various ways of preserving and managing their forests. Sacred groves in Ghana and other African countries provide a good example of indigenous protected area systems within rural communities (Ntiamoa-Baidu, 1995). These indigenous protection systems are often enshrined in religious or cultural beliefs and superstitions and enforced by taboos. The taboo according to Ntiamoa-Baidu, (1995) has no legal backing, but the belief has been strong enough to make people obey the regulations.

It is important to note that although the terms "traditional knowledge" and "indigenous knowledge" can be differentiated, many researchers and writers use them interchangeably. "Traditional knowledge" as used in this study refers to a stock of knowledge accumulated over time as a result of direct interaction between man and the natural environment. It is often orally transmitted. "Indigenous knowledge" on the

other hand, is broader term covering all knowledge considered to be characteristics of a certain cultural group (Kajembe and Rutatora, 1999). In this study these terms are used interchangeably.

The focus on indigenous knowledge particularly on the biodiversity conservation heralds a long overdue move. It represents a shift from the preoccupation with the centralized, technically oriented solutions of the past decades, which failed to improve the prospects of most of the world's peasants and small farmers. Technically oriented or scientific approach is reductionistic, in which a single component is viewed as a unit and exploited without holistic consideration (Matose and Mukamuri, 1994). For example in the reductionistic paradigm, a forest is reduced to wood for industrial purpose, whereby its regenerative capacities are first undermined and then destroyed (Mishra, 1994).

Innovation in the biodiversity management by using indigenous knowledge need to be encouraged, so that individuals can find new opportunities to mitigate the impact of resource scarcity, migration and unfavourable market conditions (Katani, 1999). If Indigenous knowledge systems are to continue to contribute to the quest for sustainable development, their capacity to focus on diversity as well as to innovate need to be recognized and respected (Fernandez, 1994).

Combination of professional and indigenous knowledge system that is "technology sharing" can be an effective approach (Katani, 1999). Richards (1975) in Kajembe

(1994) comments that “an idea borrowed from the people, developed by the scientists and returned to the people again is much more likely to be adopted than something totally alien to the culture”.

It is important to note however that indigenous knowledge manifests itself in form of indigenous practices. The study will therefore focus on indigenous practices, which under normal circumstances encodes indigenous knowledge.

## 2.5 Indigenous Practices and Biodiversity Management

During the last two decades, the link between biodiversity conservation and socio-economic development has been recognized (Heywood and Watson, 1995). It appears that the interests of some human groups have been strongly linked to the prudent use of their resource base, and that they have evolved appropriate conservation practices based on some simple and appropriate rules that have tended to ensure the long-term sustainability of the resource base. These rules, according to McNeely *et al.*, (1995), have been developed by a process of trial and error, with acceptance of practices that appeared to keep the resource base secure, coupled with rejection of those practices appeared to destroy the resource base.

The term indigenous practices as used in this study refers to the small and large decisions taken on daily basis by the local people in their generation, protection and use of biological resources. This goes beyond descriptive knowledge, to what local man does with his store of accumulated knowledge - not just what he uses resources

for, but also how (Kajembe, 1994). An example of such practices include harvesting of forest resources and how this affects the long term sustainability of such resources. Others include manipulation of tree resources through pollarding, pruning and respecting (or not) both formal social controls and common sense rules on harvesting of herbs, shrubs and trees and other forest resources (FAO, 1990).

It is important to note that indigenous practices have developed as a response to a particular situation, reflecting a variety of cultural, socio-economic, political, ecological and demographic factors. These practices are both institutionally and situationally dynamic rather than static (Kajembe, 1995). They evolve through time as a result of adaptive strategies of farmers. Such adaptive strategies are developed by the farmer as he/she strives to adjust the use of their household resources to ecological and environmental changes (Kajembe, 1995).

As asserted by McNeely *et al.*, (1995), such practices serve the group interest of communities and they remain viable so long as local community continue substantial level of dependence on the resource gathered from their immediate vicinity; they have full control over the local resource base; and they retain sufficiently high level of internal cohesion. It is however important to note that these conditions will not be fulfilled when outside actors or corporate bodies establish control over natural resources, when access to markets begin to bring in resources from outside and local resources become a source of cash income, and when local communities lose their traditional social organization (Ostrom, 1990 in Heywood and Watson, 1995).

It is important to note further that in some cases changed rural conditions does not necessarily result into loss of some important indigenous practices. In some instances, rural people can respond rather quickly and appropriately to develop new practices and new opportunities for effective management of their natural conditions. These ranges from the variation of the products that they use from the forest to the practices they employ and the amount of labour they expend (Kajembe, 1995).

It is important to note further that indigenous practices are molded within local organizations and institutions abided by members of the community.

## **2.6 The Relevance of Local Organizations and Institutions in the Management and Conservation of Biodiversity**

Local institutions constitute an essential component of any attempt to facilitate community engagement in conservation and management of biological diversity. There is a great diversity of institutions and the various types can be classified using various criteria. Umans (1993) identified two types of institutions, namely, culturally and politically motivated institutions. Culturally motivated institutions include norms, customs and taboos that regulate behaviour and responsibility among members of the society. Politically motivated institutions on the other hand represents rules and regulations which regulate behaviour. Within politically motivated institutions one can distinguish the gradient from vague interests in a resource to claims and ultimate entitlements (Dan *et al.*, 1987 in Umans, 1993).

It should be noted that understanding the social institutions that constitute a community is crucial if we wish to facilitate a community based or local level process to promote sustainable conservation. It is also crucial to understand the process involved in effective community consultation if we are to achieve a desired conservation goal ( Furze *et al.*, 1996). As stated by Gunnarsson (1991) institutions consist of rules, norms and customs and their enforcement characteristics, which determine rights and obligations between people. It is however important to point out that there are confusions between institutions and organizations.

Many analysts in the field of “new institutional economics”, “new economic history” and “public choice theory” view institutions as rules (Bromley, 1989; Ostrom, 1989; North, 1990). If institutions are the rules; then organizations according to North (1990) may be thought as the “players” or group of individuals bound together by some common purpose to achieve particular objectives. Bromley, (1989) asserts further that organizations, such as schools, Non Governmental Organizations (NGOs) Banks etc., exist only because there are set of “working rules” or underlying institutions that define and give those organizations meaning.

Many policy studies concerning the relationship between local institutions and natural resources management have indicated poor natural resources management to be attributed by intrusive state policies which are alleged to have interfered too much on the local scene and undermined local institutions, hence preventing these local institutions from playing their part in regulating resource use (Maganga, 1993). As

noted by Lawry (1989) "state assumptions of administrative rights to common property resources have reduced the ability of local communities to manage local pastures, forests and fisheries".

Bromley and Cernea (1989) argued that colonial and post independence political and administrative changes seem to have undermined the local regulations of resource use, hence opening way for unregulated exploitation or even abuse of resources. Resource degradation in developing countries and Tanzania in particular originated from the dissolution of local-level institutional arrangements whose role includes the establishment of sustainable patterns of resource use. The dissolution of common property institutions has also been the result of the socio-economic differentiation and growing stratification process within communities that initially were much more homogenous (Bromley and Cernea, 1989).

Lawry (1989) argued that, however effective they were previously, local institutions now face significant constraints as far as mobilizing collective action is concerned, and hence they cannot be relied upon alone in resource management. He suggested a greater balance (relying solely neither on state government nor on local community control) in the form of a co-management model. This argument form the basis for sustainable biodiversity management where reconciliation between government, private bodies and Non-Governmental Organizations (NGOs) and local communities is of uttermost importance.

It is therefore suggested by Furze *et al.* (1996) that sustainable conservation will only be achieved through building and strengthening the existing institutions. Institutional building is a process of developing new institutions which complement the integrated conservation approach whereas institutional strengthening is a process where existing institutional arrangements are built on and given new social, cultural, economic and political legitimacy in order to integrate conservation aims with development goals. To achieve institutional building and strengthening and to facilitate participatory actions require a careful community consultation, taking greater care to ensure application of sensitive cultural protocols.

Barbier (1987) argued that real improvement of societies cannot occur unless the strategies that are being formulated and implemented are environmentally sustainable and consistent with social values and institutions which encourage grassroots participation in the conservation process.

Also it should be noted that involvement of local communities and the need for sustainable biodiversity conservation are not without problems and challenges. Most of these problems and challenges are associated with socioeconomic factors.

## **2.7 Socio-economic Factors Influencing Sustainable Biodiversity Conservation**

Humans depend on biological resources for food, energy, construction, medicines and related products. However, biological resources upon which people depends have a critical character of being renewable, at least when they are well managed; but biological resources that are abused can also become extinct (McNeely *et al.*, 1995).

Management and/or extinction of biological resources is in this context influenced by socio-economic factors as part and parcel of the surrounding human population. Some of these factors include human population, income, gender and land size and land tenure systems to name just a few.

### 2.7.1 Population size

The global biodiversity strategy identifies the rates and magnitudes of growth, and the eventual size of the global population as being critical for biodiversity management and conservation (Furze *et al.*, 1996). Human uses of earth's resources have increased with population growth. At present it is estimated that people use or destroy 39 percent of photosynthetic materials produced on land (Furze *et al.*, 1996). As human population grows, needs for resources increase, and most agree that the present rates of resource use are unsustainable (WRI, *et al.*, 1992).

It is important to note that population growth affect biodiversity directly through increased resources consumption and indirectly through fueling the process of poverty and migration, and causing a breakdown in social institutions determining the management of natural resources (McNeely *et al.*, 1995). However the way in which population pressure affect natural resources and habitats vary, and therefore it is necessary to understand the causes of such pressure before designing interventions for its control. These as elaborated by McNeely *et al.*, (1995) include:

- i. The effect of natural population growth on the regeneration rates of resources.
- ii. Unsustainable resources consumption patterns, including excessive commercial uses of resources, urbanization and human uses of valuable or critical species.
- iii. Increased migration of poor people into ecologically fragile areas.
- iv. Resource degradation can also occur when the population exceeds the social capacity of the institutions to cope with the environmental changes.

Thus the loss of biological diversity is a complex socio-economic issue rather than a biological one. Population growth is one factor in biodiversity loss, but contrary to contemporary heavy or exclusive concentration on this factor, often relatively minor one, and its emphasis occurs at the expense of the recognition of other major more controllable socio-economic factors (Kajembe, 1994). Some of the important socio-economic factors include access to land and distribution of land and the expansion of agriculture.

More than 60 percent of the world population is found in the ecologically fragile areas (Mugabe and Clark, 1998). These people lack access to appropriate technologies to conserve and use biodiversity sustainably. Expansion of agriculture into the forestland is wrongly considered to be a result of population growth. It is not the question of expansion of agriculture but rather the question of unequal distribution of arable land. The land may be sufficient to provide food to every one, but the poor may not be able

to obtain access to it and hence open up new land at the expense of biodiversity (WCED, 1987 in Kajembe, 1994).

Allen and Barnes (1985) in McNeely *et al.*, (1995) provide statistical evidence to support the idea that population growth strongly contribute to forest clearance at least in tropics, while Anderson (1990) emphasizes such factors as uneven distribution of the human population and a complex arrays of policies, institutions and economic forces that promote and encourage forest clearing. Bilborrow and Okoth-Ogendo (1992) argues that population growth is an important factor in the destruction of tropical forests, but one that is significantly modified by the natural and institutional context within which the damage occurs.

### 2.7.2 Income

Income has a profound effect on the dependency of people to their biological resources. It is argued by Katani (1999) that people with higher income usually have more of the available resources including land and may consequently plant more trees to help secure biodiversity than people with low income. It is argued by Monela and Kihyo (1999) that as people's income improves they shift from fuelwood to other forms of fuel such as kerosene, liquefied petroleum gas and electricity. This is obviously relieving the resource base from exploitation and hence maintenance of biodiversity. The depletion of wood stocks through fuelwood harvesting has an economic implication and hence people with lower income spend more time in the forest collecting fuelwood and in the process destroying habitats and biodiversity in

particular. For example, in Kenya, ten hours per week per household are estimated to be used in fuelwood collection (Shakow *et al.*, 1981) In Tanzania the same activity consumes up to 400 man-days per family per year (Mwandosya and Luhanga, 1985). This implies that in Kenya and Tanzania 10 hours per week per household per year and 400 man-days per household per year respectively are used to destroy the potential habitat and biological resources.

### 2.7.3. Gender

Gender is a cultural construction related to the behaviour learned by men and women. It affects what they do and how they do it within a specific social group (Katani, 1999). Gender identifies the social relationship between men and women. It refers to the relationship between them and the way this relationship is socially constructed. Gender is related to how we are perceived and expected to think and act as women and men because of the way in which the society is organized. Gender is not a synonym for women, but considers both men and women and their interdependent relationship. According to Lyimo-Macha, (2000) gender relations are contextually specific and often change in response to altering economic circumstances, and vary widely both within and between cultures.

Thus, gender as a social relation has a profound influence in the role men and women play in the management and conservation of natural resources. These roles are clearly demarcated on the basis of age and sex. In Katheka, Kenya, for example, women

spend up to six hours a day collecting water; men are reportedly not involved (Project Reach, 1993).

