EFFECTS OF INSTITUTIONAL CHANGES ON FOREST CONDITION: A CASE OF CHENENE FOREST RESERVE IN BAHI DISTRICT, TANZANIA

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A THESIS SUBMITTED IN FULFILMENTS OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN FORESTRY OF THE SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

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ABSTRACT

This study assessed the effects of institutional changes on forest condition, stakeholders' interests, the performance of local institutions and factors influencing the performance of local governance structures, using a case study of Chenene Forest Reserve (CFR) in Bahi, Tanzania. Data were collected through forest inventory using 120 systematically selected sample plots. Satellite images were collected and analysed using Remote Sensing and Geographical Information System techniques. Participatory Rural Appraisal (PRA), focus group discussions (FGD), key informants and questionnaire survey were used to collect data on socio-economic factors. Quantitative data on forest condition and forest governance were subjected to descriptive and inferential statistical analysis, while qualitative data were analysed using content analysis. Logistic regression model was developed to analyze factors influencing performance of local governance structures. Nine areas of conflicting interests that occurred among stakeholders were identified which were routed in institutional and socio-economic perspectives. The study showed that the performance of Village Environmental Committees (VECs) in governing forest resources had improved. The inventory carried out in 2011 revealed that, an average number of stems per hectare (N), basal area per hectare G (m^2ha^{-1}) and volume V (m^3ha^{-1}) were 199, 1.71 and 6.46 respectively. The low parameters in wood-stock were due to massive exploitation and other human disturbances in the past. The tree diversity of 4.0 was recorded which was in line with other past studies on dry miombo woodlands. Results on forest cover changes revealed that, the forest condition had improved by 2 576 ha at the rate of 0.50% after decentralization of CFR. Socio-economic factor that significantly influenced most of the performance of local governance was found to be education level. The study concludes that, institutional change reforms on forest management are one of the best options in improving forest condition and forest governance. The study

recommends that, monitoring studies are needed in order to have comprehensive understanding on implications of institutional changes on forest resource condition and forest governance.

DECLARATION

I, Juvenal Boniface Nkonoki, do hereby declare to the Senate of Sokoine University of Agriculture, that this thesis is my own original work and that it has neither been submitted nor concurrently being submitted in any other institution.

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DEDICATION

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LIST OF ABBREVIATIONS AND SYMBOLS

BKGs	Beekeeping Groups
BDC	Bahi District Council
AD	After Decentralization
BD	Before Decentralization
CBFM	Community Based Forest Management
CBOs	Community Based Organizations
CFR	Chenene Forest Reserve
CG	Central Government
CNRM	Conservation and Natural Resources Management
CPRM	Common Pool Resource Management
CPRs	Common Pool Resources
DBH	Diameter at breast height
DC	District Commissioner
DAS	District Administrative Secretary
DFO	District Forest Officer
DNRO	District Natural Resources Officer
DED	District Executive Director
DFID	Department for International Development
DN	Digital Number
DONET	Dodoma Environmental Network
EIA	Environmental Impact Assessment
ESAP	Economic and Social Action Programme
FAO	Food and Agriculture Organization of the United Nations
FBD	Forestry and Beekeeping Division
FBOs	Faith Based Organizations

FDGs	Focus Group Discussions
FUGs	Forest User Groups
G	Basal Area per hectare
GPS	Geographical Positioning System
GCP	Ground Control Point
H’	Shannon Werner Index of Diversity
Ha	Hectare
IFM	International Monetary Fund
IP	Institutional Performance
IVI	Importance Value Index
JFM	Joint Forest Management
JKT	Jeshi la Kujenga Taifa
Km^2	Square kilometre
LG	Local Government
LGRA	Local Government Reform Agenda
MoU	Memorandum of Understanding
MDGs	Millennium Development Goals
MGESADO	Miradi ya Gesi ya Samadi Dodoma
MLC	Maximum Likelihood Classifier
MNRT	Ministry of Natural Resources and Tourism
MRALG	Ministry of Regional Administration and Local Government
N	Number of Stems per Hectare
NDVI	Normalized Difference Vegetation Index
NEMC	National Environment Management Council
NESP	National Economic Survival Programme
NFP	National Forest Policy

NDVI	Normalized Difference Vegetation
NGOs	Non-Governmental Organizations
NP	National Park
NS	Not Significant
NWFPs	Non Wood Forest Products
PFM	Participatory Forest Management
PRA	Participatory Rural Appraisal
PRSP	Poverty Reduction Strategy Programme
RD	Relative Density
RDOM	Relative Dominance
RF	Relative Frequency
SACCOS	Savings and Credit Cooperative Society
SAP	Structural Adjustment Programme
SE	Standard Error
Spp	Species
SPSS	Statistical Package for Social Sciences
TAFORI	Tanzania Forestry Research Institute
TANAPA	Tanzania National Parks
TBPAs	Trans Boundary Protected Areas
TEV	Total Economic Value
THGs	Traditional Healers Groups
TM	Thematic Mapper
TFS	Tanzania Forest Service
UNESCAP	United Nations Economic and Social Commission for Asia and Pacific
URT	United Republic of Tanzania

V	Volume
VBRs	Village Bee Reserves
WCDCs	Ward Conservation Development Committees
VECs	Village Environmental Committees
VEOs	Village Executive Officers
VFRs	Village Forest Reserves
VGs	Village Governments
WB	World Bank
WEOs	Ward Executive Officers
WRI	World Resources Institute
WMA	Wildlife Management Area
WWF	World Wide Fund for Nature

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Tanzania's forests and woodlands, cover about 33.4 million hectares (ha), which is about 38% of the total land area of 88.6 million ha (FAO, 2010). These forests and woodlands support the livelihoods of 87% of the poor populations who live in rural areas (CIFOR, 2004). Of the total forest area, about 13 million hectares cover reserved land in which there are 621 forest reserves and village land forest reserves, of varying size from 3.0 to 580,000 ha (MNRT, 2005a). Forest reserves are managed for protection, production or both and they may be under the jurisdiction of central government, local government, community and private (URT, 1998a).

Management of forest resources in Tanzania has gone through successive changes from colonial era to the present. These changes have altered the institutional structures that were responsible for the management of the resources. During the colonial era (both German 1886 - 1918 and British 1918 -1961), the property rights and power structures/ relations of the local communities were interfered, land alienation was done, while customary land ownership was transferred to the crown (The Governor). This transformation was done through the enactment of the land tenure ordinance number 3 of 1923 (commonly known as Land Ordinance Cap 113) (Bagachwa *et al.,* 1995). After independence, most of the colonial policies related to management of forest resources were inherited by the sovereign government. The most important radical change took place in the 1970s, when the implementation of Ujamaa policy started, reinforcing state control over the natural resources.

The local institutions, which were responsible for the management of these resources were further marginalized (Bagachwa *et al.,* 1995). Since then, there has been continuous socio-cultural, economic, macro and sectoral policy reforms that have influenced considerably the institutional arrangements, for management of forest resources. In the 1980s, Tanzania aiming at improving its economy, introduced market oriented economic reforms which brought in several macro and sectoral policy changes (Erickson, 1993). The reforms which include National Economic Survival Programme (NESP) (1981- 82); Structural Adjustment Programmes (SAP) (1982 – 1985); Economic and Social Action Programme (ESAP) (1989 – 92) stimulated further changes in local people's economy, market situation, ideology and livelihood strategies. The institutional set up of traditional communities radically changed whereby private buyers and the market in general, exercised more influence which further led to individualism and consumerism behaviour. A sense of responsibility and ownership of natural resources, continued to deteriorate as the government continued to have central powers in the management of resources (Manor, 1999).

In general, state control on management of natural resources failed (Bagachwa *et al.,* 1995) leaving an institutional vacuum. In response to this failure, decentralization and privatization policies were adopted to pave the way for local governments to participate in managing natural resources (URT, 1998a; 1998b). Decentralization can be either horizontal or vertical. The former disperses power among institutions at the same level, while the latter allows selective administrative functions to lower tiers of authority. Chenene Forest Reserve (CFR) falls under vertical decentralization, where central government is not giving up all authority (Manor, 1999). This study has focused on forest management under different institutional changes and their implications on the forest condition.

1.2 Decentralization of Forest Resource Management

Decentralization denotes transfer of power, authority and responsibility for decision making, planning, management or resource allocation from the central government to its field units, local government, regional or functional authorities, semi-autonomous public authorities, parastatal organizations, private entities and non-governmental, private or voluntary organizations (Rondinelli and Cheema, 1983). More often, decentralization refers to the formal devolution of power to local decision makers. Sheona *et al*. (2002) argued that, the last two decades have witnessed a paradigm shift in conservation and natural resource management (CNRM) away from costly state- centred control, towards approaches in which local people play a much more active role.

These reforms purportedly, aim to increase resource user participation in CNRM decisions and benefits by restructuring the power relations between central state and communities, through the transfer of management authority to local level organizations. In Tanzania, forests have historically been managed centrally through Forest and Beekeeping Division (FBD), under the Ministry of Natural Resources and Tourism (MNRT).

This type of management is characterized by extensive state control without involvement of local communities. The system has interfered too much on the local scene and undermined the traditional institutions, hence, prevented them from playing their role in regulating resource use (Maganga, 1993). The main problem with centrally managed forests was that, resources were thinly spread to the extent that their management was difficult. This kind of forest management resulted into forest degradation and deforestation through illegal activities and increased human pressure (MNRT, 1998; Wily and Dewees, 2001). Currently, the forest sub sector in Tanzania administratively operates under three parallel structures, Forestry and Beekeeping Division under the Ministry of

Natural Resources and Tourism, Tanzania Forest Services Agency (TFS), the Regional Secretariat which is foreseer of all natural resources in the region, and Local Government Authority which predominantly owns and manages the local government forest reserves (MNRT, 1998).

1.3 Natural Resource Governance in Tanzania

Under the colonial administration, European settlers were allocated fertile land for crop production and were given title deeds to own land while the customary laws were also respected for native areas (Manor, 1999). Apart from land, the colonial governments embarked on other natural resources several of which were declared as protected and gazetted areas including game reserves, national parks and forest reserves (URT, 1998a). The colonial government also exploited such resources commercially as game for trophy and logging for export (Othmann, 2005). This was opposite to the traditional resource management where resources were exploited mainly for subsistence purposes.

The institution set up of the traditional communities radically, changed whereby private buyers and market in general exercised more influence which further led to individualism and consumerism behaviour (Mbeyale, 2009). A sense of responsibility and ownership of natural resources, continued to deteriorate as the government continued to have central powers in management of natural resources. In general, the state control over natural resource failed Mbeyale (2009) leaving an institutional vacuum, a situation which led into an open access situation. In response to this failure, decentralization and privatization policies were adopted to pave the way for local people to participate in managing natural resources (Wily, 2001; Mbeyale, 2009). Of recent, we have been witnessing decentralization in the management of natural resources, where power is supposed to be devolved to the local communities and private individuals, as a solution to institutional

failure to control access to the resources. Agrawal (2001) asserts that, considerable variations mark the experience of CPR users in different parts of the world. This calls for the designing of property rights systems and new governance structures that fulfil the goal of sustainability, equity and efficiency in the management of natural resources in specific context.

1.4 Bahi District and Management of CFR

The objective of decentralization for the management of CFR was to protect the forest ecosystem, maintain biodiversity and natural processes. CFR is under the Ministry of Natural Resources and Tourism. CFR is governed by National Forest Policy (1998a). Forest Act No 14 (URT, 2002). Decentralization took place in 1992 whereby Bahi District Council (BDC) was vested to manage the forest. BDC and villages surrounding the forest reserve signed a Memorandum of Understanding (MoU). The MoU stipulated the rules and responsibility of each party together with mechanism of benefit sharing. This is in line with Barkes (2009) who urged that, co-management is the management arrangement which involve sharing power and responsibilities among actors for effective management of resources, in order to facilitate local governance structures in implementation, management and decision making, BDC established Ward Conservation Development Committees (WCDCs) and Village Environmental Committees (VECs) (Appendix 1).

1.5 Problem Statement and Justification of the Study

1.5.1 Problem statement

There are 234 productive forest reserves in Tanzania CFR being one of them (Holmes, 1995). However, there is no assessment of forest condition conducted in CFR and hence its status in terms of forest management, forest cover, wood-stock and tree diversity are not known. Secondly, CFR is facing a high demand for fuelwood, charcoal making, pit

sawing and pole harvesting by people living adjacent and outside leading to unsustainable utilization of forest resources. Lastly, CFR is owned by the central government but its management was devolved to Bahi District Council in 1992. Being a production forest reserve, the central government collects revenues from the forest while allocating minimal or no funds for various silvicultural operations and law enforcement. This situation leads to contested mandates in terms of duty bearing and user rights among stakeholders, namely central government, local authority and local communities. Therefore, it is crucial to study the effect of institutional change on forest condition at CFR under changing institutional arrangements.

1.5.2 Justification of study

CFR is among the most important miombo woodlands in semi-arid areas of Tanzania covering 29 800 ha (URT, 2009). Assessment of CFR would help sound management of dry miombo woodland in semi-arid areas of Tanzania. The results from the study could be used elsewhere in Tanzania and beyond to resolve ambiguities of decentralization by devolution of power.

1.6 Objectives of the Study

1.6.1 Overall objective

The overall objective of this study was to assess the effects of institutional changes on forest condition in Chenene Forest Reserve.

1.6.2 Specific objectives

The specific objectives of the study were to:

(i) Assess formal and informal institutions, involved in the management of CFR from colonial and post-independence era

(ii) Assess the effects of institutional changes on forest governance in the study area

(iii) Assess conflicting interests and power relations of key stakeholders, involved in forest resources utilization and management of CFR.

(iv) Assess effects of institutional changes on forest cover, wood stock and tree diversity in CFR.

(v) Analyze socio-economic factors that influence the performance of local institutions.

1.7 Research Questions

(i) What and how formal and informal institutions affected management of CFR?

(ii) How were forest governance changed after institutional changes in the management of CFR?

(iii) What were the interests and power relations of key stakeholders involved, in forest resources utilization and management CFR?

(iv) How institutional changes and resulting power relations contributed to forest cover changes, wood stock and tree diversity?

(v) How socio-economic factors influenced the performance of the local governance structures?

1.8 Conceptual Framework

The conceptual framework (Fig. 1) focuses more on institutional changes and power relations in the management of CFR. The way the community, local government and central government interact to modify and change rules of the game (institutions). The framework, was developed to help to understand how institutional change can influence change in the management of natural resources, how they positively or negatively influence conditions of forest resources. The conceptual framework (Fig. 1), is based on

the notion that forest resources are introduced to new rules, new norms, regulations, technologies, new actors and power relations which contest and merge or mix with local institutions. In order to address the challenges, the forest users develop strategies to negotiate, transform or negotiate the new institutions.

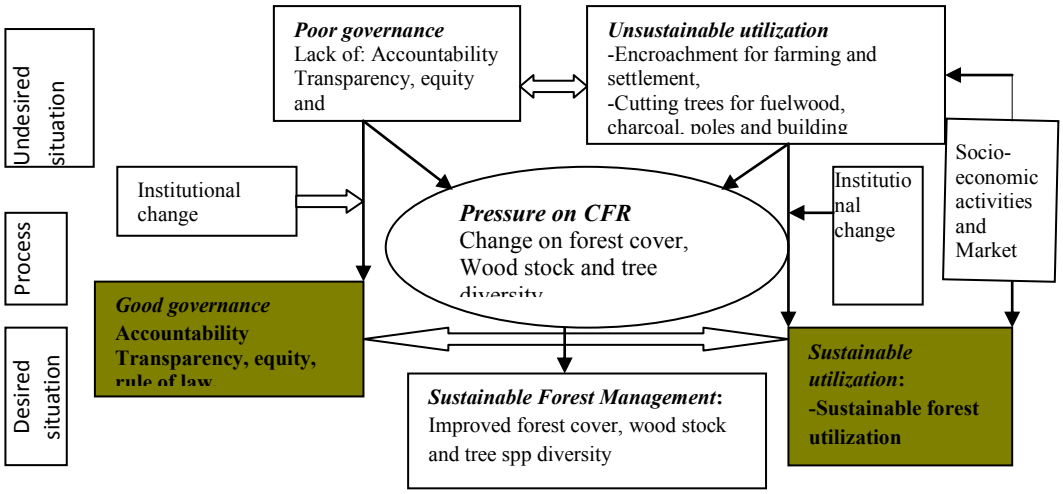

Figure 1: Conceptual framework underlying the study

Different forest resources may undergo different management developments, which provide the forest users, and forest owners with different claims over the resource use, create different power relations among users, leading to either poor forest governance or good governance in terms of transparency, accountability, equity and rule of law. Under such situation, the management of forest resources may be sustainable or unsustainable.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Importance of Forest Resources

Forests cover one third of the earth's surface and support most of the world's biodiversity and it is estimated that, half of the world's species are found in forested areas. Forests play an important economic role in African countries. They provides a range of ecological, economic and social services to human beings, including replenishing oxygen in the atmosphere, reducing soil erosion, saving as a carbon sink, habitats for wild animals, climate improvement, protection of species and genetic diversity, recreation, cultural and religious values, watershed, environmental amelioration, recreational and aesthetic values (Nair, 2007).

In addition, forests are one of the world's most important renewable natural resources; supply wood products for fuel, building materials, paper production as well as non-timber forest products including fruits, rubber and coffee (Subedi, 2006 cited by Lund and Treue (2008). FAO (1997) reported that, most of the wood harvested within African forests and woodlands is used to meet local energy needs, including fire wood and charcoal. The World Bank (2002) reported that, 90 percent of the World's 1.1 billion poor people, living on less than one dollar per day depend on forests, for at least some part of their income. Forest Reserves in Tanzania provide a number of economic values to the local people and the national economy. Some of the forest values however, are difficult to express in monetary terms. As pointed out by Emelton (1996), the total economic value (TEV) indirect and optimal. Non- use values include the existence values that are intrinsic values of a forest such as cultural, heritage, bequest, and aesthetic values.

Like other Forest Reserves in Tanzania, Chenene Forest Reserve provides various functions beneficial to people. These are among others, water conservation/watershed management (storage of water, regulating flow), control soil erosion and serving as gene pool (Pócs, 1974; Pócs; 1988; Nsolomo and Chamshama, 1988).

2.2 Natural Resource Governance Structures

Governance, is a concept used when discussing the achievement of various development goals such as poverty reduction, improvement of health and education services, or natural resource management (Human Development Report, 2002 cited by Lutz and Linder, 2004). Development efforts, have failed when resources were not used in an efficient and responsive manner.

According to UNESCAP (2007), the concept of governance is as old as human civilization, and it simply means the process of decision-making and the process by which, decisions are implemented or not implemented. Governance of natural resources can be understood as the interactions among structures, processes and traditions that determine how power and responsibilities are exercised, how decisions are taken, and how citizens or other stakeholders have their say, in the management of natural resources including biodiversity conservation (Kajembe, 2006).

Since governance refers to the process of decision-making and the process by which decisions are implemented, an analysis of governance focuses on the formal and informal actors, involved in decision-making and implementing the decisions made and the formal and informal structures, that have been set in place to arrive at and implement the decisions.

There are various actors in governance, depending on the level of governance that is under discussion. At the local setting, actors may include influential land lords, associations of peasant farmers, cooperatives, NGOs, research institutes, religious leaders, financial institutions, political parties, and the military. At the national level, in addition to the above actors, media, lobbyists, international donors and multinational corporations, may play a role in decision- making or influencing the decision making process.

Natural resource governance and ownership have to be looked upon in order to enhance local people's benefits from the resources. According to Bell (1987), local communities who are shouldering most of the costs, derive relatively a few benefits implying that, there is uneven distribution of conservation costs and benefits between local communities and the national authority. National level governments, fail to fulfil the needs and concerns of local communities and forest dependants' people, in favour of interests of the powerful. In recent years, in Tanzania, the government has been responding to demand for a greater equity in distribution of forest resources through practicing good governance and to readdress failures of traditional forestry approaches, to achieve sustainable development objectives (Wily and Mbaya, 2001).

2.3 Good Governance

Natural resources' good governance is surely about getting governance right, but since the right way is largely shaped by cultural norms and values of each particular society or organization, universal templates for good governance have limited credibility. United Nations has suggested that, some universal norms and values do apply and has published a list of characteristics of good governance (UNESCAP, 2007).

Good governance has 8 major characteristics. These include participatory, accountability, transparency, responsiveness, efficiency, equity, and inclusiveness and rule of law. It assures corruption is minimized, the views of minorities are taken into account and that, the voices of the most vulnerable in the society are heard in decision-making. It also responsive to the present and future needs of the society (Kaufmann and Bellver, 2007). These characteristics are explained below:

2.3.1 Accountability

Accountability is a key requirement in good governance, not only governmental institutions but also the private sector and civil society organizations, must be accountable to the public and their institutional stakeholders. Who is accountable to whom, varies depending on whether decisions or actions taken are internal or external to an organization or institution. In general, an organization or an institution is accountable to those who are affected by its decisions or actions. Accountability cannot be enforced without transparency (UNESCAP, 2007).

2.3.2 Rule of law

Good governance requires fair legal frameworks that are enforced impartially. It also requires a full protection of human rights, particularly the minorities. Impartial enforcement of laws requires an independent judiciary and an impartial and incorruptible Police Force (IUCN, 2004).