There is clear evidence that women play a critical role in the management of biological resources. Women are recognized as managers of the environment, beginning with their role in traditional hunter-gatherer societies; credited with collecting food for the family. For example in traditional hunter-gatherer societies like that of !kung Bushmen of Kalahari Desert, women are major food providers through gathering in the woodlands. Commenting on this, Davidson and Dankelman (1988) had this to say “the concepts of man the hunter as the only provider of family food is quite inadequate; of equal or even greater importance for family well-being is the role of woman the gatherer”

For women, trees and the forests are multifunctional, whereas men tend to concentrate on their commercial potential for timber and other goods, women think of them as providing fuel, fodder, and food. It is for this reason that women have developed a greater depth of knowledge and significant management skills than men. Van den Oever (1993) identifies women as primary educators of the young especially girls who have traditionally been helping their mothers with the daily chores associated with subsistence farming, fuelwood gathering and fresh water collection. Women are also knowledgeable about forest products. Studies show that rural women knew more about tree species than men, because they are in direct contact with the environment and the management of forest resources. In Sierra Leone for example, women were

reported to know 31 uses of trees on fallow land and in the forest and the availability of forest products, men knew only 8 (FAO, 1989).

Women in many parts of the world have traditionally played and still play a key role in preserving diversity (Quiroz, 1994 in Katani, 1999). For example, women's role in seed selection and vegetative propagation has been and is still crucial in many parts of the world, not only in the conservation and enhancement of genetic resources but also in agricultural production in general (Katani, 1999). Women are also good and active in tree planting and conservation activities. Kenya Green Belt Movement is a good example of women participation in tree planting as a means to conserve the environment. The Green Belt is focused on local participation of women in the establishment of "Green Belt Communities" and small tree nurseries. By 1982 there were 50 nurseries producing 2,000 – 10,000 seedlings per year, and 239 "Green Belts" (Davidson and Dankelman, 1988).

It is important to note, however, that in some areas strict customary tenure codes prohibit women from planting trees. For example, a study in Dodoma, Tanzania, revealed that women, especially the married ones, were not ready to plant trees because they did not own land and they did not benefit from the income obtained from trees (Mhaville, 1996). When women do not control land, they lack the confidence to plant trees even though tree planting in many cases has combated soil erosion, improved soil fertility and enhanced biodiversity potential.

Sustainable resource use depends partly on local peoples ownership and control of land and other resources. Women, however, consistently lack access to and tenure of land and other natural resources, and their rights to land ownership are often prohibited or restricted by the state laws and traditional norms (Mehra, 1995). This has hindered their full participation in the management and conservation of biological and other resources.

#### **2.7.4 Land**

Land is one of the most important determinant factor in effective intervention for sustainable conservation of biodiversity in protected areas. One of the important issues to consider is the issue of land holding and uses. Here a distinction has to be drawn between title to land and actual use of land. One often come across the conflict between “statutory” and “traditional” land use patterns. According to Kajembe (1994) the state may lay claim to areas of land which are “unused” or vacant but infact the right to use these lands under traditional systems may be well defined. Although an individual may have no title to land, he may be entitled (through inheritance) to use land permanently and disposal of it. Where a piece of land is held permanently, the potential for growing trees is greater than where shifting cultivation is practiced. In the latter case, although a member of the group may be entitled to a plot of land, it is not the same every year. Consequently, there are questions about maintenance of trees and who will finally obtain benefit from them.

In many agricultural countries, skewed distribution of land ownership greatly intensify

the pressure that degrades natural ecosystems. When a small minority control the most productive lands, many landless rural people have no alternative but to seek their livelihoods in forests and fragile upland areas, many of which cannot sustain agriculture (WRI, 1992). Land tenure security also provides incentives for long term planning and management. This helps farmers to sedentize and incite them to invest in medium term soil conservation, agroforestry and reforestation (Bloch, 1993). Fedel *et al.* (1988) argues that increased security of tenure tends to increase incentive for increasing land productivity via the longer planning horizon that land ownership permits, better access to credit and other inputs. This tendency, reduces the pressure on land and hence on biological diversity.

## CHAPTER THREE

### 3.0 MATERIALS AND METHODS

#### 3.1 Study area

##### 3.1.1 Location

The study was carried out in the communities adjacent to the Udzungwa Mountains National Park. Udzungwa Mountains National Park (UMNP) is located approximately 36°41"- 37° East and 6°44" - 7°48" South with a total area of 199,000 ha<sup>2</sup>. The Mountains arise from 250m in the Great Ruaha River valley in the north and northeast to 2576m above sea level.

The UMNP falls in the Iringa and Morogoro regions in Tanzania and is bordered by the Great Ruaha River to the North and the Mikumi Ifakara road to the east (Figure 3).

##### 3.1.2 Communication

The Udzungwa Mountains can be reached after about six hours drive southwest of Dar-es-salaam and 75 km or after two hours drive beyond Mikumi National Park. From Dar-es-Salaam, the tarmac road heads west to the town of Morogoro lying in the shadows of the Uluguru Mountains. Here the road branches southwest to Mikumi National Park.

After Mikumi National Park the road to the Udzungwa Mountains National Park turns left off the Iringa road and head due south towards Ifakara through a gorge which

follows the Luhembe River. At Kidatu (36 km from Mikumi) the Great Ruaha River bridge is crossed towards Kilombo Sugar Plantation heading south 24 km to the park headquarters at Mang'ula.

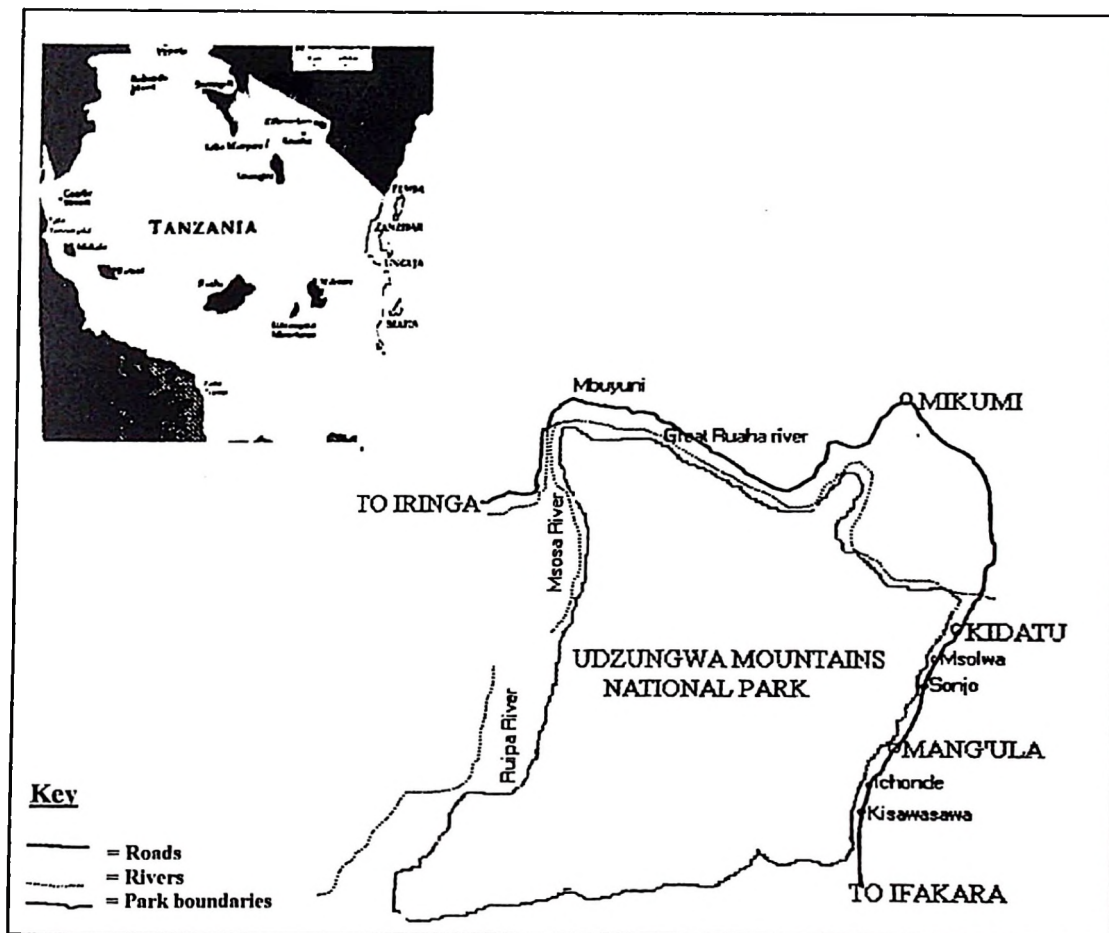


Figure 3. Sketch map of the Udzungwa Mountains National Park

### 3.1.3 Study villages

The study was conducted in four villages namely Msolwa, Sonjo, Kisawasawa and Ichonde. The population profile and the main ethnic groups are given in Table 1.

**Table 1: Population profile and main ethnic groups**

Village	Population	Number of Households	Number of Subvillages	Main ethnic groupings
Msolwa	6740	760	7	Wapogoro, Wahche, Wangoni, Waluguru
Sonjo	2529	418	6	Wapogoro, Wasagara, Wazigua Wandengercko, Wahche, Wangoni
Ichonde	2217	438	6	Wandamba, Wabena, Wangindo
Kisawasawa	3840	755	7	Wabena, Wandewe, Wambungu, Wandamba, Wangoni, Wapangwa
Total	15325	2371	26	

### 3.1.4 Climate

The study area has a bimodal rainfall distribution with short rains between October and December followed by a dry spell starting in January to February. The long rains begin in March and continue up to May. The mean annual rainfall ranges between 600mm on the northwest part of the UMNP to 2000mm in the southeast of the mountain. The area experiences dry conditions in June to October with the maximum and minimum temperature ranging between 21<sup>o</sup>C and 27<sup>o</sup>C respectively.

### 3.1.5 Vegetation

A blanket of green mantled forest form conditions for the growth of hundreds of different species of trees, shrubs, climbers and herbs of which around 50 are restricted to the area. These endemic spp include trees, *Drypetes gerrardii nodides*, and the shrub, *Zimmermanniopsis*, which are only found in the Udzungwa together with a

flowering plant, *Saint paulia* which is also endemic to other Eastern Arc Mountains (Martin, 1999).

Roughly 20 percent of Udzungwa Mountains National Park is under a closed canopy forest. The remainder is composed of woodlands, grassland and the dry Somalia/Maasai arid woodlands in the extreme northwest found along the Great Ruaha River. The dry woodlands are dominated by *Adansonia digitata* and *Acacia spp* and the rare *Erytheria spp*. The intermediate or submontane rainforest (750-1250m) similar to that found in the lowlands forest, is underpinned by complex layers of underwood and shrubs (largely *Rubiaceae*).

### 3.1.6 Biodiversity value

UMNP has exceptional biological resources in Tanzania. These include plant species found nowhere else in the world, such as *Lethowiathus stelatus*, and *Saint paulia*. Tree species common in the moist, eastern section of the UMNP includes *Cephalosphaera usambarensis*, *Trichoscypha uluguruensis* and *Leptonychia usambarensis*. The montane forest includes local endemics such as *Drypetes gerrardinoides* and the shrub *Zimmermanniopsis*. There are also other common species like, *Albizzia vesicola*, *Rauwolfia caffra*, *Melicia excelsa* and wild coffee. Some of the trees reach up to 30 meters high. UMNP is rich in primate fauna, it has six species of primate, two of them, the Iringa Red Colobus Monkey (*Procolobus badius gordonorum*) and the Sanje Crested Mangabay (*Cercocebus galeritus sanjei*) are endemic and are regarded to be endangered species.

UMNP is also among the top ten most important forests for bird conservation in Africa (Collar and Stuart, 1988). The bird species include the locally endemic Udzungwa Partridge (*Xenoperdix udzunguensis*) and rufous winged sunbird (*Nectarinia rufipennis*). The park has a diverse large mammal community of elephants, buffaloes, lions, leopards, elands and waterbucks to mention just a few. Udzungwa has the richest bird habitat in Tanzania with several endemics, including a recently discovered species of Francolin (*Modulatrix osenjel*), and Udzungwa partridge (*Xenoperdix udzunguensis*). The endemic species of chameleon, *Chameleo laterispinis* is also unique in the world.

### **3.1.7 Farming system**

The farming system of the surrounding communities is mainly peasantry, producing crops for food and sale. Main crops are maize, rice, sugarcane with some few farmers cultivating cotton. Other crops include cassava, beans, sesame, bananas, and sweetpotatoes grown mainly for home consumption. Production is done in permanent plots especially for maize and paddy. Maize and rice are normally grown in rotation whereby maize is followed by rice. Mixed cropping is prominent and most of it is done near the homesteads.

## **3.2 Methods**

### **3.2.1 Research phases and methods**

The study was carried out under two phases. Phase one involved reconnaissance

survey and Participatory Rural Appraisal (PRA); while the second phase was mainly based on questionnaire surveys, checklist and participant observation. Prior to carrying out PRA, a reconnaissance survey was done to provide a general picture of the research area. Main activities during reconnaissance survey consisted of identifying and meeting various stakeholders around UMNP including village leaders, village extension agents, women groups, park officials and religious leaders to name just a few. Reconnaissance survey enabled the researcher to obtain basic information on population size, ethnicity, and economic activities of the study villages.