2.3.3 Transparency

Transparency means that, decisions taken and their enforcement are done in a manner that follows rules and regulations. It also means that, information is freely available and directly accessible to those who are affected by such decisions and their enforcement. It

also means that, enough information is provided and that it is provided in easily understandable forms and media (Lutz and Linder, 2004; Kaufman and Bellver, 2007).

2.3.4 Equity

A society's well-being depends on ensuring that all its members' feel that they have a stake in it and do not, feel excluded from the mainstream of society. This requires all groups, but particularly the most vulnerable, to have opportunities to improve or maintain their well-being (Wily and Mbaya, 2001).

2.4 Global Governance Structure

Global governance, refers to an intervention aiming at changes in environmental related behaviour of global actors (Lemos and Angwal, 2006 cited by Solòrzano, 2007). These interventions or governance mechanisms used by global actors may include policy requirement or policy inducement to recipient countries of financial aid and technical assistance. Likewise, global actors, particularly NGOs and corporations, through the diffusion of ideas and information, can foster different value systems that result in social awareness and public pressure for changes in policies and institutions. If successful, global actors influence social behaviour worldwide without having legal authority to do so.

Global governance is the political interaction of trans-national actors aiming at solving problems that affect more than one state or region, when there is no power of enforcing compliance. Global actors, such as donors and NGOs active worldwide and Intergovernmental organizations – United Nations or World Bank, are interested in the conservation of biodiversity given that it represents a global common heritage or at least a global common concern (Hunter *et al.,* 2002 cited by Solörzano, 2007). Beyond interest, these actors have the power to govern by steering social actions (Shahbaz *et al.,* 2007).

Global actors can influence decision making processes made by nation states as well as communities.

2.5 National Governance Structures

National governance refers to the governance mechanisms implemented within the Trans Boundary Protected Area (TBPA). These, are mainly associated with policies for Tran's boundary natural resources management, regulations for the use and allocation of property rights (Solórzano, 2007). These governance mechanisms can be implemented individually by each national state sharing the TBPA or jointly.

In a narrow sense, there are three main goals of governance, mostly pursued by governments on the state level (Solórzano, 2007); these are (1) to provide the population with physical security, (2) to guarantee the stable reproduction of their natural environment, and (3) to ensure their livelihood, i.e. the production and distribution of needed goods and services.

2.5.1 Local governance structures

Local governance refers to governance at local level. According to Lutz and Linder (2004), local governance, is defined as governance which contains a set of institutions, mechanisms and processes, through which citizens and their groups can articulate their interests, mediate their differences and exercise their rights and obligations at the local level. It requires partnership between local governmental institutions, civil society organizations and private sector for participatory, transparent, accountable and equitable service delivery and local development. It necessitates empowering local governments with authority and resources and building their capacity, to function as participatory institutions that are responsive and accountable to the concerns and needs of all citizens.

At the same time, it is concerned with strengthening of grass roots democracy and empowering citizens, communities and their organizations such as CBOs and NGOs, to participate as equal partners in local governance and local development process.

Successful local governance has been identified as an essential to meet the Millennium Development Goals (MDGs) outlined at the UN Millennium Summit in 2000, and the World Bank Poverty Reduction Strategy (PRSP) (World Bank, 2000; Lutz and Linder, 2004). This implies a stronger focus on decentralization, community empowerment and local governance in development work. Due to the growing interest and support for local development in recent years, many countries have passed legislations to decentralize governmental structures and this, has been supported by many international agencies. The way in which decentralized structures are organized and how decentralization policies are implemented, determines the resources available at local level and the functions of local governments.

It is clear that, successful decentralization is not just building good political institutions it is also an essential to improve overall governance at the local level. This include a meaningful participation of the local population and their inclusion into decision making processes to foster transparency, accountability and responsiveness, and to guarantee efficient and effective policy implementation. Meaningful inclusion of all relevant actors at the local level is a decisive for successful local development, to ensure that, different local power structures work with each other.

The shift in focus from the national to the local level makes a closer look at the social, political and economic dynamics in communities as more important. In developing countries the state is often weak, and the penetration of the state in rural areas has been

poor. Decentralization in these cases, is not only about shifting power and resources to the local level and making local authorities more effective. It is often the case that, the capacity for good local governance also has to be built in areas, where governmental activities in general have been very limited (Lutz and Linder, 2004). It is increasingly realized that, local governance system plays an important role in improving environment (King, 2005). However, at the local level, there is interplay between formal and informal governance structures which sometimes can lead to resource use conflicts.

2.5.2 Formal local governance structures

Formal local structures have been the dominant mode of governance. They are based on Western philosophy and are backed by written law, implying enforcement of rules by the state (Leach *et al.,* 1997). Formal local governance structures in this study, refers to the professional working rules that govern the sustainable management of particular area with respect to forestry. They encompass all the rules and regulations governing management and utilization of forest resources. Forestry Department provides capacity building to the local forest management committees, including training on record keeping and book keeping enhancing financial management by the committees. Example of formal local governance structures includes the village government and Village Environmental Committees.

2.5.3 Informal local governance structures

Informal governance structures are those governance structures that are not part of the written legal framework and include private mechanisms. These governance structures can be defined as social norms, customs, attitudes and beliefs that define a way of life within a given area. These include religion, ideas about right and wrong, and rules of enforcement. In order to qualify as governance structures, these measures need to be persistent over

time and show depth and durability (Glaeser *et al*., 2004). Informal local governance structures have always played an important role and still do in many countries. In the rural areas of many developing countries with a weak presence of the state, informal local governance structures survived the colonial as well as post colonial periods. Informal local governance structures, remains important in organizing the life of the people at the local level despite the emergence of modern state structures.

2.6 Decentralization and Local Governance Structures

2.6.1 Overview on decentralization

Decentralization "is the process whereby central governments relinquishes some of their management responsibilities and powers to local government levels, local leaders, or community institutions" (WRI, 2003). Decentralization is often seen as an important means to foster and nurture important elements of good governance in developing countries. Policymakers and researchers, recommend decentralized natural resource management for many reasons. Some of them are that (i) local people are likely to identify and prioritize their environmental problems more accurately than centralized organizations, (ii) resource allocation is more efficient and transaction costs lower when decisions are taken locally, so that, state expenditure on management can be reduced, while resource conservation is improved, (iii) local groups are more likely to respect decisions that they have participated in taking, (iv) monitoring of resource use is improved, and (v) marginalized groups can gain greater influence on local policy.

Decentralization has been a very fashionable concept in development literature since the early 1980s. The 1990s, have witnessed a major resurgence and interesting decentralization as a key element of public sector policy reforms and management in sub-Saharan Africa (Stockmayer, 1999). The majority of the countries have adopted

decentralization policies, including strengthening local governments and initiating processes of devolution, in their national and sub-national development planning and programming (Reddy, 1999). Many bilateral donors and international development agencies have sought to encourage this. The World Bank (2000), has seen decentralization as one of the key components to face the world's development challenges in 21st century, such as reducing poverty and promoting sustainable development. The fundamental aim of decentralization is to bring the government closer in the interests of enhancing efficiency and democratic accountability. Transfer of power and resources to the local level, will help to empower communities to work together to define and resolve their problems (Stockmayer, 1999; Singhal, 2006).

2.6.2 Types of decentralization

Numerous definitions of decentralization emerge from the literature and it is generally accepted that it is impossible to standardize the word decentralization (Manor, 1999). However, in broad sense decentralization denotes the transfer of power, authority and responsibility for decision-making, planning**,** management as well as resource allocation, from the central governments to its field units, district administrative units, local governments, regional or functional authorities, and semiautonomous public authorities, parastatal organizations, private entities and nongovernmental private or voluntary organizations (Rondinelli and Cheema, 1983). More often, decentralization refers to a formal transfer of power to local decision makers (World Bank, 1999).

Decentralization can be either horizontal or vertical. Horizontal decentralization disperses power among institutions at the same level, while vertical decentralization allows some of the powers of a central government to be delegated downwards to lower tiers of authority. Four major types of decentralization are commonly described in the literature, namely

delegation, decentralization, devolution and privatization (Rondinelli and Cheema, 1983). Agrawal and Gupta (2005) emphasize another type of decentralization referring to fiscal transfer.

Delegation is the transfer of some responsibilities and decision-making powers to organizations that are outside, the regular bureaucratic structures and are only indirectly controlled by the central government. Delegation has only rarely been attempted. When it has been tried it has either failed to facilitate a genuine decentralization of decision-making or it has impeded project implementation, or both (Manor, 1999).

Privatization refers to the transfer of all responsibilities of government functions and services, to private enterprises or non-governmental organizations independent of the government (Reddy, 1999). Critics argue that, the private sector firms which take over the tasks from the state are themselves often quite large so that, far from being decentralized, power is actually passing from one major power centre to others. They also argue that, user charges, which often come with privatization, exclude many poor people and thus, do not necessarily increase choice (Manor, 1999).

Decentralization or administrative decentralization is the passing-down of selective administrative functions to lower levels or sub national units, within central government ministries and agencies (Reddy, 1999). The central government is not giving up any authority. It is simply relocating its officers at different levels or points in the national territory. In such circumstances, it tends in practice to reconstitute centralization (URT, 1982).

Devolution or democratic decentralization is the transfer of resources, tasks and decision-making powers to lower level authorities which are largely or wholly independent of the central government and which are democratic in some way and to some degree (Manor, 1995). This includes financial power as well as authority to design and execute local development projects and programmes (Hope, 2000; Dahal, 2003). This type of democratic decentralization would be of further discussion and plays an important role in the Tanzania context.

Sometimes decentralization refers to down-ward fiscal transfer by which higher levels in a system control over budgets and financial decisions to lower levels. This authority can pass either to deconcentrated bureaucrats and/or unelected appointees on the one hand, or to elected politicians on the other. When the later occurs, fiscal decentralization becomes relevant to democratic governance (Manor, 1999). In recent decades, many developing countries have embarked on decentralization reforms in relation to natural resource management. For example in Bolivia, ownership management rights and responsibilities of managing certain natural resources been handed over, to elected local governments in a process of devolution (Agrawal and Gupta, 2005).

In Tanzania, some models are applied, including Joint Forest Management (JFM) schemes, where part of government-owned forest reserves are managed jointly by local branches of government and local communities, in accordance with negotiated management agreements. In Cambodia, decentralization of forest management has mainly taken the shape of decentralization, where control over natural resources has mainly been handed over to local branches of the forest administration. In Nepal, decentralization within the Department of Forestry authorize district forest officers to delegate

management of forest resources to self-forming local forest user groups, which are created specifically for this purpose, and are independent of local governments (Agrawal, 2001).