PRA is based on interactive learning, shared knowledge and yet structured analysis (Devavaram and Johansson, 1993). It involves self-critical awareness of the attitudes and behaviour of the part of the researcher towards the people. It is this relaxed rapport, open dialogue and mutual sharing that makes the approach effective. The methods used in PRA include, observing directly, participatory mapping and modeling, Venn diagramming, direct matrix and pairwise ranking and scoring. Other methods include, time line, activity profiles and daily routine. These methods were designed to generate information and obtain the picture of local conditions as quickly as possible. The important point to note is that through PRA techniques, the researcher was in a position to constantly evaluate and assess the situation on the ground and, over time, the researcher became a familiar and trusted appearance in the community.

The second phase involved questionnaire survey as a main tool for data collection.

Other tools used were Checklist and participant observation. Prior to questionnaire survey sampling was done.

### **3.2.1.1 Sampling Procedure for questionnaire survey**

A multi stage sampling procedure was employed. Two divisions in the district were purposely selected on the basis of closeness to the UMNP and ease of communication. From each of the two divisions (i.e. Kidatu and Kiberege divisions) two villages were selected randomly making a total of four villages. These are Msolwa, Sonjo, Kisawasawa and Ichonde.

Interviews were done with randomly selected household members. Household in this case is defined as a group of people who eat from a common pot, sharing the same dwelling and may cultivate the same land (Katani, 1999). Households were also defined as a group of people living together and identifying the authority of one person, the household head, who is the decision-maker for a household. The study adopted the later definition of a household. Thus, interviews were done with household heads, however other members were allowed to participate to supplement information.

The village executive officer for each village assisted in compiling a list of households in the study villages. To ensure equal representation of ideas, wealth was used as a criterion for grouping households. In this case households were categorised according to their wealth status which includes poor, moderate and rich (Table 2).

**Table 2. Wealth categories in the study villages**

<b>Attribute</b>	<b>Rich</b>	<b>Moderate</b>	<b>Poor</b>
Source of income	Agriculture and Business (shops, milling machines etc).	Agriculture and small business	Casual labour
Farm size	Own more than 10 ha of sugarcane and more than 10 ha of Paddy and maize	Between 5-10ha of farms growing sugarcane and 2-3ha of maize and paddy.	Very small plots of maize.
Housing	Bricks house with electricity usually larger than household size.	Burnt brick houses with corrugated iron sheets with or without electricity	Mud houses roofed by grasses.
Fuel energy	Charcoal and Electricity	Firewood and charcoal	Firewood only

Thereafter, 5 % of households from each wealth category was picked randomly for interviews. This procedure is adopted by Kajembe and Luoga (1996) who argues that significant population representation is achieved when a random sample of at least 5 % of the total population is taken for the study. It can therefore be seen from Table 1 that 5 % of the total number of households would be 38, 21, 22 and 37 for Msolwa, Sonjo, Ichonde and Kisawasawa respectively.

However, according to Akitanda (1994) the minimum size of sampled units for a population ought to be not less than 30 for each sampling category. Thus 21 and 22 households from Sonjo and Ichonde respectively were raised to 30 households for effective representation of the population under study. Table 3 shows household gender composition and marital status of the sampled population.

**Table 3: Sex classification and marital status of the sampled population**

Alternative	Attribute	VILLAGE									
		Msolwa		Sonjo		Ichonde		Kisawasawa		Total	
		F	P	F	P	F	P	F	P	F	P
Sex	Male	17	56.7	18	60	17	56.7	15	50.0	67	55.8
	Female	13	43.3	12	40	13	43.3	15	50.0	53	44.2
	Total	30	100	30	100	30	100	30	100	120	100
Marital status	Single	5	16.5	6	19.8	4	13.2	3	9.9	18	14.9
	Married	22	72.6	21	69.3	23	75.9	25	82.5	91	75.5
	Divorced	2	6.6	2	6.6	3	9.9	1	3.3	8	6.6
	Widowed	1	3.3	1	3.3	-	-	1	3.3	3	2.5
	Total	30	100	29	100	30	100	30	100	120	100

F= Frequence P= Percentage

Table 3 shows that the sampled population constituted both males and female who accounted for 55.8 % and 44.2 % respectively. The majority of the sampled population were married couples accounting for more than 75 %. Others were single (14.9 %), divorced (6.6 %) and widowed (2.5 %).

### 3.2.1.2 Structured questionnaire

The structured questionnaire was designed to provide answers to specific issues of the study. Pre-testing of the questionnaire was done prior to questionnaire survey to check reliability and validity of the questionnaire items. It was essential to pre-test the questionnaire in order to take into account ambiguity of some of the questionnaire items (Mettrick, 1993). Pre-testing was conducted to 15 randomly selected individuals from Msolwa and Ichonde villages. As a result a number of questions were modified in the process.

The questionnaire consisted of two main categories of questions, namely; closed and open-ended questions. In the closed-ended questions, a number of alternative answers

were provided and respondents had to choose from a set of answers. Open-ended questions on the other hand, were designed to allow the respondents to provide their own answers. It is important to note that the questionnaire is based on the fact that information is collected about the same variable (or characteristic) from more than one case and end with a data matrix (Kajembe and Luoga, 1996; Mettrick, 1993). A sample of a questionnaire is attached as appendix 1.

#### **3.2.1.3 Checklist**

A checklist was used to collect information from key informants. A key informant is an individual who is accessible, willing to talk and has a greater depth of knowledge about the issue in question (Katani, 1999). Key informants are not only members of the clientele, but are most often informed outsiders (Mettrick, 1993). Key informants in this study included UMNP officials, District Forest Officer, Divisional Extension Officer, Divisional Secretary and WWF programme officer. A sample of a checklist is attached as Appendix 2.

#### **3.2.1.4 Participant observation**

Participant observation is a technique we all use when we enter in a community which is not our own to overcome feelings of alienation (Kajembe and Luoga, 1996). Participant observation is distinguished by the fact that the observer himself/herself forms part of the situation being studied (Kajembe and Wiersum, 1998). In this study participant observation involved observation of the community and household

activities. The method of participant observation was primarily used to tie together the more discrete elements of the data collected by other methods. Thus an iterative process between participant observation and the other research methods evolved. Other research methods allowed aspect of life in the study area to be isolated and studied in the context of community life. Participant observation permitted these elements to be examined within the context of the social system.

### **3.2.2 Data analysis**

#### **3.2.2.1 Descriptive and inferential statistics**

Data collected by using PRA techniques in phase one were analyzed with the help of the communities and the results were communicated back to them.

Data collected in phase two were analyzed by using both qualitative and quantitative methods. The Statistical Package for Social Sciences (SPSS) was used to analyze quantitative data whereas Content and Structural Functional Analysis were used to analyze the qualitative data.

The first step during quantitative analysis was the preparation of the variables to make them be in a form suitable for addressing the research questions and the computer program used i.e. Statistical Package for Social Sciences (SPSS). These preparations involved coding and an opportunity was taken sometimes to change the order of categories or even grouping some variables. Each question was analyzed to show the

range of distribution of replies, the existence of any concentration or central tendency in those replies and the shape of distribution or the extent to which the replies were clustered around the central point. Most of the analysis described above fall on the domain of "descriptive statistics".

Inferential statistics were used to provide an idea about whether the patterns described in the samples were likely to apply in the population from which the samples were drawn (de Vaus, 1986). In this regard a multiple regression equations were developed to show the relationship between socio-economic factors and tree growing. Socio-economic factors in this respect included age, farm size, income, level of education, sex, household labour and duration of residence. The regression equation is as shown below:

$$Y = a + b_1x_1 + b_2x_2 + \dots + b_ix_i + e$$

Where:

$Y_i$  = The  $i^{\text{th}}$  observed value of the dependent variable (number of planted trees).

$X_1$  to  $X_i$  = independent variables (Age, sex, education, Labour, duration of residence, income, and land size).

$a$  = intercept

$b_1$  to  $b_i$  = independent variables coefficients

$e$  = random error

$i = 1, 2, \dots, n$ , where  $n$  is the total number of variables.

Specifically, the hypotheses tested were:

$H_0: (\beta = 0$  (meaning that there is no relationship between dependent and independent variable)

$H_1: (\beta \neq 0$  (meaning that there is a positive or negative relationship between dependent and independent variables)

A two-tailed t-test at 0.05 percent level of significance was used to reject or accept the test hypothesis. In this case,  $H_0$  was rejected only where  $P < 0.05$  percent.

To assess goodness of fit of the regression model, a coefficient of determination ( $R^2$ ) was employed. Coefficient of determination shows the strength of relationship between dependent and independent variables. According to de Vaus (1986) coefficient of determination act as an index of assessing how much reliance is to be placed on the regression estimates.

Linearity was assumed to postulate the relationship between dependent and independent variables. Kajembe (1994) pointed out the reason for adopting this assumption as first, numerous relationship are empirically linear; second, linear specification is generally the most parsimonious and thirdly, non-linear relationship are difficult to predict. It is important to note however that in developing a regression equations emphasis was placed on providing explanation rather than prediction.

Kajembe (1994) explains the preference of a multiple regression rather than simple regression in two folds; first, it almost inevitably offers a fuller explanation of the dependent variables, since very few phenomena are products of single cause; second, the effects of a particular independent variable is made more certain for the possibility of distorting influences from other independent variables is removed.

Both non-standardized and standardized equations using partial regression coefficients (b) and beta weights (b\*) respectively were developed in this study. Normally when predictions are made, non-standardized equations are used. Standardized figures are used more when trying to assess the relative impact of each independent variable. Standardized partial regression coefficients (beta weights) were used to explain different phenomena in this study.

### **3.2.2.2 Content and Structural-Functional Analysis**

Content and Structural-Functional Analysis techniques were used to analyze qualitative data and information. The components of verbal discussion were analyzed in detail with the help of content analysis method. In this way the recorded dialogue with respondents was broken down into smallest meaningful units of information or themes and tendencies. This helped the researcher in ascertaining values and attitudes of respondents. Structural-Functional Analysis was also used to explain the way social facts relate to each other within a social system and the manner they relate to the physical surroundings. This type of analysis helped the researcher to distinguish between manifest and latent functions.

Manifest functions are those consequences that are "intended and recognized by the actors in the system" (Katani, 1999). Latent functions are those consequences that are neither intended nor recognized (Kajembe, 1994).

## CHAPTER FOUR

### 4.0 RESULTS AND DISCUSSION

#### 4.1 Historical Analysis of Institutional change in the Udzungwa Mountains National Park (UMNP)

History cannot be ignored in any analysis of institutional change (Mukamuri, *et al.*, 1999 in Kajembe and Kessy, 1999), and thus this section is intended to bring to light some of the events in the past that have driven change in UMNP. Changes in the management and conservation of UMNP are both endogenous and exogenous.

Endogenous change relate to the way the society is internally organized and linked to the natural events such as migration, drought, internal conflicts, as well as internally realized growth - related opportunities (Kajembe and Kessy, 1999). The same authors argues that exogenous change relate to those forces that are internal to the community and simultaneously affecting the functions of those communities and consequently their natural resources.

About 90 percent of the respondents in the sampled population had more or less similar perception with regard to the changes that have occurred in relation to the management regimes. Beginning with an arbitrary base period of 1950, respondents generally associated changes in the Udzungwa Forest Reserve with four historical periods, namely; Colonial, Independence, Villagezation and Structural Adjustment Program (SAP) eras.

Colonial period in this respect represent the time before Tanzania mainland (Tanganyika by then) got independence. During this time the colonial government severely restricted exploitation of Udzungwa Mountains Forest Reserve. However, Respondents indicated that the colonial administration undermined local people's rights over the resource they purportedly own through the removal of the customary ownership and discouraged tree planting. Thus, the colonial administration regarded all entrance into the forest as illegal and they were very strict towards any mismanagement. As a consequence, the forest was perceived by most respondents as being fairly dense and rivers flowing out of the forest were more reliable with plenty of water. However, continued alienation of local communities from the management of the natural resources created a negative attitude, resulting into a situation whereby some communities openly questioned the legitimacy of forest boundaries and unfriendly laws. Cases of violation of resource conservation rules were high resulting in growing incidences of timber poaching and forest encroachment.

The period following the gaining of independence in 1961 was characterized by the relaxation of the forest protection rules to the extent that The Udzungwa Mountains Forest Reserve under the central government became open access for timber exploitation, unregulated charcoal making, firewood collection and encroachment for agriculture

Then came the villagezation era when people were forced to shift to some new predetermined sites. This was thought to enhance easy access to facilities such as

reliable roads, hospitals, and adequate land for cultivation. Msolwa and Sonjo study Villages were established under this policy. Given the time constraints, sites selection was neither given adequate supervision nor was the natural resource base or the environmental impact of such village settlements was considered. The purpose of the villagelization program were: to provide a population large enough for social services; to act as agents of land reform (that is to allocate land among private cultivators); to be primary units for marketing (as collection points) and be the potential units for communal production. Since the whole community had to start constructing shelters/houses the demand for construction poles, ropes and other building materials increased putting a toll to the forest reserve. Also important was the increase in human population around the forest reserve. Population density greatly influences the structure and magnitude of forest resources (Seip 1996 in Katani, 1999). Since the number of plant species is clearly determined by the size of the forest area, a growing population leads to reduced biodiversity due to the increased demand of the benefits generated by the forest. It can be speculated that villagelization policy had a profound effect upon biodiversity in the study area. Thus, villagelization coupled with the relaxation of forest protection rules enhanced encroachment and uncontrolled exploitation of the resource base.

Structural Adjustment Program (SAP) era which started in mid 1980s was characterized by the emergence of commercialization of forest products in the study area. As Mukamuri *et al.*, (1999) argues, when trading class develops within a community, a possibility arises that the traders seek out the resource irrespective of its

politico-religious roles. Commercialization of forest products particularly commercial logging did not only threaten some tree species but also opened up land for further encroachment. Some of the most threatened tree species during SAP period includes *Milicia excelsa* and *Khaya anthotheca* as mentioned by 34 and 31 percent of the respondents respectively. *Cephalosphaera usambarensis*, *Ocotea usambarensis* and *Beilschmeideo kweo* were less threatened as mentioned by nearly 11 percent of the respondents. *Milicia excelsa* and *Khaya anthotheca* were most threatened as they offer relatively good quality timber as claimed by most respondents.

Respondents associated the present era i.e. the period following the formation of Udzungwa Mountains National Park with positive changes namely, rejuvenation of forest and increased animal population. This, they claimed to be a result of restricted entry and enhancement of tree planting outside the protected area. They also associated positive changes with the increased collaboration between surrounding communities and the Tanzania National Park (TANAPA) through its Community Conservation Services facility.

#### **4.2 Joint Natural Resources Management in Udzungwa Mountain National Park (UMNP)**

Management of the UMNP is under the TANAPA whose mandate includes the management and regulation of the use of areas designated as National Parks. Other mandates includes the preservation of country's heritage, encompassing natural and cultural resources, including the flora and fauna, wildlife habitat, natural processes, wilderness quality and scenery therein and to provide for human benefits and

enjoyment in such a manner and by such means as will leave them impaired for future generations.

Currently, joint management is facilitated by TANAPA through Community Conservation Services (CCS) whose objectives are:

- i. To improve the relationship between park officials and local communities.
- ii. To ensure that the interests of the National Park with respect to natural resources conservation and community welfare are represented at all levels.
- iii. To facilitate sharing of benefits with local communities.
- iv. To assist communities to gain access to information, resources and services that promotes sustainable development.

These objectives are achieved through provision of extension, education and community consultation. The approach according to park officials is through building and/or strengthening local organizations.

So far the park has managed to enhance or rather influence the formation of Village Community Conservation Committees (VCCCs), fire brigades and various other community organizations. Effectiveness of these organizations as ranked by respondents is given in Table 4.

**Table 4: local organizations and their ranks with respect to conservation of UMNP**

Local organization	Village			
	Msolwa	Sonjo	Ichonde	Kisawasawa
Fire brigade	6	5	5	3
Village Community Conservation Committee	4	3	4	4
Village government	1	1	1	1
Women group	3	4	2	5
Primary School	2	2	3	2
Secondary School	8	n.m	n.m	n.m
Dispensary	9	7	n.m	n.m
Cooperative union	n.m	9	n.m	n.m
Extension Service	5	n.m	6	7
Traditional healers	7	6	7	6
Mosque	10	8	n.m	n.m
Bokela	11	10	8	8

Key: n.m = Not mentioned

Table 4 shows that village government was ranked high in terms of effectiveness in decision making for joint management of UMNP. This study like the previous ones (Kessy, 1998; and Kajembe and Kessy, 1999) confirm the fact that local people are the best assessors of the relative importance of various local organizations on the basis of their functions.

The presence of these organizations illustrates the extent to which communities are involved in the conservation of UMNP. Such community organizations have strong potential to overcome the force that drives individuals to overuse natural resources. Community involvement can often enforce responsible natural resources uses without devoting tremendous financial and manpower resources since it can often depend on social pressure and community spirit rather than armed guards (Ascher, 1995).

### 4.3 Functions of Local Organizations

Respondents in the sampled population had different opinions regarding the function of the organizations presented in table 4. Whereas 33 percent of the respondents in Table 5 indicated the role of these organizations to be tree planting 18 percent mentioned law enforcement as the main function. About 49 percent of the respondents mentioned the role of these organizations to be both tree planting and enforcement of the rules.

**Table 5: Percentage response on the functions of local organizations**

Function	Response (%)				
	Village				
	Msolwa (n=30)	Sonjo (n=30)	Ichonde (n=30)	Kisawasawa (n=30)	All (n=120)
Law Enforcement	10.0	10.7	32.0	23.0	18.4
Tree Planting	40.0	28.6	16.0	46.2	33.0
Both	50.0	60.7	52.0	30.8	48.6
Total	100.0	100.0	100.0	100.0	100.0

### 4.4 Rules and Regulations Governing Joint Natural Resources Management of the UMNP

Joint natural resources management between TANAPA and local communities is mediated by rules and regulation which in this study are referred to as institutions. Institutions governing joint action in this study are basically divided into two main groups; externally and internally sponsored institutions. Internally sponsored institutions encountered in this study were mainly traditional institutions.

#### 4.4.1 Externally sponsored institutions

Externally sponsored institutions in this study are rules set by TANAPA and those agreed between villagers through their representatives and UMNP officials. Table 6 shows rules and regulations governing joint natural resources management in UMNP.

**Table 6. Rules and regulations governing joint action in the conservation of UMNP**

<b>Rules and Regulations</b>	<b>TANAPA Rules</b>	<b>Jointly agreed Rules</b>
Restriction on Disturbing animals and birds	X	
Restriction on picking flowers and cutting and/or destroying vegetation in the national park.	X	X
Restriction on Collection of dead wood except on Fridays and Sundays		X
Restriction on carrying any cutting equipments when collecting dead wood.		X
Restriction on Collection of medicinal plants and thatching grasses except on special permission.		X
Restriction on starting fire in and around the national Park and villagers are obliged to identify the culeripts and participate without delay in fire fighting incidences		X
Restriction on grazing any animal in the national park	X	X
Restriction on Pitsawing and associated activities in the national park	X	

Joint agreements on the rules and regulation between park officials and local community indicated in Table 6 is an indication that the community rights are respected. The survival of joint management of natural resources depends very much on the respect of the rights of communities as joint managers. In the words of Metcalfe (1995) recognition of the rights of the local communities to organize and define their local institutions for natural resources management is the fundamental policy principle

that enhance co-management strategies. The success for local level management depends critically on the recognition and legitimization of community initiatives.

It is important to note that management rules and regulations need to be known by all stakeholders in order to avoid unintended violation. Response on the knowledge of the rules and regulation are presented in Table 7. This table shows that about 77 percent of the respondents in the sampled population are aware of the rules and about 23 are not aware of the rules governing joint action in the management and conservation of UMNP. This group represents the portion of the community that probably does not participate in joint natural resources management or has a negative attitude towards the conservation of UMNP.

**Table 7: Response on the knowledge of rules and regulations**

Response	Village %				
	Msolwa (n=30)	Sonjo (n=30)	Ichonde (n=30)	Kisawasawa (n=30)	All (n=120)
Yes	73.3	75.0	72.0	88.5	77.1
No	26.7	25.0	28.0	11.5	22.9
Total	100.0	100.0	100.0	100.0	100.0

This study revealed that in some cases rules are not followed. Cases of illegal entry for timber, firewood collection and hunting are still common. Both park officials and village governments, Village Community Conservation Committee (VCCC) and fire brigades tries to enforce the rules through imposition of penalties depending on the seriousness of the offence. Commenting on this, Ostrom (1996) had this to say 'appropriators who violate operational rules should be subjected to graduated sanctions depending on the seriousness and context of the offence'. Graduated

sanctions are common in long- enduring Common Pool Resources (CPR) institutions because they allow flexibility in the system (Marrow and Hull, 1996). Kajembe and Kessy (1999) argues further that a person who is a rule follower but who is in dire need of the resource and therefore cheats can be treated leniently compared to an offender who shows little allegiance to the rule structure of the institutions.

In this study penalties for illegal entry ranges from verbal warnings to fines. The court punishes bigger offences such as pitsawing and poaching animals such as leopards, elephants, lions, buffalos, hippopotamus and antelopes. Discussions with park officials and village government leaders indicated a range of penalties to various offences as shown in Table 8. It can be seen from Table 8 that most of the penalties are rather lenient. This serves to enhance cohesion between the community and the offenders. If penalties are too harsh then the community itself will not enforce them or the violators will sever their relationship with the community organization (Ascher, 1995).

**Table 8. Penalties to various offences in then study area**

		Penalty	
Offence		Fine (Tsh)	
Charcoal Making		5,000-10,000	
Pitsawing/logging	Court		
Trespassing			Verbal warning**
Causing fire	Court	2,000-5,000	
Hunting*	Court	5,000-10,000	
Collection of building poles		2,000-5,000	
Collection of firewood		2,000-5,000	Verbal warning
Cutting of grasses for roofing			Verbal warning

\*A hunter may be taken to court if found with a dead animal, otherwise, He/she is fined and his weapon confiscated.

\*\* verbal warning are given by park officials to offenders who are caught for the first time with minor offences (1 US\$ = 800 Tsh).

#### 4.4.2 Internally Sponsored Institutions

Internally sponsored institutions encountered in this study are mainly traditional institutions. Internally sponsored institutions which are essentially traditional are important in natural resources management and play a greater role in regulating access and utilization of various natural resources in a given society.

Traditional institutions represent the established local system of authority and other phenomena derived from the sociocultural and historical process of a given society (Appia-Opoku and Hyma, 1999). Traditional institutions which originate from local cultures, have firm roots in the past and reflect knowledge and experience of the local people. Identification of these institutions can serve as a point of entry in the search for local level and broad based approaches to the management of natural resources. They include norms, rituals and customs governing protection of natural resources.

Traditional institutions in this study include those related to traditional healing and *Bokela* (Mountain spirit). Table 9 shows the response on the existence of these institutions in the study area.

**Table 9: Responses over traditional institutions in the study area.**

Response	Response (%)				
	Village				
	Msolwa (n=30)	Sonjo (n=30)	Ichonde (n=30)	Kisawasawa (n=30)	All (n=120)
<i>Bokela</i>	47.5	39.4	52.3	49.7	47.2
Traditional healing	52.5	60.6	47.7	50.3	52.8
Total	100.0	100.0	100.0	100.0	100.0

#### 4.4.2.1 Traditional Healing

The study identified two main groups of traditional healers, namely, those who cure physical ailments and those who treat spiritual problems associated with witchcraft, love, security enhancement and self defense. Discussion with some traditional healers revealed that they have a vast amount of knowledge of medicinal plants. The skill of traditional medical practices is acquired primarily through a long period of apprenticeship and observation. Most of the knowledge is passed from one generation to another (Otieno, 2000).

It should be noted that Tanzanians have a rich cultural heritage and the role of traditional healers have been important, but sadly not given recognition it deserves. In the west, traditional healing practices such as homeopathy and osteopathy and spiritual faith healing are all registered and recognized (Kajembe, 1994). It should be noted that the role of the traditional healer (*Mganga*) is completely different from that of the witch doctor (*Mchawi*). A traditional healer identifies, treats or remedies people who have been harmed by witchcraft or supernatural forces.

Cultural background has an important influence on the aspect of people lives including their beliefs, behaviour, perceptions and attitudes to illness and pain. Each culture has its own unique language of expressing distress and pain. Everyday objects such as charms, amulets, horns, fly-whisks, calabashes and powder are used either directly as medicine or indirectly in a symbolic manner. The symbols often become the language and media of diagnosis and treatment.

The study revealed that traditional healing as an institution plays an important role in the conservation and management of UMNP. This is through the tendency of the traditional healers to attach some myths that exclude others from harvesting medicinal plants. For example in Msolwa village one traditional healer disclosed that her woodlot cannot be reached by any person because it is protected by unknown spirit and that she can only get into it when wearing special black clothes. Another traditional healer said that some tree species could only be harvested when specially treated coins are left under the tree a night before harvesting. Other traditional healers claimed that special prayers need to be said before collecting roots of certain plants. Similar strategies are reported by Otieno (2000) that traditional healers in Duru-Haitemba, Babati, Arusha, Tanzania reach some tree species in a backwards movement. Studies in Kenya indicate that sustainable use of medicinal plants through 'traditional healing' as an institution has been facilitated in the past by several inadvertent or indirect local controls and some intentional traditional management strategies. Taboos, seasonal and social restriction on gathering medicinal plants and the nature of plant gathering equipments have contributed to limit medicinal plants harvesting to some degree (Odera, 1997). Some societies in western Kenya, for example, insists that certain plants should only be harvested at night, with minimum disturbances, after offering a token fee and prayers. Taboos against the collection of medicinal plants by menstruating women, contending that this will reduce the healing power of the medicine, taboos against young people cutting trees such as *Erythrina abyssinica* in western Kenya as reported by Odera (1997) are some of the restrictions

controlling the use of medicinal plants

All these strategies tend to alienate other people from harvesting and hence consolidate their dependency and trust in the services given by a few traditional healers. As a consequence most of the traditional medicinal plants are protected and conserved.