Wily and Mbaya (2001) argued that, many countries in eastern and southern Africa experience a number of policy reforms most of which, are geared towards devolving the management of common pool resources. The ultimate purpose of decentralization by devolution is to improve economic efficiency, social and economic equity, and sustainability in forest resource management and conservation (Agrawal and Ostrom, 1999). The achievement of this purpose is based on a number of assumptions. On the efficiency aspect, it is assumed that, participation in decision making and management of local resources allows local communities who bear the costs of resource use, to make the decision themselves instead of putting the decision making in the hands of somebody else (Niedzialkowski, *et al.,* 2012). In addition, since the local people live in or around the resource areas, the administrative and management costs can be reduced and local skills and knowledge could be used. Furthermore, decentralization by devolution increases the effectiveness of coordination and flexibility among state agencies in the development and conservation planning and implementation (Agrawal amd Ostrom, 1999). As of equity aspect, it is assumed that participation can increase equity through more equal distribution of benefits (Ribot, 1999). Overall, in order for decentralization by devolution to improve sustainability, equity and efficiency in forest management, it is assumed that, local people have a voice in and control of significant decision making and they take the role formerly taken by the state (Meinzen-Dick and Pradhan, 2001).

The potentials of local government institutions can be realized more effectively where there is devolution of power. Accountability, transparency, participation, empowerment, equity and all other attributes of good governance, can be in full play and become part of

the daily work of the local government bodies when decentralization by devolution take place (Kumar, 2005). Without decentralization by devolution, local government bodies remain paper organizations without any effective role (Kumar and Shamim, 2002).

At present, at least 60 countries in the world have some forms of decentralization in natural resource management, particular forest resource (WRI, 2003). However, empirical studies show that, outcomes of forest decentralization at the local level are mixed and rather disappointing (Edmunds and Wollenberg, 2001; Edmunds *et al.,* 2003; Katon and Meinzen-Dick, 2001; Shackleton and Gumbo, 2010). In general, state forestry organizations still maintain key control over the forest resources (Edmunds and Wollenberg, 2001; McDemott, 2001). In many cases, forest decentralization fails to improve people's livelihoods.

In Tanzania, people centred forest management is a paradigm shift that resulted due to several reasons. Kajembe and Kessy (2000) outlined a number of reasons that have caused the shift: the failure of state agencies to manage effectively the protected areas, the potential for cost effectiveness in managing the forest through local communities, the relevance of local knowledge of ecological dynamics to proper management, the increased motivation for local community to conserve forest following recognition of their critical role in the management of local forests, eventual increasing tangible benefits from forest (economic incentives) and the sense of ownership regained over their forest resources.

Since 1988, the Government of United Republic of Tanzania has reversed the forest policy from centralized resource management whereby, communities around are given mandate to manage the forests under Participatory Forest Management arrangements. Various Community Based Forest Management models (CBFM), have been established with

success including Duru- haitemba in Manyara region. As currently, the involvement of local people in management of forest resources, is operating/ being established in over 1,800 villages and cover over 3.6 million hectares of forest land (Blomly and Ramadhani, 2006). Various stages on JFM and CBFM have been reached. These include formulation of formal local governance structures for example, Village Natural Resources Committees and Village Environmental Committees. These local institutions are said to be more effective than State Forest Departments in managing the forests (Abdallah and Ssuer, 2007 cited by Abdallah and Monella, 2007).

2.7 Stakeholders' Interests and Power Relations in Management of Forest Resources

2.7.1 Stakeholders' interests in management of forest resources

Forest resources offer a number of ecological and socio-economic opportunities to various stakeholders (FAO, 2007). Stakeholders, include all those with specific stake, experience or interest in the topic being addressed. In this case they can be persons, groups or organizations. They are the ones who affect or are affected by policies, decisions and action of the system (Baran and Jantunen, 2004). In this study, stakeholders include regulators, facilitators and users, who are directly and indirectly involved in forest resources utilization and management. Sometimes, the interests of stakeholders in natural resources management are difficult to define or are hidden since, each stakeholder may have several administrative, ownership (title), lease, license, permit, quota, customary rights, collective rights, community rights, littoral rights, public rights, rights of use, and public goods (Sutherland and Nichols, 2006) .

2.7.1.1 Interests of regulators in management of forest resources

Regulators are defined as statutory stakeholders that have the mandate to promote, regulate and enforce proper natural resources management at different levels namely national, local and village (Smajgl and Larson, 2006). In this case regulators include central, local and village government officials, responsible for control and supervision of utilization and management of forest resources. Smajgl and Larson (2006) explained the role played by central government officials in making among others policies, laws, acts, procedures and rules over natural resources management. In conjunction to this, Poffenberger (2000) and Shahbaz *et al*. (2007) noted that, most of these natural resources sector policies and their administration were heavily influenced by the colonial administration. Pokharel and Amatya (2001), identified the regulators are interested in managing forest resources through strategic planning, that have implication in scaling-up forest activities as well as coordinating developmental and conservation activities provided by facilitators. Lund and Treue (2008) pointed out, interests of regulators in protecting wider public goods such as watersheds, biodiversity, carbon sinks and other ecological services as well as mediating resource use conflicts.

The role played by clan heads and chiefs before the colonial era as the main custodian in forest resources management, was well appreciated and documented (Ahmed, 2000; Sultan-i-Rome, 2005; Marfo, 2006). Sumaila *et al*. (2003) put forward the interests of clan heads and chiefs in management of natural resources, in terms of their capacity to provide goods and services that are important for both ecological and social economic benefits. Decisions made by clan heads and chiefs, related to the success of resources, distribution of benefits and responsibilities are deeply rooted in social- cultural mechanisms such as customary laws and council of tribal elders (Sultan-i-Rome, 2005; Marfo, 2006). However, during colonial period forest management became a centralized state subject

and the major part of the forests, was brought under government control. As a result, the then existing community rights became proscribed (Agrawal and Gupta, 2005).

With devolution of power, regulators of local government are given some discretionary authority in decision making and in the management of local affairs and delivery of services, to their communities (MNRT, 2006). Shemwetta *et al.* (2004) noted one of the shortcomings associated with devolution of power, was the existence of improper coordination among regulators of the central and local government over tax revenues, accruing from forest resources, each claiming to be the rightful collector. With Participatory Forest Management (PFM), Lund and Treue (2008) elaborated the role assigned to regulators at village levels in the management, utilization and development of the forests under the guidance of by-laws and operational plans of the forest. In this case, regulators at the village level are recognized as self-governing, autonomous bodies, enabled to sell and distribute forest products, as they have the right to exclude others from using the forests, and the right to use their funds for forest conservation and other community development activities.

2.7.1.2 Interests of facilitators in management of forest resources

Facilitators are defined as non-statutory stakeholders that aim at facilitating proper forest resources management, mainly at community level (Smajgl and Larson, 2006). They include national and international non-governmental organizations (NGOs), development partners, private sectors as well as research, education and training organizations. Facilitators are normally instrumental in promoting and facilitating communication on the management of forest resources between stakeholders.

According to Lissu (1999) facilitators at research, education and training organizations are interested in carrying out research, advocacy, and selected public interest litigation to ensure sound management of natural resources and environmental protection. Harrison and Laizer (2007) reported the interests of development partners like Department for International Development (DFID), World Bank (WB) and International Monetary Fund (IMF) in supporting conservation activities of forest resources and livelihoods development projects in the world. Langlands (2005) explained the interest of facilitators in research that aimed at advising decision makers, on sustainable management of forest resources in Gulf of Fonseca. Lissu (1999) pointed out that, facilitators are basically involved in issues related to the establishment of an enabling policy environment for civil society, including civil liberties and human rights towards the management of forest resources.

The global conservation organization such as, World Wide Funds for Nature (WWF) are interested in stopping the degradation of the earth's natural environment and to build a future in which humans live in harmony, with nature by conserving the world's biological diversity, ensuring that, the use of renewable natural resources is sustainable and reducing pollution and wasteful consumption. Some facilitators are appreciated for their support in raising awareness for rural communities on environmental conservation, through environmental education programmes and democratic governance. Facilitators like private sector (firms and individuals), are interested in forest resources for commercial products, which may be extracted from them (Sumaila *et al.,* 2003).

2.7.1.3 Interests of users in the management of forest resources

Users are defined as the stakeholders that rely on forest resources for subsistence and commercial interests. Forest ecosystem, is diverse and highly productive ecosystem hence,

its users are multiple (FAO, 2007). The local people living in and around forest areas are the most important actors and users of the forest resources (Shahbaz *et al.,* 2008). Communities bordering forests are interested in them for number of reasons, including clearing for agriculture, firewood, building poles, timber cutting, and a number of other products for local consumption and trade (COCATRAM, 2003). According to Anderson (2004), users have right to use and harvest forest products as envisaged in the operational plan, and they are responsible to participate in forest management and assembly meetings, and share views in rules making without distinction of ward members of their residence.

2.7.2 Stakeholders power relations in management of forest resources

Nuijiten (2005), in deriving his argument from the concepts of force-dynamic model, defines power relations as what enables who to do what to whom, or more explicitly, he defines power relations as the matrix of possible actors and their possible interactions. Power relations in many societies, are embedded in a social control, social hierarchy and the roles given to some individuals in a given society. These power structures, in most cases, are perpetuated by the prevailing institutions and ideology, and can raise groups with a more bargaining power than others.

Barrow *et al.* (2002), defined power relations to encompass environmental governance and the distribution, exercise and accountability over nature. In this case the term authority is often used for power, perceived as legitimate by the social structure (Poppe, 2003). According to Anderson (2004), this kind of power, is based on the perception that someone has the right to prescribe behaviour due to election or appointment to a position of authority. For rural Africans, a major governance issue is control and access over resources (Brokaw, 2006). Generally, power relations are defined as the power the actor 1 exercises over another actor 2 (Wiese, 2007). According to Anderson (2004) power

relations may constitute executive, legislative and judiciary powers. Executive powers encompass the rights to make decisions, implementation and enforcement while the mandate to make rules is legislative power and judiciary powers, concern with dispute resolution and recourse. According to Langlands (2005), misuse of public power for private gain lead into corruption and this implies a failure of good governance. Corruption often, has negative impacts on welfare of local communities and natural resources status (Barrow *et al.,* 2002).

Natural resources available to a village or other communities often have several uses and users. This is the case with miombo woodlands, as it is seen as one of the potential areas for attracting various stakeholders with diverse interests in its management. In this case, the utilization and management of miombo woodlands resources is associated with a multi-layered process, with stakeholders from village, local, and national levels (Abdallah and Monella, 2007). This is attributed to multiple values generated from miombo woodland ecosystem. The diversity of interests' yield various degree of power as stakeholders seek to lay claim on forest resources (Kitula, 2012).

According to Brokaw (2006) understanding the power of different groups of stakeholders involved in managing forest resources, help to arrive at compromises and put off conflicting ideas. Wiese (2007) put forward the argument that struggle for power over natural resources management, can be studied on a continuum covering intra-personal, inter- personal, inter-group, and ideological level. Wiese (2007) pointed out power comparisons, among stakeholders may be evaluated in five rating order as power relations are:

(i) Determinate if the affirmative power of every coalition is limited only by preclusive power of its complement

(ii) Decisive if the power of every coalition is equal to its affirmative power

(iii) Simple if they are both determinate and decisive

(iv) Maximally weak if no coalition other than the coalition of the whole has potent strategies and

(v) Maximally strong if every coalition or its complement is all powerful.

Some people try to analyse power relations in accessing common pool resources (CPRs) as a source of income. According to Reddy (1999) dominants and high status members in the society are more powerful in accessing CPRs than members of subordinated and low status groups. Along with this line Brokaw (2006) reported that, the use of natural resources by local communities differs according to wealth group as rich and poor people use natural resources in different ways. Because of greater economic power, the rich exercise greater power over access to resources under common pool management. WRI (2003) put forward that, individuals or groups are powerful when their outcomes depend on others' outcomes depend on them. WRI (2003) proposed shared power on natural resources management as a necessary precursor to social influence strategies. This is because natural resources often provide diverse benefits to multiple groups of stakeholders, rights, resource flows and relationships are all complex and dynamic, often contradictory and frequently lead to conflicts between and among stakeholders (Langlands, 2005).

Brokaw (2006) noted the existence of parallel hierarchies of traditional leadership, local and central government in resource management which are often in conflicts. Brokaw (2006) explains the power is not control of people's outcomes but the control of people's active contributions or inputs, as this provides the synthesis on how processes and institutions produce results that meet the needs of society while making the best use of

resources at their disposal. This more about the examination of the efficiency use of power by the stakeholders, for the sustainable use of natural resources and protection of the environment. Therefore, in the context of power relations of stakeholders involved in the use and management of forest resources, it is important to understand the relations of stakeholders interacting in power hierarchies, found in government settings for developing strategies that mitigate stakeholders conflicting interests.

2.8 Institutional Performance and Overlaps in Management of Forest Resources

2.8.1 Institutions

Sociologist, defines an institution as an organized and established procedure (Bandaragoda, 2000), represented as rules of society or "rules of the game". Institutional economists, adopted a similar interpretation in which institutions are referred to as humanly devised constraints, that shape human actions and in due course structure incentives in human exchange (North, 1990). They are set of rules and regulations that constrain and motivate stakeholders to interact with ecosystems to ensure equity and sustainability of forest resources (Ostrom, 1997; Smajgl and Larson, 2006).

Institutions are set of rules that govern ownership and use of resources, production, exchange and consumption under which economies work (Bandaragoda, 2000). A key analytical objective of institutional analysis is to establish how institutions influence or affect outcomes arising from interactions among stakeholders in various social settings (Levy *et al.,* 1995). The approach, allows exploring institutional arrangements in trying to achieve holistic management system, for sustainable utilization and management of forest resources. On the other hand, institutional arrangement is defined as the way in which powers and functions of government agencies are structured, between and within agencies, in order to deliver administration services to members of the public (North, 1990 and

Gombya-Ssembajjwe, 1999). Institutional arrangements are essential component in the management of forest resources. Though institutions are not identical to organizations, they reciprocally influence each other.

2.8.2 Organizations

In contrast to institutions, organizations are not ideas or conventions but a group of people brought together by some common purpose to reach their objective (Bandaragoda, 2000). North (1990) defines organizations as purposive entities designed by their creator to maximize wealth, income, or other objectives defined by the opportunities afforded by the institutional structure of the society. These purposive entities are formed to facilitate the achievement of natural resources or business ventures. Thus, we can safely say organizations are groups of people by some common purpose and some rules and procedures, to achieve the defined goals consequently, organizations are central to collective action in natural resources.

In the same line of thinking Smajgl and Larson (2006), further argues that, these groups may be organized with expressed purpose of campaigning for change, in the institutional structure or even the underlying ideology of society, conversely, organizations, thus, include schools, universities, churches, village governments, NGOs, and local groups. They also play an important role in shaping people's behaviour (Kitula, 2012).

2.8.3 Evolution of institutional arrangements in management of forest resources

Through the time, several formal and informal institutional arrangements emerged worldwide, all focusing on the management of forest resources (COCATRAM, 2003). Their success in performing management duty differs with era and country. Therefore, the evaluation of efficiency of the institutions is important, since it can facilitate comparing

them with other efficient institutional arrangements, and possibly show the direction of change. Ostrom (1990) distinguishes three levels of institutional arrangements as regulating access, use rights and management of resource that have evolved from pre-colonial era to date. These institutional arrangements include operational rules (day- to-day working rules made by resource users), collective-choice rule (rules used by users and external agents) and constitutional-choice rules (determine eligibility to participate in the system and set out rules, that will be used to design collective – choice rules). Ostrom's levels of institutional arrangements have been used to illustrate types of formal institutional arrangements as shown in (Figure 2).

The role played by informal institutions before colonial era as the main custodian of forest resources management, was well appreciated and documented (Marfo, 2006). Many customary and indigenous access rights systems have evolved (COCATRAM, 2003). Traditional leaders exercise ownership rights over the lands their families, have inhabited for generations (Brokaw, 2006).

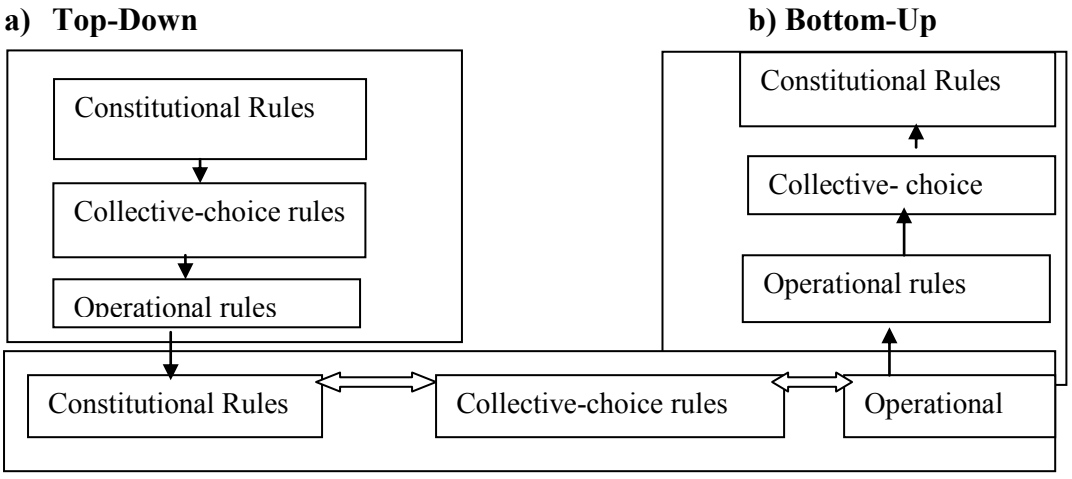

Figure 2: Types of institutional arrangements (Ostrom, 1990).

Sumaila *et al.* (2003) put forward the interests of traditional leaders in management of natural resources, in terms of their capacity to provide goods and services that are important for both ecological and socio-economic benefits. Decisions made by traditional leaders related to the access of resources, distribution of benefits and responsibilities are deeply rooted in socio-cultural mechanism such as customary laws and council of tribe elders (Marfo, 2006). However, during colonial period forest management became a centralized state subject and the major part of the forests, was brought under government control. As a result, the formal access rights to resources lie largely in the hands of the state and then existing community rights became proscribed (Ostrom, 1990). Brokaw (2006), noted the existence of parallel hierarchies of traditional leadership, local and central government in resource management are often in conflicts.

Globally, land and forests, and the rights to their resources, are concentrated in hands of sovereign governments that provide concessions for economic activities to a variety of groups and individuals for timber and charcoal production (URT, 2009). With devolution of power, regulators of local government, are given some discrinary authority in decision making and the management of local affairs and delivery of services to their communities (Junge, 2002). Along this line, Kajembe *et al.* (2004) and Brokaw (2006) argued that, the existence of many institutions with overlapping mandates tend to result into regulatory duplication, confusion and conflicts of interests.

The formal top-down institutional arrangements in the management of forest resources, was strengthened during the post-colonial era (from 1961 – 1967) and neglected the development of indigenous informal, “lateral” (collaborative) arrangements. As the Arusha Declaration of 1967 which aimed at building a socialist state in Tanzania, forests were nationalized; however, the socialist experiment was overwhelmed by economic

problems, which also affected the forest sector. The main problem of the management of forests in Tanzania during the thirty years of the socialist experiment, is the large area which is under public lands and therefore, virtually no management activities undertaken, although the central government is responsible for its management. These areas are actually open access. The areas designated as forest reserves, which are also under the government suffer from poor management because of the limited capacity of the government in terms of manpower and other resources (Kihiyo, 1998). Major threats to Tanzanian forests include rampant pit sawing, wild honey harvesting using fire, firewood and charcoal harvesting, harvesting for building materials, annual fires, settlements and cultivation (URT, 1998a; Luoga *et al.,* 2005).

During the mid-1980s economic reforms were initiated and the economy was liberalized, practically doing away with socialist economic policies. Liberalization on the forest sector include joint management of forests between the government and communities and other decentralized concerns, as a way of making management of this natural resource sustainable (URT, 2006). In the response to this concern, Tanzania has gone through a number of institutional reforms, including the revision natural resources sector policies. The new forest policy for example, has clearly put an emphasis on the involvement and participation of stakeholders in management of forest resources (URT, 1998a).

Participatory Forest Management (PFM) or Collaborative Forest Management (CFM), is basically a common property regime (Dubois, 1999; Kajembe and Kessy, 2000; Luoga *et al.,* 2005) which entails two of Joint Forest Management (JFM) and Community-Based Forest Management (CBFM). The latter being more devolution as it involves both user and ownership rights over the resource.

2.8.4 Institutional overlaps in management of forest resources

The institutional performance cannot be simply attributed to the existence of private or public institutions, neither to those of formal or informal institutional arrangements. The institutions, should find the state where they can function with the lowest transaction costs, by combining the formal institutions with the informal ones. Therefore, they should adapt to the already existent institutional setting, and improve it by finding the most efficient-lowest cost equilibrium.

2.9 Policies and Legal Framework in the Management of Forest Resources

2.9.1 Policy framework in the management of forest resources

In Tanzania, natural resources such as forest, land, water, minerals and wildlife are owned by the state and they are regarded as public property. Power to manage and regulate the use of these resources, is given to various ministerial sectors and public institutions on behalf of all Tanzanians. Individuals and private organizations are given rights of access and use for specified period of time through statutory licenses but not private ownership is envisaged. The most relevant ministerial sectors include agriculture, forestry, land, mining, water, human development and settlement, environment, tourism, beekeeping, wildlife and Local Government (URT 1988a).