It was learnt from this study that all traditional healers are given a special permission renewable in an interval of three months and have the right to question and report whomever they find in the forest. Traditional healers also plant some indigenous medicinal plants and some of them own small natural woodlots for medicinal purposes. Table 10 shows some medicinal plant species which are used for treating some physical ailments.

**Table 10. Traditional medicines treating some physical ailments**

Name	Language	Scientific name	Part used	Preparation	Diseases cured
Mpululu	Swahili	<i>Mastuea brunonis</i>	Leaves	Leaves pounded and juice squeezed into the ear	Ear infection
Mpululu jike	Swahili	<i>Cambetum pentagonum</i>	Leaves	Leaves pounded with water, mixed with oil from sheep together with lemon leaves.	Heart ailments
Mkangazi	Swahili	<i>Khaya anthotheca</i>	Bark	Bark pounded and dried	Stomach ache
Mvule	Swahili	<i>Milicia excelsa</i>	Bark	Pounded with water and the juice is drunk	Ingestion
Mkole	Luguru	<i>Crewia conocarpa</i>	Leaves	Leaves pounded and sap drunk	Diarrhoea and stomach ache
Mkenge	Pangva	<i>Cassia singuenu</i>	Roots	Roots soaked in water over night and the juice is drunk	Gonorrhoea
Myombo	Swahili	<i>Bragystegia spp</i>	Roots-leaves	Leaves and roots boiled and water drunk	Healing of broken Bones

#### 4.4.2.2 'Bokela' (Mountain God)

*Bokela*, seen in Table 9, refers to the "Mountain of God". For many years, local people surrounding this mountain (*Bokela*) used to offer sacrifices in times of drought, diseases and famine. *Bokela* was also believed to create rains for the surrounding communities. *Bokela* was considered as a sacred place where only the elders were allowed into *Bokela* for prayers and offering of sacrifices. Trees traditionally protected in the *Bokela* include *Adansonia digitata*, *Afroseralisia cerasifera*, *Bombax rhodognaphalon*, *Funtumia africana*, *Erythrophleum Suaveoles* and *Ricinodendron heudelotii*. It is important to mention that *Adansonia digitata* protected in the *Bokela* is a popular tree in Africa, and is believed to be surrounded by myths and legends. It is worshipped as a fertility tree by communities in Kenya, Sudan and West Africa (Odera, 1997). The Nuer of Sudan, for example, regards it as a birthplace for man.

*Bokela* was also used for burial purposes. Grave sites in the *Bokela* are sacred and trees used as grave markers are not used for other purposes. It is traditionally believed that collection of wood or other products from grave sites is the invitation of evils at home or may provoke anger and vengeance in the form of calamities such as famine, floods or death. Similar protection strategies are reported from Ghana. The patch of the forest used as a grave site is protected because of the respect of the dead and the belief that the ancestral spirits live there (Ntiadou-Baidu, 1995). Entry into such a forest is prohibited, and only limited classes of people (such as the member of the royal family, village elders and clans heads) are allowed access for the burial purposes. As a consequence trees and other natural resources in such areas are conserved.

It is important to note that religious significance of sacred groves that are widespread among many African communities appear to have originated from the basic beliefs on the psychoactive values and taboos attached to trees and their associated habitats. A tree sacred to a clan/community had a territorial jurisdiction and was selected by the elders in consultation with the prominent seer. Quite often the sacred groves are associated with the past community initiation, localities where social and political values, morals, cultural norms, secrets and laws and traditions are passed to the younger generations. Thus sacred groves are not only providing sites for communication with the ancestral spirits and the gods but are also the media where the past meets the present, and the present merges with the future.

It was however learnt that more than 89 percent of the respondents could not name with certainty the function and institutional arrangement of *Bokela*. The rest (11%) mentioned *Bokela* as a sacred grove providing a meeting place for traditional leaders and healers. The study revealed further that *Bokela* is known by the majority (78%) of the respondents as an old institution which protected the forest but no longer in practice. This may be attributed by lack of continuity of traditional institutions in Tanzania and in the study area in particular. It is also possible that *Bokela* and other traditional institutions lost their viability in the face of pressure from both within their own society (often as a result of increased population and modernization) and from outside the society as a result of in-migration and lack of ability to exclude other resource users who might contradict with the traditional institutional arrangements.

Ritual uses of forests and trees tend in most cases to be disregarded in classical forest literature (Kajembe, 1994), but indigenous knowledge accompanying these ritual uses of forests and trees if studied carefully can be valuable for forest conservation. So far, the practice behind sacred forest grooves such as *Bokela* have hardly been studied and described with the objective of investigating how they fit with the contemporary forest management systems.

Kajembe and Kessy (1999) argued that traditional institutions in Tanzania have been undermined at various stages in the colonial and post-colonial periods. New institutions were created and some of the functions of the traditional leadership were transferred to the new institutional structures created. For example, elders who stood as traditional leaders are no longer confined to traditional functions but are given responsibilities as leaders of formal organizations such as village governments. Traditional experience and knowledge may be lost in this way.

#### 4.5 Conflicts

According to Mvena *et al.*, (2000) conflict ensue when resources become scarce and that the more unequal the distribution of scarce resources in a system the greater will be the conflict of interest between dominant and subordinate segments in a particular system. Conflict does not imply outright violence, it may include tension, hostility, competition and disagreements over goals and values.

In this study an attempt was made to identify two main categories of conflicts, namely:

conflict between external and internal organizations and conflict between individuals in the same community. Conflict between internal and external organizations occurs when there is a clash of interests between internal and external organizations. This kind of conflict can destroy the often fragile trust between internal and external organizations (Ascher, 1995).

The second category of conflict occurs as a result of conflicting interest between individuals in a community. Other reason for individual conflict according to Ostrom (1997) as cited by Mvena *et al.*, (2000) includes lack of design principles defined as an element or condition that help to account for the success of institutions in sustaining common pool resources and gaining the compliance of generation after generation of appropriators to the rules in use. Some of the design principles include clearly defined boundaries, congruence between the rules that assign costs and collective arrangements used to modify the operational rules over resources (Ostrom, 1996).

There are essentially two externally sponsored organizations involved in the conservation of UMNP; these are TANAPA and World Wildlife Fund (WWF). WWF has been funding part of the UMNP management costs and providing support for tree planting program in the study area.

Table 11 shows that about 85 percent the sampled population is of the opinion that there are virtually no conflicts between internal and externally sponsored organizations.

**Table 11. The state of conflict between internal and externally organizations**

Response	Village %				
	Msolwa (n=30)	Sonjo (n=30)	Ichonde (n=30)	Kisawasawa (n=30)	All (n=120)
Yes	20.0	10.7	12.0	15.4	14.7
No	80.0	89.3	88.0	84.6	85.3
Total	100.0	100.0	100.0	100.0	100.0

The response indicates harmonious relationship between internal and externally organizations. This is based upon the recognition of TANAPA and WWF that the surrounding communities are capable of developing resource management systems and organizations that may be incorporated in joint natural resources management. Lack of conflict may also be explained by the fact that UMNP was established after local consultation that put emphasis on education and public awareness over the formation of UMNP. Without this approach, forced relocation and other forms of resettlements could have caused negative attitudes that might have weakened the opportunities for building strong partnership.

The study also revealed no particular individual conflict. This emanates from the fact that nearly 90 percent of respondents are aware of individual or collective responsibilities and rights. These include knowledge and respect of boundaries and rules as shown in table 12. As Table 12 shows, more than 98 percent of the respondents know the boundaries of the UMNP and more than 93 percent respect them. In reference to Table 7 77 percent of the respondents know the rules and regulations governing the conservation and management of UMNP.

**Table 12. Respondents' knowledge and respects towards UMNP boundaries**

Attribute	Response	Village %				
		Msolwa N=30	Sonjo N=30	Ichonde N=30	Kisawasawa N=30	All N=120
Boundaries Known	YES	96.7	96.4	100	100	98.2
	NO	3.3	3.6			1.8
<b>Total</b>		<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
Boundaries respected	YES	92.7	91.4	95.4	93.7	93.3
	NO	7.3	8.6	4.6	6.3	6.7
<b>Total</b>		<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

#### 4.6 Indigenous Management Practices

Interviews and observation showed that farmers in the study area perform various practices associated with tree planting and management. The observed practices include the arrangement of trees in farms and other management techniques such as pollarding, pruning and protection of seedlings against termites.

##### 4.6.1 Arrangement of Trees on Farms

Arrangement of trees varied considerably between farms and home-gardens. Whereas large tree cover and complex spatial arrangements were observed in home-gardens, lesser tree cover and simpler arrangements were observed on farms away from homesteads.

Observation on tree arrangement around homestead revealed zonal arrangement including single rows and wider trips of trees. This kind of arrangement is purposely done to provide room for intercropping trees with other crops such as maize, beans, cassava and sweetpotatoes. This enhances the growth of a large number of plants in a

given piece of land.

Relatively few exotic and indigenous tree species are planted or retained in farms. This is possibly because farm areas are always flooded providing environments that are suitable for paddy growing but not suitable for tree planting and retention.

#### **4.6.2 Pruning and Pollarding**

In the study area, farmers use different techniques for tending and controlling harvest of the trees. Branches are normally removed from the trees to adjust growth and shape and to obtain firewood. Although discussion with extension agents revealed that pruning is normally done to release nutrients for tree productivity none of the farmers saw it as a way of releasing nutrients. To them, pruning is a way of obtaining firewood and removing excessive branches from the trees. This practice is particularly done on *Mangifera indica*. Wood obtained from *Mangifera indica* is particularly used to provide firewood for brick making. *Mangifera indica* wood according to most respondents is preferred because it produces fire that lasts longer than fire from other tree species.

It was learnt from this study that the timing of pruning varies from farmer to farmer. Whereas some prune at the end of dry season others prune at the beginning of the dry season. Those who prune at the end of the dry season argues that this period is having relatively lower humidity which provide conditions for healing of scars. The return of the rain after the dry season enhances prolific establishment of shoots and branches.

Depending on the demand for firewood, pruning can be intensive or restrictive. Some farmers prune more intensively, that is higher up the trunk while others prune more restrictively.

#### **4.6.3 Protection of Trees Against Termites**

Most farmers claimed that termites could endanger successful growth and establishment of tree especially young seedlings. The damage could often result into total destruction of planted seedlings. Generally, farmers said fruit trees such as *Mangifera indica*, *Carica papaya* and *Citrus spp* are more susceptible than other tree species. Less susceptible trees include *Senna siamea*, *Azadirachta indica* and *Milicia excelsa*.

Protection against termites is done by smearing ashes on the trunk. This practice they argue is very effective and that there is no need to apply industrial chemicals. On the contrary, forest officers seem to advocate the use of chemicals to control termites and other insects. It is possible that these chemicals can be more effective than the method used by the farmers. However, the question is how many farmers can afford to buy those chemicals? It is therefore logical for the forest officers to look into the possibility of improving the indigenous protection methods that are of low cost and in most cases affordable.

#### **4.7 Tree Planting as a Way of Sustaining UMNP**

Tree planting is done under the agroforestry programme supported by WWF. The

main objective of this programme is to enhance people's capacity to get alternative sources of forest products that could otherwise be obtained from UMNP. Meanwhile farmers are allowed to enter the park to collect dead wood provided that they carry no cutting implements. Arrangements like this have also been reported by Miller *et al.*, (1995), whereby local people in Kasungu National Park in Malawi are given the right to harvest tree caterpillars and to establish beehives in the national park. Similar programs have also been established in Nyeka National Park and Vwaza Game Reserve in Malawi (Mkanda, 1992 as cited by Miller *et al.*, 1995).

It is however important to note that collection of dead wood in UMNP is temporary and more than 60 percent of the respondents are aware that the park will be closed against collection of anything including deadwood. This knowledge provides an incentive for effective participation in tree planting by the people. The study revealed that more than 75 percent of the respondents participate in tree planting as indicated in Table 13.

**Table 13. Responses towards tree planting in the study villages**

Response	Village %				
	Msolwa (n=30)	Sonjo (n=30)	Ichonde (n=30)	Kisawasawa (n=30)	All (n=120)
No	13.3	24.7	43.0	16.4	24.4
Yes	86.7	75.3	57.0	83.6	75.6
Total	100.0	100.0	100.0	100.0	100.0

#### 4.7.1 Reasons for tree planting

The study found that farmers gave various reasons for their tree planting efforts. A simple and most evident reason as indicated in Table 14 was the fact that more than 60

percent of the respondents are aware that the park will soon be closed and that farmers should start establishing their own sources of trees products by planting trees on their farms. About 32 percent of the respondents gave other reasons ranging from what they expect to harvest from the trees to soil fertility and financial gains. Firewood collection, extraction of building poles and sale of timber are some of the utilitarian reasons given by most respondents. Demarcation of farms or residential plots were also noted by about 8 percent of respondents.

Table 15 shows that about 67 percent of the respondents in the sampled population had planted trees around their houses. Nearly 17 percent of the sampled population planted their trees on farms and nearly 16 percent participated in tree planting as collective efforts in church grounds, schools, farmers group woodlots and on village boundaries.

**Table 14: Reasons for tree planting**

Reason	Village %				
	Msolwa (n=30)	Sonjo (n=30)	Ichonde (n=30)	Kisawasawa (n=30)	All (n=120)
Park will be closed	50.6	62.9	67.1	60.1	60.2
Utilitarian	37.2	27.4	30.7	32.4	31.9
Demarcation	12.2	9.7	2.1	7.5	7.9
Total	100.0	100.0	100.0	100.0	100.0

Planting trees near homesteads provide opportunity for farmers to tend and give a closer look to the young seedlings. Similar findings were also reported in Dodoma by Kajembe (1994) whereby trees were planted around homesteads, presumably to keep an eye on them.

**Table 15. Response on sites where trees are planted.**

Site	Village %				
	Msolwa (n=30)	Sonjo (n=30)	Ichonde (n=30)	Kisawasawa (n=30)	All (n=120)
Home gardens	67.5	69.7	61.3	71.4	67.4
On farms	17.7	13.4	14.7	21.3	16.8
Communal lands	14.8	16.9	24.0	7.3	15.8
Total	100.0	100.0	100.0	100.0	100.0

#### 4.7.2 Socio-economic Factors Influencing Tree Planting

Participation in tree planting and other forms of management practices are influenced by a number of socio-economic factors. Any effort to conserve the valuable biodiversity in the Udzungwa mountains need to consider and/or predict factors that directly or indirectly influences people perception and therefore commitment to sustainable conservation. Thus, a multiple regression model was developed to show the relationship between socio-economic factors and tree planting.

Table 16 shows significant correlation between the number of trees planted with age, education, household labour and income. The table also shows negative correlation between sex, duration of residence and farm size.

**Table 16: The relationship between socio-economic factors and tree planting.**

Xi	Yi		
	B	Beta (b*)	Sig. t
	$R^2 = 0.62$		
Age	1.701	0.854	0.009*
Sex	-5.319	-0.097	0.201 <sup>ns</sup>
Education	8.536	0.193	0.023*
Res. Duration	-0.11	-0.05	0.601 <sup>ns</sup>
Farm size	-4.467	-0.032	0.791 <sup>ns</sup>
Household labour	1.998	0.105	0.016*
Income	1.33	0.074	0.048*

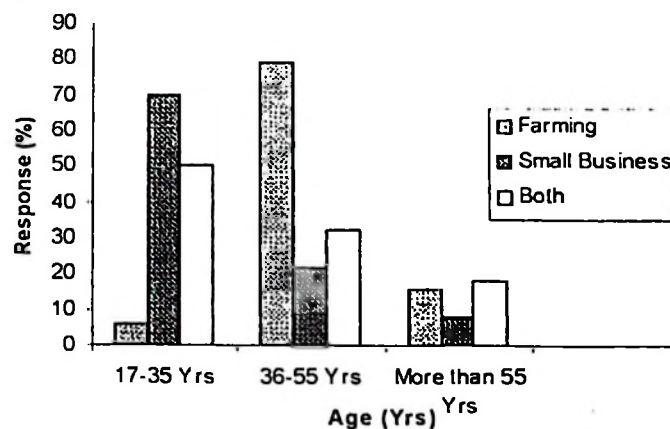
Key:

- X<sub>1</sub> = All independent variables
- Y = Number of planted trees (dependent variables)
- R<sup>2</sup> = coefficient of determination (0.62)
- \* = Significant at 0.05 level
- ns = Non-significant
- b\* = beta weight

#### 4.7.2.1 Age

In this study 19 percent of the sampled population had the age below 30 years, 45 percent between 30-45 years of age and about 36 percent had the age above 45 years. The study revealed that age is significantly correlated with the number of trees planted. This indicates that older people plant more trees than younger people. Older people may be planting more trees than younger people possibly because they own relatively larger portions of residential areas which are mostly used for tree planting.

Another rather plausible explanation is that most of the young people in the sampled population are engaged in small business than farming as indicated by figure 4.

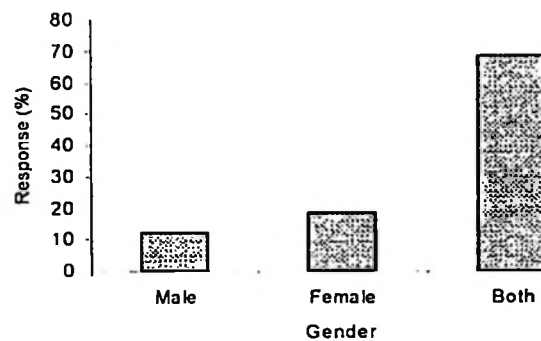


**Figure 4: The relationship between age and source of income**

It was learnt from the sampled population that older people (36 years and above) are involved in farming and thus may have more opportunities to plant trees.

#### 4.7.2.2 Sex

The study indicated a negative correlation between sex and the number of trees planted. Chi-square analysis also indicated that there is no significant difference between sex and tree planting at 0.05 percent level of significance. As figure 5 shows sex does not have any influence in tree planting and that both male and female participate more or less equally in tree planting.



**Figure 5: The percentage response on tree planting by gender**

However, when asked to name gender responsibility between men and women 84 percent of the respondents mentioned tree tending and care to be done by women and 16 percent of the respondents mentioned men to do some care and tending of trees.

Table 17 shows response of farmers on gender roles in tree management.

**Table 17. Response of farmers on gender roles in tree planting and management**

Gender	Responsibility	
	Planting (%)	Tending (%)
Male	51	16
Female	49	84
Total	100	100

The reason for tree management to be done by women more than men is the fact that women are responsible for fetching water which could be combined with watering of young seedlings. Moreover, women have patience and nursing instincts and therefore more adapted to tending delicate seedlings and trees. It is also possible that since trees are planted around homesteads, this provides greater opportunities for women to tend and manage the trees than men because men are always away from home.

The tendency for women to tend and manage trees more than men can also be explained by the fact that women have more knowledge in tree management than men. This knowledge is attained through longer periods of observation and experimentation with plants as providers of food and firewood. It is argued by Astolfi (1995) that women have developed a thorough knowledge of plant growth, maturation and reproduction through their daily occupations as food gatherers. Women are not only pioneers in tree management but also other plant interventions. For example, It was through women intervention that early grain seeds such as sorghum and wheat were culled and valued. Results reported by Astolfi (1995) indicate that ecological stability through sound management of forest, agriculture and livestock in India depends on rural women's knowledge and labour.

Despite of these realities women's potential for maintaining biodiversity is neither fully understood nor taken into account. Biases have been inherent in scientific research, in protected area management, in agriculture and rural development at large. These biases have often led to an inadequate analysis of women productive roles and have resulted into undervaluing their contribution.

#### 4.7.2.3 Education

Table 16 shows that about 78 percent of the respondents in the sampled population have primary education, whereas about 11 percent attended adult education and about 5 percent secondary education. About 6 percent of the sampled population did not receive any formal education.

**Table 18: Percentage response towards level of education in the study villages**

Education	Village %				
	Msolwa (n=30)	Sonjo (n=30)	Ichonde (n=30)	Kisawasawa (n=30)	All (n=120)
No formal education	4.3	5.3	8.0	4.5	5.5
Adult education	9.3	10.1	12.0	12.3	10.9
Primary education	70.9	78.2	76.0	77.7	78.2
Secondary education	5.5	6.4	4.0	5.5	5.4
Total	100.0	100.0	100.0	100.0	100.0

With reference to Table 16 the number of trees planted are significantly correlated with education level. This means that farmers with more education tend to plant more trees than those who are less educated. This implies that education has a direct influence towards people participation in conservation activities. According to Katani (1999), education creates awareness positive attitudes, values and motivation for better natural resources management among the people. Kajembe and Luoga (1996) asserts it

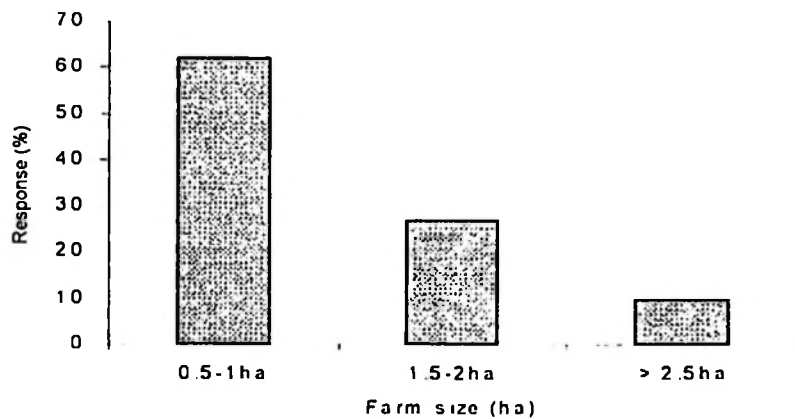
further that there is no development without education.

#### **4.7.2.4 Duration of residence**

Table 16 shows a negative correlation between number of trees planted and duration of residence. These results reflect the fact that the less the number of years an individual has stayed in the village the more the number of trees he/she planted. This may be due to the fact that the people who have stayed longer in the village are used to get tree product from the forest. To them trees are natural gifts that are obtained from the forest. People with shorter duration of residence includes retrenched workers from sugar factories/plantations, Mang'ula Mechanics and Machine Tools and others from other places of work. These people have a greater awareness on the importance of trees, as they are in most cases educated, and they want, through free planting, to establish property rights to the land allocated to them by the village governments or sold to them by local people.

#### **4.7.2.5 Farm size**

About 62 percent (Figure 6) of the sampled population had a farm size ranging between 0.5-1 ha, about 27 percent between 1.5-2 ha while 10 percent had farm size above 2.5 ha



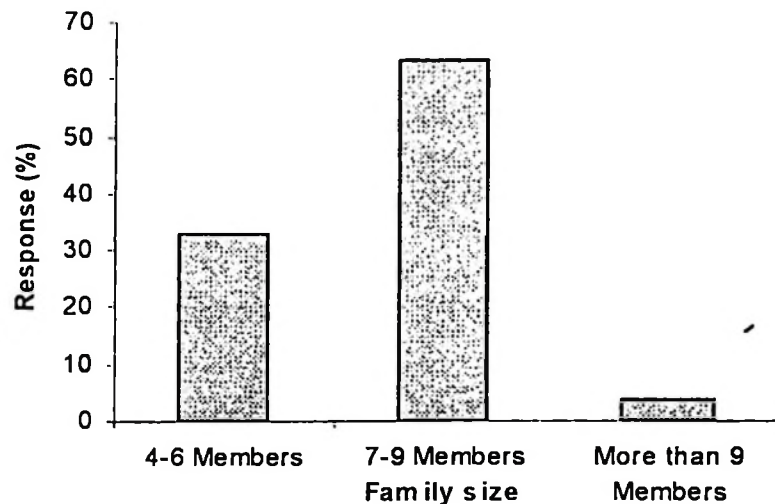
**Figure 6. Responses towards farms size.**

The study revealed that there is negative correlation between the number of trees planted and farms size (Table 16). This implies that the higher the farm size the less the number of trees planted. These rather peculiar results contradict other results by Katani (1999) who carried out his study in Mwanza district and showed that the number of trees planted increases with farm size. The reason behind these unexpected results may be that the largest portion of the land in the study area is used for paddy and sugar cane growing. It was also learnt from the sampled population that most of the households economy in the study area depends on rice and sugar cane whose soil characteristics are heavy alluvial soils and stay flooded throughout the season. This kind of environment does not support adequate tree growing.

#### **4.7.2.6 Household labour**

In this study a household was considered to be a combination of persons who eat from the same pot, sharing the same dwelling and may cultivate the same land. Shrestha

(1996) reported that a household size is an important variable determining the possible supply of family labour for crop and tree farming. In this study 33 percent (Figure 7) of respondents had families with members ranging between 4-6, 63.3 percent between 7-9 members and only about 4 percent had family size of more than 9 members.



**Figure 7. Response on family size**

There was a significant correlation between household labour and the number of trees planted (Table 16). It seems from this study that larger families plant more trees than small families. These results contradict with what was found by Katani (1999) and Njana (1998) that as households size increases the number of trees planted tend to decrease. Larger families have less time constraints in family activities and therefore may participate more in tree planting than smaller families. Also important is the organization of labor in the household.

This has an important implication on land use management and conservation activities.

There are always labour demand conflicts between tree planting and other household activities. Small families are more liable to face labour conflicts than larger families. As a consequence larger families have more chance to plant trees than small families.

#### 4.7.2.7 Income

Table 16 shows a significant correlation between trees planted and the level of income. This shows that the higher the income the more the number of trees planted. It was learnt from this study that tree seedlings are given free of charge and thus a possible explanation for people with higher income to plant more trees may be due to the fact that higher income provide possibilities for them to hire labour than those with lower income. Furthermore, people with higher income have relatively larger residential areas and hence plant more trees.

#### 4.7.3 Uses of Trees

The study revealed a number of uses from different tree spp planted by farmers as indicated in table 19. It can be seen that 82 percent of the respondents mentioned *Albizia lebeck* to be used for building poles, firewood and soil enrichment. Although mentioned by 72 percent of the respondents, *Senna siamea* was noted as having more uses as compared to other tree species. Other tree species were observed to be planted by most farmers but had minimum uses. These include *Milicia excelsa*, which was mentioned by 27 percent of the respondents and *Azadirachta indica* which was mentioned by only 17 percent of the respondents. Whereas *Sesbania sesban* was mentioned by only 14 percent of the respondents and *Pterocarpus angolensis* was

mentioned by only 12 percent. The reasons for minimum uses of these tree species include longer rotation age (e.g. *Milicia excelsa* being an excellent timber but takes up to 80 years to mature while *Pterocarpus angolensis* takes more than 40 years to mature) and poor knowledge of utilization (e.g. *Azadirachta indica* mentioned for medicinal uses with the majority being unaware of the types of diseases and the methods for preparation). *Senna siamea*, *Albizia lebeck*, *Khaya anthotheca* were mentioned by the majority of the sampled population presumably because of their nature of growing relatively fast and their ability to provide many uses.