2.9.2 Legal framework and their effects on forest condition

Management of natural resources, involves different actors who experience and know different legal or rule based systems of assigning property rights, to land and forest resources which all together generate a basis for the negotiations of property rights and management obligations, government agencies, development projects, religion organizations, local authorities and local people, all have different role in the management

of natural resources which make them generate their own principles, rules and regulations related to natural resources management (Meinzen-Dick and Nkonya, 2007).

Depending on what provides the best option, a person may use formal law or defend accessing to forest resources, on the basis of local customary practices. Law is not a monopoly property of the state but can be seen as a cognitive and normative order created and sustained by the social field. Individuals make use of different strategies to claim the use of resources (Meinzen-Dick and Pradhan, 2001). This means that, even in the presence of formal property rights over a certain resource, if these formal property rights do not favour the interests of that particular individuals or group of people, different strategies are devised to legitimize the rights to use the resource. As Meinzen-Dick and Pradhan (2001) argue, property rights institutions are influential in mediating interaction of people with natural resources as compared to other institutions. They are not only determining how the resources are owned, used by whom, how and when, but they also have an influence on the extent at which individuals or group of people should invest in maintaining the resource base over time. Thus, to consider the existence of multiple legal systems under external intervention in managing natural resources is relevant, especially, when one considers the implication for property rights on resources use and management. The laws created by different levels of government and non-governmental actors, may have common or contradicting interests and often partly overlap. This may have implications for access and use of resources (Nuijten, 2005).

The literature provides many examples of the distinction between forest and tree tenure (FAO, 1989). Forest tenure determines who can use what resources, when and under what conditions. Forest tenure combines a bundle of rights which include the right to own, manage, use resources, and transfer forest resources and land; and this can be defined

legally or customarily (FAO, 2008). Forest tenure can be defined in general terms such as government forest reserves, private forests, community forest and open access. Within these categories, tree tenure can be distinguished from the forest rights. For example, tree tenure can be distinguished between planted trees and wild trees; some species of tree can be subjected to particular rules; rights to use some trees can be determined by the type of the use (personal or commercial uses); and the rights to use trees can be granted to individuals according to the provisions of labour and other investment (FAO, 1989). From this perspective, tree tenure consists of a bundle of rights, which may be held by different people at different times. The rights that make the bundle can be categorized as the right to own or inherit the right to plant, the right to use, and right of disposal (Katon *et al*., 2001). For example, the state may regulate or attempt to regulate the use of trees owned by others, e.g. declaring certain species as protected no matter where they are located and to be used only with official permission.

Furthermore, use of resources can be granted by the government to local communities, who are living close to forest reserves as incentives for their participation, in managing the reserves under special arrangements like Participatory Forest Management (PFM) (Blomley *et al.,* 2008). Tree planting in most cases, is used as a basis for claiming the rights to land and for that case, planting trees on borrowed land can lead to termination of the agreement (FAO, 1995). Also at the Kingship or family level, members may also have different rights on trees depending on gender, birth order or intra-family status (Katon *et al.,* 2001).

In rural areas of Tanzania, some tree species are traditionally considered sacred or dwelling places of sprits and thus, tree cutting is strictly prohibited (Kajembe and Mbwambo, 2000) or they may be places for cultural ceremonies such as rain making

(Kessy, 1998). In the Bahi cases, *Xeroderris stulhmannii, Steculia africana, Adansonia digitata, Brachystegia* spp. are traditionally believed to be good for cultural ceremonies, and thus is a taboo to cut them.

2.10 Biological diversity values of the forest

2.10.1 Forest biodiversity conservation and tree diversity

Biological diversity, describes the variety of biotic genetic to ecosystem (Kent and Coker, 1992). Biodiversity provides resilience to our lives at household level (Mongo, 2013). Conserving forest biodiversity means maintaining a forest cover with ecological conditions suitable to provide food, shelter, energy and income for the community (Lupala, 2009). Understanding the context of the biodiversity status of a particular forest, provides an important key to management strategies that should be adopted under different circumstances.

Ecologically often we use biodiversity measurements to determine the health of an ecosystem (Mongo, 2013). In this case, a declining biodiversity indicates a declining ecosystem and is a sign of some environmental stress (Belsky and Canham, 1994). According to Munishi *et al.* (2011) an emerging criterion of describing mixed uneven forests is the diversity index, high desirable property for a forest community. The knowledge of species diversity is particularly useful when one wishes to study the influence of biotic disturbance or the state of succession, or stability of a forest community. Diversity indices are the measure of tree species diversity and richness in a forest community. The indices provide more information about community composition rather than species richness; also take relative abundances of different species into account (Belsky and Canham, 1994).

2.10.2 Estimation of forest biodiversity

There different ways in which biodiversity can be estimated. One of which is from the structure of a forest stand, this can provide a useful indicator of the ecosystem function and changes through time (Krebs, 1989 and Magurran, 1998). Different ways of measuring forest structure include stem density and forest basal area. These have direct response with human impact (Mongo, 2013). For example, mean basal area in a stand decreases as a consequence of increasing disturbance pressure, where as stem density of smaller trees may increase after disturbance (Lupala, 2009). The density and size distribution of tree contributes to the structural pattern characteristic of forests and forest structural features (Isango, 2007).

Species composition is another measure of diversity in a forest. Species composition is the assemblage of plant species that characterize the vegetation (Isango, 2007). It is one of the major components of biologically spatial structure (Chingonikaya, 2010). The most common measure of composition is richness (number of different species) and abundance (the number of individuals per species found in specifies area) and richness can be documented by calculating its relative density (RD), while the distribution of species is shown by relative frequency (RF). The abundance is calculated as relative dominance (RD_O) whereas the importance value index (IVI) is the sum of relative density, relative frequency and relative dominance of species (Lupala, 2009). The IVI of a species in the community gives idea of its relative importance in the community (Munishi *et al.,* 2008).

Within biologically conservation, there are other ecologically-oriented valuation measures (Backeus *et al.,* 2006). Munishi *et al.* (2008) for example, discussed the use of indicator species in ecological valuation, which is important for application in ecologically suitable forest management whereas in biologically richness; genetic, species and community

diversity are important measurements used (Mongo, 2013). Ecosystem health or quality approaches, are equally important in valuations when viewing ecosystem functioning and services, as they assess ecosystem performance and quality (Chingonikaya, 2010). In general, biodiversity valuation can help decision makers to protect species and other biological values of forest (Lupala, 2009).

2.10.3 The need for biodiversity valuation and monitoring

Monitoring and valuing of forest biodiversity and ecosystem services, is essential not only for assessing the relative importance of different components in the system, but also for informing decision-makers, who are often unaware of the value and importance of biodiversity and its accompanying ecosystem (Metz, *et al.,* 2007). A significant property of the world's population directly depends on forests and the surrounding environment for livelihood support (Munishi *et al.,* 2011). The correlation between forest and livelihoods is strongest for poor and rural community who have the least or limited influence in the key decision-making, concerning their adjacent forest and environments (Sunderlin, 2008). There is, therefore, a growing need to better understand the association between livelihoods and the conservation of forest biodiversity resources (FAO, 2010).

Biodiversity provides a range of services, including aesthetic, cultural and recreational values as well as goods that have direct use values (FAO, 2010). Apart from that, it enhances many other ecosystem services including carbon storage, water supply and soil fertility (Munishi *et al.,* 2011). Ecosystem services concept is of significant importance in appreciating the role of nature for sustaining human livelihoods (Mertz *et al.,* 2007). Therefore, there is a need for effective valuation of biodiversity for ecosystem services (FAO, 2010).

Species diversity measurements, allow objective assessment of level of biodiversity and the effects of institutional change on forest condition (Syampungani, 2008). It is more effective and scientifically accepted to use a combination of indices or measures, to assess plant diversity so as to combine separate aspects of diversity for example richness and evenness (Mongo, 2013). The scale, design and intensity of monitoring programmes vary to a great extent. Tomppo (2007) explained how combination of field survey and remote sensing could improve results of monitoring biodiversity of a particular area.

2.10.4 Biodiversity of the miombo vegetation

Most miombo woodlands have been heavily disturbed because they have great local value (Munishi *et al.,* 2011). They provide dry-season fodder for large livestock populations and fuelwood and rural industries uses. They offer construction material for farm structures and homes foe millions. They are rich source of wild foods and fruits, reducing the vulnerability of poor rural households from the risks of crop failure. Although miombo woodlands are disturbed the species composition is virtually unchanged because regeneration is very easy through stump or root sucker shoots (Timberlake *et al.,* 2010). Mongo (2013) argued that the composition of species should be characteristic for eco-region.

Miombo woodlands are characterized by the three *Cesalpinoideae* genera: *Brachystegia, Julbernadia* and *Isoberlinia* (Munishi *et al.,* 2011). These species produce hard timber, and have fibrous, tannin-rich barks used by local communities. Both species structure and composition in miombo eco-region are sensitive to environmental impacts (pressure) that they can be used as indicators for degradation of forests (Bakarr, 2000; Mwase, *et al.,* 2007).

2.11 Forest Cover Change Concepts

2.11.1 Forest cover and its relationship to forest dependent communities

Forest cover, is one of the types of land cover. A forest cover may consist of closed or open forest pattern with trees of different storeys and thick or open undergrowth (Kashaigili, 2006). As part of the forest condition, forest cover provides the first indication of adequate or inadequate forest resources in a country or region (FAO, 2010). An adequate forest cover ensures high capacity production of goods and services from the forest including watersheds protection and maintenance of biological diversity, without overlooking amenity and recreation (Mbilinyi *et al.,* 2007).

Forest adjacent to communities, have been linked to the forest due to their highly dependence on forest resources for their livelihoods. This has been observed since the hunting and gathering era to sedentary agriculture. Since then, forests tend to become less dense and forest cover decreases due to increased population densities, higher market demands and changing types of forest use by local communities (Mongo, 2013). Above all, developments in the forest area have seen dramatic change on the forest ecosystem, which has created many impacts on livelihoods of forest adjacent communities depending on them Sunderlin *et al.* (2008) had the opinion that, areas of poverty and forest cover extent overlap. Maintaining forest cover is important for people who gains livelihood from the forest (FAO, 2010). Adequate or better forest cover can overcome vulnerability and is, associated with better welfare of forest adjacent communities. Decreased forest cover has direct impact to important livelihood services of forest adjacent communities (Kitula, 2012).