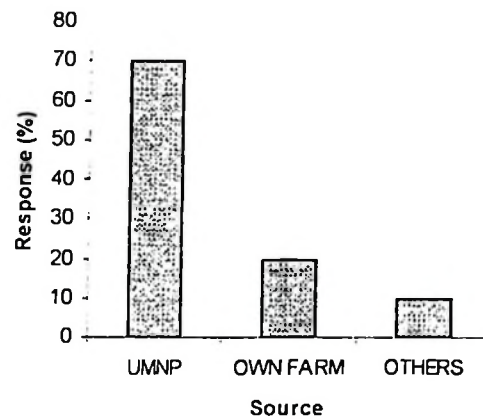
**Table 19. Responses on planted tree species and their uses**

Local Name	Scientific Name	Uses	HH%
Mjohoro	<i>Senna siamea</i>	BU, SE, FW, TB, CH,	72.0
Mmanga	<i>Pericopsis angolensis</i>	MD	56.0
Mkangazi	<i>Khaya anthotheca</i>	SE, FW, CH	78.0
Mchekwa	<i>Bauhenia variagata</i>	BU, FW, TB	42.0
Mtiki	<i>Tectona grandis</i>	BU, SE, FW	75.0
Mninga	<i>Pterocarpus angolensis</i>	BU, FW, TB, CH	12.0
Mwembe	<i>Mangifera indica</i>	BU, FW, TB, MD	66.0
Mkenge	<i>Albizia lebeck</i>	FW, FR	82.0
Myombo	<i>Brachystegia speciformis</i>	BU, FW, SE	47.0
Mvule	<i>Milicia excelsa</i>	BU, FW, CH	27.0
Mlusina	<i>Leucaena leucocephala</i>	BU, TB	52.0
Mlindawiza	<i>Sesbania sesban</i>	SE	14.0
Mwarobaini	<i>Azadirachta indica</i>	SE MD	17.0

Key : BU =Building; SE = Soil enrichment; FW = Firewood; CH = charcoal;

TB= Timber; MD= Medicine; FR = Fruits

However, other than tree planting and agroforestry program being in the area for 9 years, the majority of the respondents still depends on UMNP for fuel wood requirements as indicated in figure 8.



**Figure 8: Major Source of fuelwood**

It can be speculated from Figure 8 that trees so far planted (see appendix 3) are still young and hence do not provide sufficient and quality firewood for domestic uses. It is also possible that people are not used to the use of exotic tree species as a source of firewood. They claim that indigenous tree species provide better quality firewood for cooking and local brewing than exotic tree species. Table 20 shows uses of different indigenous tree species.

**Table 20: Responses on preferred indigenous tree spp**

Local Name	Scientific name	Uses	HH %
Mpululu	<i>Terminalia sericea</i>	FW TI BU CH	42
Mkangazi	<i>Khaya anthotheca</i>	FW TI BU CH MD	60
Mvule	<i>Milicia excelsa</i>	FW BU TI CH	76
Myombo	<i>Brachystegia spp</i>	MD FW CH	56
Mgunga	<i>Acacia spp</i>	FW CH	14
Mkole	<i>Crewia conocarpa</i>	FW BU CH	26
Mtarawanda	<i>Markhamia lutea</i>	FW MD	11

Key: FW = Fuelwood; TI= Timber, BU= Building, CH= Charcoal, MD= Medicine; FR= Fruits

It appears from Table 19 that only two indigenous tree species i.e *Khaya anthotheca* and *Milicia excelsa* are planted by most farmers, the rest of the indigenous tree species

are still not planted. One plausible explanation may be lack of knowledge and ability to propagate indigenous trees.

#### **4.8 A model for Sustainable Conservation of UMNP**

##### **4.8.1 Overview**

One of the objectives of this study was to propose a model that is likely to ensure sustainable conservation of the biodiversity in the UMNP. A model is a simplified representation of something that has to be described, explained or understood (Kajembe, 1994). Its purpose is to generate answers to questions or problems (Van Maaren 1990 in Kajembe, 1994). Models have three connotations. They may represent states, objects or events in much the same sense in which architect construct a small-scale model of a building. They may imply a degree of perfection or idealization, e.g. a model student, or they may represent how something works. In the words of Kajembe (1994) models are less complicated than reality and hence may lead more directly to generalization. A social model as the one proposed in this study is based on selected sets of "statements" about the reality in a given situation.

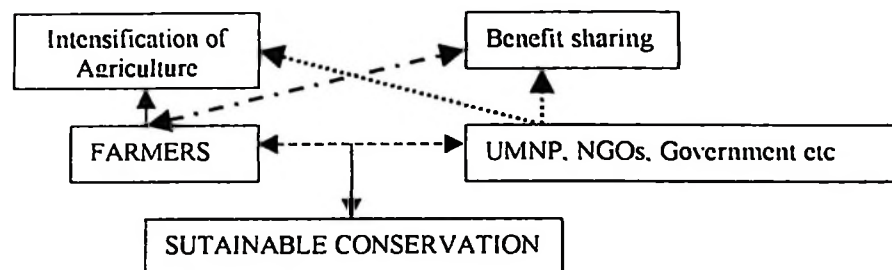
##### **4.8.2 Model for Sustainable Conservation of Biodiversity in Udzungwa Mountains**

It was learnt that people living close to the UMNP had greatest influence on the effectiveness of various management regimes and that their socio-economic characteristics greatly influences the implementation of different management

strategies. The absence of enforcement of the rules after independence, for example, led to indiscriminate encroachment and illegal harvesting of biological resources by the local people. Community involvement and intervention within and outside the protected area will enhance the increase of biodiversity. Community involvement will as well empower the surrounding communities to take appropriate measures as important partners in sustainable conservation of biological resources in their area. Given these realities a model is thus proposed to ensure that:

- People living adjacent to the resource base have sufficient incentives to conserve and manage the resource for the present and future generations.
- Resource users are empowered, accountable and have enough knowledge over issues related to conservation and sustainable use of resources within and outside the protected area.
- Biodiversity outside the protected area is increased to meet demand for forest related products and to enhance the growth of community welfare.

To address the above issues the model is thus proposed (Figure 9).



Key:

- ..... = UMNP support for Intensification of agriculture and revolving funds for credit
- - - - = Farmers receiving credit from a revolving fund
- = Farmers intensifying their agriculture
- ..... = Collaboration between farmers and UMNP, NGOs

**Figure 9. Model for Sustainable conservation of Biodiversity in Udzungwa Mountains**

### 4.8.3 Key actors

The study showed that there are four actors from which sustainable conservation of UMNP depends. These includes; Farmers (including local leaders), UMNP officials (particularly CCS), Extension agents (livestock, crop and community development) and Non-Governmental Organizations (NGO) Cooperation and interaction between these four actors forms the basis for sustainable conservation of biological resources in UMNP.

The interaction between the four actors depicted by the study represents an effective social process whereby each actor is identified with a particular responsibility for attaining a common goal. What is suggested by this model is that there is interaction between actors within a common ground and that objectives are harmonized and actions executed with a common target of sustainable conservation of UMNP".

This model emphasizes the need to understand each of the key actors and their role in sustainable conservation of UMNP. In the case of farmers, for example, it is important to find if there are any tree/forest management practices and how these can be used in joint management efforts. There is also a need to establish cordial relationship and trust between extension staff, park officials and NGOs, giving more decision making responsibilities, promote experience sharing and help extension workers to identify problems and define new approaches towards more effective management strategies.

#### **4.8.4 Operationalization of the model**

The model entails the importance of providing the people with new economic resources or alternative means of survival. This calls for a concept of ecodevelopment. Ecodevelopment aims to conserve biodiversity by addressing both the impact of local people on the protected area and the impact of protected area on local people.

Ecodevelopment has two main thrusts, namely, improvement of protected area management and involvement of local people. It seeks to improve the capacity of protected area management to conserve biodiversity, to involve local people in protected area planning and protection, to develop incentives for conservation and to support sustainable alternatives to harmful use of resources. Ecodevelopment aims at improving both biodiversity management as well as the living conditions of the local people.

It should be noted that ecodevelopment activities differ little from the type of ordinary village development such as; providing the local people with the infrastructure for drinking water supplies, roads, schools and dispensaries. Besides of these, ecodevelopment deals with education and public awareness programmes that aims at changing peoples' attitudes and provide the opportunities for the empowerment of the local people to participate in development and sustainable conservation of biological resources. Changes in people attitude and their empowerment can be achieved through the following;

- First, development of appropriate agricultural technologies and facilities to increase the productivity of land through increasing yield per unit area. This will result into the development of an intensive agriculture that decreases the demand for land, increase household income and enhance the growth of biodiversity on the farmland.
- Secondly, there is a need to increase collaboration with local extension staff in the field of agriculture, livestock and community development. This kind of collaboration will promote multidisciplinary approach in overall decision making process. Collaboration may be enhanced through running participatory workshops with the aim of re-orienting extension workers towards their new role of integrating their field and professional experiences for sustainable conservation and development.
- Thirdly, there is a need to stimulate self-development and build-up the self-confidence among women. These include carrying out a thorough assessment of women's needs, paying attention to the opinion of women and incorporation of women in planning, decision making, implementation, monitoring and evaluation of various conservation programs. Women should also be provided with opportunities to participate in workshops and study visits to enhance their capacity as potential resource managers.
- Lastly, the value of biological resources to rural community is often overlooked in national policy. Rural people can be (and often are) allies not adversaries in the sustainable management of biological resources. Government agencies and NGOs will need to invest heavily in working with

local organizations to educate and train residents and their local leaders to be effective managers of biodiversity and how to use it for both social and economic development.

## CHAPTER FIVE

### 5.0 CONCLUSION AND RECOMMENDATIONS

#### 5.1 Conclusion

The study demonstrated that local people could work and provide the means for sustainable management and conservation of biological resources. This is clearly demonstrated by the fact that they have been living with the resources and consequently developed various traditional management systems manifested through organizations, institutions and practices.

However, these traditional management systems have been undermined at one point in time as a result of exogenous and endogenous factors. Changes in the management structure and implementation of government policies such as Villagelization and SAPs brought negative consequences not only to the traditional management systems but also to the resource base.

Given the potential for development of biodiversity management strategies, local people can be easily incorporated in joint management efforts. Joint formation of management rules, participation in tree planting and formation of various local organizations as shown in this study provide the evidence that conservation in partnership with local communities can yield good results.

Traditional institutions such as *Bokela* and traditional healing practices as discussed in this study provide a framework of ideas, guiding principles and institutional foundations that can serve as entry points in the search for more participatory management approach in natural resource management. Although traditional institutions suffered and continue to suffer from erosion, this does not necessarily render them outdated; far from being anachronisms in today's world, traditional institutions have much to offer to contemporary policy makers searching for bottom-up approaches to resource management. However, the increasing decline of the capacity of the state to give necessary support to local institutions puts the purported local institutions in the state of reduced legitimacy. The fact that local institutions can either lie dormant or reformulate or reconstitute as observed in the case of *Bokela* in this study, make local institutions capable of either living behind or beyond their designed frames.

Participation of women in tree planting and their role as tree managers as illustrated in this study provides the evidence that many differences between women and men are socially constructed and can be changed. Given more opportunities to training workshops and study visits, women can have powerful incentive to protect and manage natural resources better than men. The study further demonstrates the need for more participation of various stakeholders in order to bring about a collaborative network which addresses a broader perspective of rural conditions. The sustainable conservation model proposed in this study emphasizes the need for a realistic interaction between the "farmers", "extension agents", "UMNP" and "NGOs".

## **5.2 Recommendations**

### **5.2.1 Strengthening of Agroforestry Program**

The current agroforestry program is thought to increase biodiversity outside the protected area and to enable local people to obtain tree related products that could otherwise be obtained from the UMNP. The program has the following weaknesses, first, the program is stressing planting of exotic species with very few incorporation of indigenous species; secondly, the entire philosophy of agroforestry is not covered since there are very few households involved in livestock production which is an important component in agroforestry, and lastly, seedlings are given free of charge and this may jeopardize long term sustainability of the whole program. The following are thus recommended;

#### **5.2.1.1 Joint Ownership of Tree Nurseries**

It is recommended that the WWF/TANAPA owned tree nurseries should be jointly owned by both the village governments and the park authorities. Joint ownership of the tree nurseries will, first; encourage community participation in tree establishment and thus reduce unnecessary running costs; secondly, it is possible that joint management will provide opportunity to apply indigenous propagation practices and hence higher chances for indigenous tree species to be incorporated. This will enhance the use of locally available seeds and thus reduce the financial burden of purchasing exotic seeds; lastly, joint ownership will as well provide the means for long term

sustainability since local people will have the capacity to manage the nurseries even after donor's pullout.

#### **5.2.1.2 Establishment of Jointly Owned Agroforestry Demonstration Plots**

Since the aim is to establish an effective agroforestry program, it is recommended that a demonstration plots be established along with the existing nurseries. The demonstration plots will be used as a field laboratory for farmers to learn different agroforestry systems. The demonstration plots should include at least a livestock component so that farmers could be sensitized on livestock production currently lacking in the majority of the farms in the study area.

#### **5.2.1.3 Emphasis on Education and Extension**

There is a need to put more emphasis on education and extension through organization of open days and demonstrations to provide opportunities for farmers to learn about the agroforestry models. Education and extension should be done in close collaboration with the village extension agents, village executive secretaries, and other key stakeholders.

#### **5.2.2 More Research on Traditional Medicines**

It appears from this study that traditional healing depends to a larger extent on plant materials taken from the UMNP. Most of these plant materials may be typical of more or less disturbed forest ecosystems. Little is known of the type and long term

sustainability of the medicinal plants in the UMNP. There is a need to carry out an inventory coupled with proper taxonomic identification and distribution of various medicinal plants in the UMNP. This will add knowledge and input towards more sustainable conservation strategies. This will also help to establish some rare or threatened medicinal plants and thus plan for their effective conservation.

### **5.2.3 Ecological Monitoring and Evaluation**

UMNP is still relatively new and there is scattered information over the potential biological resources. Currently ecological monitoring and evaluation is not sufficiently done and thus there is no clear data on the occurrence, distribution, and richness of biodiversity in UMNP. There is a need to carry out baseline studies over the ecological and biodiversity potential of UMNP and thereafter carry routine ecological monitoring and evaluation.

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APPENDICES

Appendix 1: HOUSEHOLD QUESTIONNAIRE

Village-----  
 Date-----  
 Enumerator-----  
 Household Identification Number-----

I. HOUSEHOLD DATA

- 1.1 Name of the household head-----
- 1.2 Gender            1. Male     -----  
                           2. Female  -----
- 1.3 Marital Status   1. Single   -----  
                           2. Married  -----  
                           3. Divorced -----  
                           4. Widowed  -----
- 1.4 Age of the Household Head -----Years.
- 1.5 Household Composition.

Age	Male	Female
< 18 Years		
18-55 Years		
> 55 Years		

- 1.6 Major Sources of Income
  - 1. Farming -----
  - 2. Small business
  - 3. Both
- 1.7 Estimated annual Income-----
- 1.8 Residence Duration in the village-----Years
- 1.9 Level of Education
  - 1. No formal education-----
  - 2. Adult education-----
  - 3. Primary education-----
  - 4. Secondary-----
  - 5. Others (Specify)-----

2. LAND USE SYSTEMS

- 2.1 How is land ownership?
  - 1. Communal-----
  - 2. Private-----
  - 3. Others (Specify)-----
- 2.2 Do you plant/retrain tree in your own land?
  - 1. Yes-----
  - 2. No-----
- 2.2.1 If yes how many per year, what uses and which spp?

Species	Number	Uses

- 2.2.2 Where do you get seedlings from (specify)?

1. Tanzania National Park nurseries-----
2. Own farm-----
3. Both-----

2.2.3 Where do you plant your trees?

1. Home gardens.....
2. On farm.....
3. Others (specify).....

2.2.4 What are the reasons for planting trees?

1. Park will be closed.....
2. To get trees products.....
3. Demarcation of farms boundaries.....

2.2.5 If you don't plant, what is the reason?

1. No seedlings -----
2. No need -----
3. No land to plant -----
4. Seedlings are expensive-----
5. Others (specify)-----

2.2.6 Who participate in tree planting?

1. Male -----
2. Female -----
3. Both -----

2.2.7 Who participate in: (a). Tree planting

1. Male-----
2. Female-----

(b) Tree tending

1. Male-----
2. female-----

3. Forest Reserve Utilization

3.1 What forest products do you know and where do you get them?

Product	Uses	source

3.2 Do you get into the forest reserve to collect forest products?

1. Yes -----
2. No -----

3.2.1 If yes, how do you get access to the forest reserve?

1. Free -----
2. Permission -----
3. Fee. -----

3.3 What is the main fuel energy do you use?

1. Firewood -----
2. Charcoal -----
3. Kerosene -----

3.4 What is the distance to the forest Reserve-----

3.5 Who is responsible for forest product collection?

Product	Person responsible
1	Male ----- Female -----
2.	Male ----- Female-----

3.6. Are there any ritual sites in the forest reserve?

1. Yes-----
2. No-----

If yes how do you get access to that?

1. Permission---
2. Free-----
3. Illegally-----

3.7 What main activities are done on the ritual sites?

4.0 MANAGEMENT AND LOCAL PEOPLES PERCEPTIONS ON MANAGEMENT

4.1 Who own the forest Reserve?

1. Central Government-----
2. Village
3. Tanzania National Park-----
4. Others (specify)-----

4.2 Do you know the boundaries of the reserve?

1. Yes -----
2. No -----

4.3 If yes are they respected?

1. Yes -----
2. No -----

4.4 List all the rules that you know regarding protection of the Udzungwa Forest Reserve

Government Rules	Traditional Rules	Village Government Rules

4.4.1 What happens to a person if he/she break the rules?

1. Government rules -----
2. Traditional rules -----
3. Village Government rules-----

4.5 Are there any indigenous practices, which have been used in managing and protecting the forest reserve?

1. Yes -----
2. No -----

4.5.1 If yes what are they and what role are they playing in managing the Udzungwa forest reserve? ----

4.6 Are there any indigenous practices, which existed in the past and are no longer practised today?

1. Yes-----
2. No -----

4.6.1 If yes what were they and what roles did they play in conserving the udzungwa forest reserve? ----

4.6.2. In your opinion what are the reason for those practices to disappear? -----

4.7 Do you know any case of encroachment to the forest reserve?

1. Yes -----
2. No -----

4.7.1 If yes mention reasons for encroachment

1. Boundaries not known -----
2. Poor fertility outside the forest reserve ----
3. Land scarcity -----
4. Others (specify) -----

4.8 Do you know any cases of fire outbreak in the reserve?

- 1. Yes-----
- 2. No-----

4.8.1 If yes what are the reason of fire in the forest reserves?

-----

4.8 Are there any trees/animal spp which are traditionally protected?

- 1. Yes-----
- 2. No-----

4.8.1 If yes, list them and reason for protection

Tree/Animal spp	Reason

4.8.2 What happen to a person who remove them illegally?

-----

4.9 Are people being involved in the management of Udzungwa forest reserve?

- 1. Yes -----
- 2. No -----

4.9.1 If yes how

-----

4.9.2 If no do you think the government/project/organisations should involve local people in managing the forest reserve?

- 1. Yes-----
- 2. No-----

4.10. Do you have Further comments on how can the forest reserve be best managed?

-----

5. LOCAL INSTITUTIONS AND THEIR ROLE IN FOREST RESERVE MANAGEMENT

5.1 Are there any local institutions in this village?

- 1. Yes-----
- 2. No-----

5.1.1 If yes what are they and what are their functions?

-----

5.1.2 If yes is forest management one of their functions?

- 1. Yes-----
- 2. No-----

5.1.3 If yes how is forest management achieved through the local institutions?

-----

5.2 Are there local institutions which used to exist in the past and which now are none existent?

- 1. Yes-----
- 2. No-----

1 If yes what are they and what role did they play in Udzungwa forest Management?

-----

In your opinion what made/caused the institutions above to vanish?

-----

5.3 Do you think there is a need to legitimise or empower the local institutions?

- 1. Yes-----
- 2. No-----

5.3.1 If yes what do you think should be done?-----

5.4 Is there any cultural value that the natural forests offers (or offered)

- 1. Yes -----
- 2. No -----

5.4.1 If yes what are they?

- 1. Sacred groves -----
- 2. Traditional rituals -----
- 3. Initiation of teenagers -----
- 4. Others (specify) -----

5.5 Are there any organisations involved in conserving Udzungwa forest reserve?

- 1. Yes -----
- 2. No -----

5.5.1 If yes describe briefly the type of organisation, who initiated it, when, and what was done-----

Is there any conflicts between the management of these organisations and those by the local institutions

- 1. Conflict-----
- 2. No conflicts-----

5.6 Are there interest that these externally sponsored institutions overlook and which you feel the local institutions would take care of them?

- 1. Yes -----
- 2. No -----

5.6.1 If yes what are they? -----

5.7 Do you think the local institutions can work hand in hand with the professional forest institutions?

- 1. Yes -----
- 2. No -----

5.7.1 If yes suggest how can this be achieved-----

## 6 BIODIVERSITY STATUS

6.1 Please list any plant/animal species that were harvested from this forest approximately 5 years ago that are no longer available and list the reason for their disappearance.

Name of Species		Reason for disappearance
Local name	Botanical name	

6.2 Please list any plant/animal species that were harvested from this forest approximately 10 years ago that are no longer available and list the reason for their disappearance.

Name of Species		Reason for disappearance
Local name	Botanical name	

6.3 Please list any plant/animal species that were harvested from this forest approximately 15 years ago that are no longer available and list the reason for their disappearance.

Name of Species		Reason for disappearance
Local name	Botanical name	

**Appendix 2:**

**CHECKLIST FOR KEY INFORMANTS**

**PARK OFFICIALS**

Main activities

Management objectives

Management problems and underlying causes

Strategies to improve management

Management rules and regulations

How and how frequent are local people allowed into the forest reserve

What products are allowed and how sustainable is the exercise

**VILLAGE LEADERS**

Awareness to the importance of the Udzungwa forest reserve

Village strategies in conserving Udzungwa forest reserve

Tree planting

Enforcement of rules and regulations

Existing local institutions

How are village conservation activities tied with external interventions

Socio-economic factors constraining or favouring sustainable conservation of the forest reserve

**FOREST OFFICIALS**

Foresters appraisal of the overall conditions of the forest

General responsibilities

Constraints and opportunities

Suggestions on community participation

Appendix 3:

Seedling survivorship for trees planted up to June 1997/1998.

SPE  
Q477  
T34  
M8



Species	Mwapa		Mudwa		Kidatu		Sange		Kisumu		Kiberege		Mbatia		Average	
	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S
<i>Neem sumera</i>	1423	76.8	641.1	90.9	433	80.7	3307	86.2	181.4	82.5	1290	92.4	7037	73.0		88.9
<i>Casearia indica</i>	1522	57.0	1715	86.2	1130	71.0	406	87.9	678	79.1	430	93.3	1784	76.9		76.3
<i>Castanea grandis</i>	513	61.2	1558	85.0	1394	68.7	828	71.1	1430	86.7	3795	83.2				79.7
<i>Albizia lebbek</i>	195	71.4	906	81.9	366	80.8	715	86.7	340	78.8	308	78.6	300	86.7		81.9
<i>Khaya gambeyi</i>	226	93.4	725	74.5	676	78.6	71	94.4	369	86.7	398	78.6	301	83.7		80.8
<i>Acacia mangium</i>	857	51.8	909	84.4	530	57.1			445	78.4	438	93.4	210	91.9		75.6
<i>Acacia mangium, nsa</i>	106	27.4	562	77.9	20	80.0	45	66.7	54	92.6	140	96.4				75.3
<i>Bodonia wrightii</i>	74	83.8							15	86.7	102	96.1				90.6
<i>Podium acuta</i>	58	96.6	10	60.0	80	70.0	115	80.0	5	80.0	525	82.8	420	85.0		82.9
<i>Casearia rostrata</i>	158	92.4	45	88.4	17	88.2							25	96.0		91.8
<i>Acacia mangium</i>	199	40.2	100	70.0	276	61.4	4025	95.5	340	85.3	635	86.1	1557	81.8		88.1
<i>Acacia mangium</i>	17	88.2							40	87.5						87.7
<i>Podium acutula</i>	70	40.0	190	78.9			115	86.1			241	42.3	1200	59.1		59.9
<i>Podium acutula</i>	453	79.5	597	74.7	232	84.5			1400	94.3	339	82.6				86.1
<i>Podium acutula</i>	4	100							3	66.3	89	89.9				89.6
<i>Podium acutula</i>	54	81.5	41	75.6	12	91.7	24	75.0	757	93.8	39	82.8	10	80.0		91.3
<i>Podium acutula</i>	3498	84.1			110	63.6	400	47.3	2496	78.1	1225	99.0				82.5
<i>Podium acutula</i>	6	83.3							32	75.0	8	75.0				76.1
<i>Podium acutula</i>									45	95.6	32	75.0				87.0
<i>Podium acutula</i>			617	87.7					2301	87.9						84.7
<i>Podium acutula</i>	480	54.2	562	77.9	251	57.4			115	77.4	94	77.7	150	36.0		65.7
<i>Podium acutula</i>	54	68.5							33	78.8	36	77.8				73.5
<i>Podium acutula</i>			55	61.8	36	38.5			24	66.7						69.7
<i>Podium acutula</i>	2	100	4	75.0					6	66.7						90.0
<i>Podium acutula</i>	70	58.6	645	94.6	199	86.9					80	87.5				89.9
<b>Total</b>	10039	71.7	16545	85.9	8572	75.4			11041	83.8	9921	86.5	12996	74.2		82.8

Key  
P Number of seedling planted  
S Sum total seedlings (%)