2.11.2 Forest cover change estimation

Monitoring forest cover is important in sustainable development and management of forest ecosystem (Mpanda *et al.,* 2008). There different methods used in estimating and analysing forest cover changes. Remote sensing technologies have been found to facilitate the process (Mbilinyi *et al.,* 2007). Remote sensing provides an opportunity of examining vast areas at frequent intervals, and also has an advantage of detecting and delineating major changes (Kashaigili, 2006). Change detection, is a method of identifying differences of a phenomenon by observing it at different epochs (Kashaigili and Majaliwa, 2010).

Forest cover conditions are not static; they are unstable due to constant changes that may be abrupt or gradual, from natural and/or anthropogenic forces (Hayes and Cohen, 2007). These forest cover changes are complex ranging from simple degradation to total deforestation (Mongo, 2013). Information on the condition and change trends of forest is crucial to forest policy decisions and the data can act as early warning systems (Nagendra and Gokhale, 2008). On-time and accurate change, detection provides a basis for improved understanding of relationships and interactions between forest and adjacent communities (Panigrahy *et al.,* 2010).

Forest cover and change detection data, are important feature of forest inventory in which remote sensing technique play a role in keeping the inventory up-to-date (Negendra and Gokhale, 2008). From remote sensed data, forest stand structure parameters can be retrieved whereby estimation on volume of the stand, biodiversity and carbon stocks can be done (Panigrahy *et al.,* 2010). These stand structure parameters also provide information on potential determinants of plant species distribution (Hayes and Cohen, 2007).

2.11.3 Accuracy assessment

Accuracy assessment is the process of estimating the accuracy of the classification in a map, by comparing the map with reference information believed to accurately reflect the true land cover (Congalton, 2001). Sources of reference data include ground truthing, higher resolution satellite images and maps. Accuracy assessment is an important element of any land or vegetation cover classification derived from remotely sensed data, since some errors may occur due to thematic error, positional errors, land cover mixtures (mixed pixels) or human errors (Congalton, 2001). Accuracy assessment, determines how useful the classified maps are to the user.

The most effective way to represent classification accuracy is through an error matrix. It is a square array of numbers laid out in rows and columns that express the number of sample assigned to a particular category, relative to the actual category as verified in the field (Congalton, 2001). The column normally represents the reference data, while the rows indicate the classification generated from remotely sensed data. The common used indices for accuracy assessment are overall accuracy, producer's accuracy, user's accuracy and Kappa coefficient (Kashaigili and Majaliwa, 2010).

2.11.4 Application of remote sensing in forest cover change assessment

Remote sensing technologies are widely used to monitor landscape and vegetation change in many parts of the world (Tomppo, 2007; Panigrahy, *et al.,* 2010 and Thomlinson *et al.,* 1999). While the availability of extensive and timely images from various satellite sensors, can assist in identifying the rates and pattern of deforestation, modelling techniques can evaluate the socio-economic and biophysical factors deriving deforestation processes (Congalton, 2001).

With time, monitoring rate of deforestation and forest degradation can be done through analysis of remotely sensed data. In Kenya for example, Ochego (2003) applied remote sensing in deforestation monitoring in the Aberdare Range Mountains, which are important water catchments areas for many rivers and streams in Kenya. When using GIS to measure change in temporal and spatial dynamics of forestland in north-west Spain, Perez *et al.* (2006) discovered an increase in the forest cover in Galicia region. In Tanzania, a study tracked forest cover changes in the Eastern Arc mountain forests and calculated that approximately 70% of the original forest cover, has been lost and the remainder is retreating towards the boundaries of National Forest Reserve (Mbilinyi and Kashaigili, 2005).

2.12 Theories of Forest Dynamics

Disturbance regime of the ecosystem is one of the major factors in biological resources dynamics (Whitemore, 1989). Disturbances are major sources of both temporal and spatial changes in forest structure and dynamics of the ecosystem (Luoga *et al.,* 2000). The biological resources have renewability characteristics over time; hence can be sustainable when managed properly. However, when the disturbance (natural or anthropogenic) exceed beyond the renewal capacity, deterioration or degradation of the resources may occur (Shemdoe *et al.,* 2007).

2.12.1 Intermediate disturbance hypothesis

The hypothesis predicts the highest biotic diversity, is achieved when a community is subjected to moderate disturbance. Such a disturbance will allow the community to renew or recruit young ones and persistence of species that would otherwise be excluded (Hobbie *et al.,* 1993). The hypothesis urged that, periodic or recurring disturbance at moderate level enhance both pioneer and primary species, such that different species of different life

history strategies, are able to co-exist and consequently high species density are maintained. However, when the disturbance is below the moderate level, only climax species which are able to compete for resources would exist and equilibrium would eventually be attained. Therefore, species richness would be maintained and hence lower level of species diversity. On the other hand, when the disturbance is beyond the moderate level, only colonizing species with fast growing and pioneer species are able to co-exist, hence lower species diversity.

2.12.2 Patches dynamics

This is applicable in situation whereby the disturbance regimes are not stable and consequently landscape is not in equilibrium (Romme and Knight, 1981). While, opening in forest canopy is generally referred as gap, the area which is influenced by gap is referred as patch. Most forest gaps form, develop and disappear relatively quickly at least between 10 -30 years (Belsky and Canham, 1994). Species diversity at old growth forest assumed to be maintained by patch dynamics as a result, most species such as shade tolerant tree, shrubs and herbs respond positively to tree gaps (Dirzo *et al.,* 1992).

2.12.3 Landscape dynamics

Landscape dynamics consider spatial- temporal scale of disturbance on a landscape level. This is because landscape tends to be affected by multiple disturbances, which occur at different spatial and temporal scale and which may interact (Belsky and Canham, 1994). The theory urged that, when the disturbance interval is long relative to recovery time and small proportional to the landscape is affected, the system is stable and exhibits variation. When the disturbance interval is shorter than recovery time and a large proportional of the landscape is affected, the system becomes unstable and shift into different trajectory (Turner *et al.,* 1993).

2.13 Socio-economic Factors Influencing Institutional performance

Several factors may affect the performance of institutions (Agrawal 2001; Balint, *et al.,* 2002; Lankina, 2008). Successful institutions, depend on the ability of users to device rules than when their externally imposed on them for success to and maintain of CPRs (Ostrom, 1990; Shemwetta *et al.,* 2004). Local level institutions are considered better at providing, *inter alia*, rules related to access, harvesting and management; committees and meetings that can respond to conflicts more quickly and realistically; and that their monitoring and sanctioning methods are more efficient (Gibson *et al.,* 2005). Increasing frequency in organizing forest patrol and enforcement of rules, are considered key factors in improvement of forest condition and increasing institutional performance (Salum, 2009). Along this line, Ostrom (1990) argued that, institutional effectiveness is associated with availability of funds to enable critical monitoring of rules compliance by community and protection of CPRs. Compliance to rules is also found to be extremely important for effective functioning of an institution. There is compelling evidence that subjects voluntarily contribute resources to monitor and sanction others, who are not cooperative in collective action because rules enforcement is necessary to maintain cooperation (Gibson *et al.,* 2005).

Kajembe *et al.* (2004) and Saunders *et al.* (2010) argued that, communities with high positive attitude towards CPRs tend to increase institutional performance, through greater participation in conservation activities. This is likely to benefit performance through reducing transaction costs and disseminating knowledge, hence providing positive externalities Ghate and Nagendra (2005) argued that, successful institutions depend on the level of community awareness regarding resource utilization and management. (Kitula, 2012) reported the role played by awareness raising, in changing attitudes of local communities towards wise use of CPRs. Along this line, Luoga *et al.* (2006) mentioned

that, education level is important in increasing performance of institutions since it facilitates awareness raising in understanding and adapting new technologies. Promoting education creates awareness and positive attitudes of communities in sustainable use and management of natural resources (Sumra and Rajani, 2006).

Ostrom (1990) and Jacobi and Monteiro (2006) observed that, institutions performs better when private and public stakeholders have the ability to coordinate their actions. What allows groups with high heterogeneity to achieve high scores of efficiency, in their programmes and policies is the amalgamation between private and public stakeholders, expressed by dense social networks among public servants and civil society representatives, in what has been referred to as embedded autonomy. The idea behind the concept of embedded autonomy refers to that day-to day interactions between public and private domains and to all liability built upon this relationship (Ostrom, 1990). Jacobi and Monteiro (2006) conclude that, the coordination between strong public institutions and organized communities can be effective development mechanism. Stronger ties, cohesion and reciprocity between these stakeholders, will ultimately make collective action more likely to happen, thus promoting higher institutional performance. Gombya-Ssembajjwe (2002) argued that greater cooperation among politicians and bureaucrats reduce the possibility of gridlock in decision making and are therefore, likely to lead to a higher quality of governance.

Local institutions that function well in some settings, in others fall prey to the ills of mismanagement, corruption, patronage, and elite capture (Lankina, 2008). In Tanzania and elsewhere in developing countries, governments' capacity to protect forests, has been progressively deteriorating because of declining budgets and human resources (Luoga *et al.,* 2006). There is general consensus that illegal logging occur at large scale and it is on

the increase. Illegal logging and timber trade from none or under payment of loyalties, tend to contribute to loss of government revenues a situation that hamper monitoring activities (Milledge *et al.,* 2007). With population and development needs, the situation tends to become worse, as people tend to exploit the forests beyond the management objectives (Luoga *et al.,* 2006). According URT (2006) institutional performance, may sometimes by natural hazards such as drought, floods and, outbreak of pests and crop diseases. The occurrence of natural hazards tends to result in encroachment in forests resources (Shemdoe *et al.,* 2007).

2.14 Management of Common Pool Resources

The common does not imply any kind of ownership. When resources exist in a common location may be claimed by and individual, or community or state. Ostrom *et al.* (1990) defined the commons as ability to exclude other users from its use, and Common Pool Resources, are resources that can be utilized by group of individuals or community (Ostrom, 2002). Most natural resources can be regarded as common pool resources either natural or human made facilities, and have both stock and flow aspect Jacobi and Manteiro (2006) such as forestland, water flow and rangeland.

Common Pool Resources have two characteristics, firstly, exclusion of other potential users from accessing the resources is difficult and costly, sub tractability that resource unit that is extracted by one user is not available to other users (Ostrom, 1990). In terms of property right regimes, resource can be grouped into: First, Open access regime which do not have well-defined property rights; secondly, Private property regime whereby an individual has the right to exclude other from using the resources; thirdly, Common property regime whereby community has right to exclude non-community members and regulate the use of the resources through formal and informal institutions (Schlager and

Ostrom, 1992); and fourthly, State property regime when the rights are held by the state, which controls access and regulate use of the resources.

Generally, it is accepted that, when the resources are held in common they are vulnerable to over exploitation as popularized by Hardin (1968) in his paper on "Tragedy of the Commons". Also it is argued that, for the commons to be managed sustainably, they should be either private or state regimes (Barkes, 1989). However, several studies have shown that, there are other ways the commons can well be managed than private or state property regimes (Lawry, 1990). For example, several communities surrounding common poll resources have managed them sustainably through their designed institutional arrangements (Schlager and Ostrom, 1992).

2.14.1 Theories of common pool resources

An article by Hardin (1968) entitled "Tragedy of the Commons" is one of the famous article which developed the theory of common pool resources. In this article, the author used herdsman to explain his simplistic economic model: assuming the pasture land is open to all. That the herdsman is assumed to be rational utility maximize, such that, he will add more herds as the benefit from adding, is more than the cost of overgrazing which is shared among herdsman. When the number of cattle increased beyond the capacity of the pastureland to support (carrying capacity) will lead to degradation (tragedy) of the common. The author concluded that, the only solution to this problem is placing the common resources either under private or state property regime.

2.14.2 The prisoner's dilemma

Another theory is Prisoner's dilemma theory. The theory used two people who committed an offence and are interrogated separately (Wade, 1987). The theory was narrated as

follow: if both stay silent will receive light punishment, if both confesses will receive medium punishment, and if the first confesses and the second stay silent, the first one will go free, while the second one will receive heavy punishment. Each person can choose once and no opportunity to change after choice of the other. While their joint interest is to keep silent, no one is sure whether other will confess or not. Therefore, the choice of best strategy is to confess such that: if boss confess will receive medium punishment, if other persons stays silent, he has a chance to be free, than if he stays silent while other confesses. If one extends this game to common pool resources, the individual is faced with following options:

(i) Everybody by the rules while one individual enjoy the benefit of unrestricted access (free ride)

(ii) Everybody, including himself follows the rule (co-operate)

(iii) No one follows the rule; and

(iv) He follows the rule while no one else does (he is looser)

Wade (1987) argued that a stable group will choose alternative three (no one follows the rule). However, the second option is desirable but it is not stable as each individual has an incentive to cheat (alternative one) without being noticed. Rational people will choose alternative one, such that even if it turns out no body follows the rules, at least he is assured that he has avoided the fourth alternative. Therefore, rational people cannot agree on a collective action. Like in Hardin's tragedy of the commons, the theory ends with the conclusion that: common pool resources can be best managed either under private or state property regime.

2.14.3 Logic of collective action

The theory was developed by Olson (1971) and Sletten *et al.* (2008), which is basically in line with Prisoner's dilemma theory. The author urged that, there must be coercion or some other special device to make individuals act towards a common interest otherwise; rational, self-interested individuals will not act towards a common or group interest. That is, selective incentives (punishment and inducements) are added in order to deter those who do not contribute to the common goal, without which the individual will free ride, and the common goal will not be achieved. Further, the author grouped interest groups into three namely: small, intermediate and large groups. Small group is when an individual has an interest in providing public good regardless of the contribution of the other. Intermediate and large groups, are those when no one individual has an interest in providing public goods and is when some cooperation is necessary. The difference between the two is that, an action of single member with regard to whether he contributes or not can be noticed by others in an intermediate group, but not in large groups. Examples of large groups are such as trader union or professional association while peasant communities with interest groups, are an example of intermediate groups. This means according to the author, even a peasant group can not collectively mange the common pool resources (Olson *ibid*).

Therefore, the author argued that, voluntary collective action is more likely to work in small interest groups as free riders, are easily noticed (hence no need of selective punishment) compared to larger interest groups, while selective incentive whether negative or positive may work in large groups such that, those who do not contribute can be treated differently from those who do. While the author mentioned whether the source of selective incentive is inside or outside the society, but from the reading it is clear that, the author suggested that outsider especially the state should be the source of such

selective punishment or inducements. In this case, the logic collective action theory is in line with the previous theories of the Prisoner's dilemma and tragedy of the commons (Olson, 1971).

2.14.4 Emerging views raised regarding common pool resources theories

The theory of tragedy of the commons has been criticized because of over simplification (Dietz *et al.,* 2003). Hardin (1968) equate common pool resources under common property regime and common pool resources under open access, with no any institutional arrangement to manage and control the resource. Indeed, the concept of property right regime, provided a useful corrective measure to Hardin's over simplification on critique of collective action (Lawry, 1990). However, Hardin corrected himself in another article "the tragedies of unmanaged commons" (Hardin, 1994) arguing that, tragedy of the commons will only occur in unmanaged common pool resources Nevertheless, the Hardin's model has profound effect as many development and environmental policies, were miss guided by the tragedy of the commons model and by wrong assumption that, common poll resources can only be managed by state or private regime. For example, in most developing countries their natural resources have been managed and controlled by the state after independence (Kowero *et al.,* 2003) with the assumption that is the best strategic way to manage the common resources sustainably.

For prisoner's dilemma to work, two assumptions must hold true. First, each player should decide out of ignorance of the other's choice; and secondly, the choice is once and for all even if one realises the choice of the other player (Wade, 1987). However, these assumptions are unrealistic in real situation. If the two assumptions do not hold true, then the best option will to co-operate first and defect if the other defects. Therefore, rational individuals can achieve rational collective outcomes. In addition, if the players can

negotiate changes in the rules of the game among themselves, then there is likelihood of introducing penalties for the violating agreements.

For logic of collective action, Wade (1987) urged that presence or absence of collective action. Based on his work in India, Wade (1987) found that when net collective benefit is high enough, collective action can emerge and be sustained without even selective incentives. Therefore, free riding will occur when net collective benefits is low and not because of the absence of selective incentives (punishment and inducement). However, at least logic of collection theory provided the solution of the tragedy of the commons.

Population growth and technological changes have increased pressure on natural resources to the extent that common property rules may not provide effective regulations (Lawry, 1990). Local common property regime operating at local level matters. Currently, Common Property regime is faced with two problems: problem of incentives meaning economic incentives are often insufficient, to stimulate individuals to participate or sanction local level resource management; and problem of authority which means difficult in local communities, in establishing rule and procedures for governing resource use when interests are heterogeneous and views, towards appropriate resources use standard vary between individuals (Lawry, 1990). Therefore, since states have failed in law enforcement in natural resources management regimes. The latter will involve assigning rights to a group to specific territory, provide technical guidance on resource management and help to create more positive economic development and cooperation.

Scholors such as Ostrom (1999) and Chatre and Agrawal (2008), have developed different conditions for management of common pool resources at local level. They focus on small size of user group, a location closer to the resources, homogeneity among group members,

effective enforcement mechanism and past experience of cooperation. In addition, other factors such as characteristics of the resource, nature of the group depending on the resource, rules and regulations, through which resources are managed through which the resources are managed, and the nature of the relationship between a group and external force and authorities such as market, state and technology, are important for successful management of common pool resources.

Therefore, the current institutional change in the management of natural resources by involving local communities emerged from Common Pool Resource theories. In most cases PFM approaches such as CBMF and JFM, were designed based on earlier theories of common pool property regime such as clearly defined boundaries, homogeneity in groups, harmony and equal distribution of forest resources (Lugandu, 2010).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Description of the Study Area

3.1.1 Location of the study area

CFR is located in Bahi District, in Dodoma Region which is located between latitude 4^{o} and 8^{o}S, longitude 35^{o} and 37^{o}E. Bahi District is one of the seven districts of Dodoma Region. Others are Kondoa, Chamwino, Dodoma Municipality, Mpwapwa, Chemba and Kongwa. The headquarters of the district is located at Bahi ward which is 50 km away from Dodoma Municipality, along the highway linking Singida and Dodoma regions. On the east, the district shares its border with Chamwino District and Dodoma Municipal; Kondoa on the north, Iringa Region on the Southwest, and Manyoni District on the West. CFR is surrounded by four villages namely Babayu, Chenene, Mkondai and Mayamaya (URT, 2009). The location of CFR is indicated in (Fig. 3).

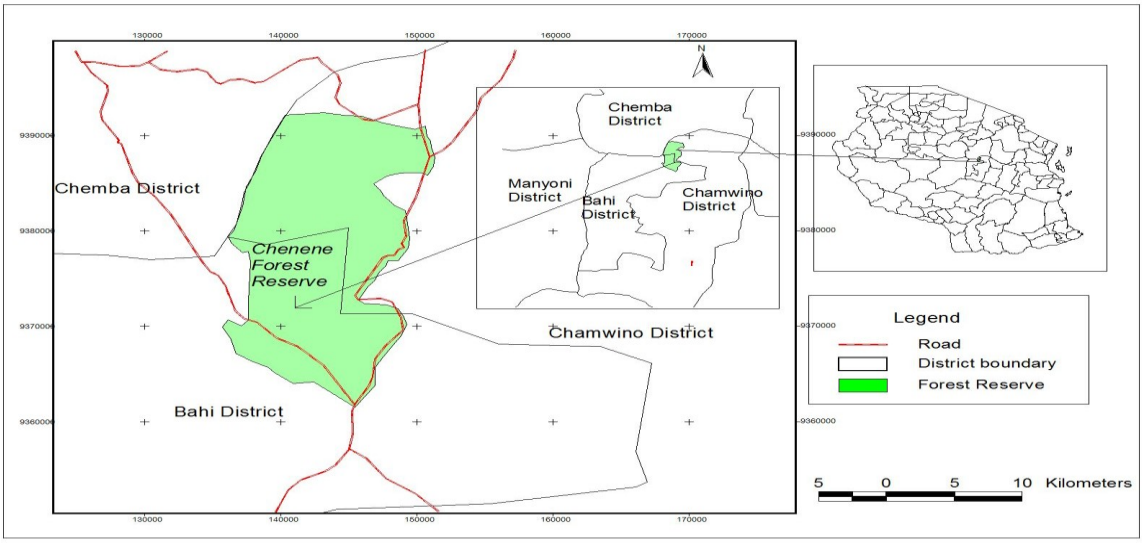

Figure 3: Location of the study area showing Chenene Forest Reserve.

3.1.2 Topography

Most parts of Bahi District, is flatland with gentle sloping hills and lowlands in some places. The district is raised to an altitude ranging between 560 – 1200m above sea level. In the eastern part of the district, there is Bahi lowland area. This area has a swampy characteristic which makes it suitable for paddy farming. As a result, Bahi, is one of the districts which cultivate paddy in Dodoma Region. In the northwest part there is Nondwa and Mchito dam, while in the central part (Ilindi) there is a wetland endowed with salt. Relatively high altitude areas are located in the northern part of the District wherein there is Chenene Mountain ranges covered with miombo forests. Other parts of District are more or less flatland with undulating hills (URT, 2009).

3.1.3 Climate, soils and hydrology

Rainfall

Most parts of the Bahi District, is semi-arid characterized by a low and erratic rainfall. Bahi District, experiences one rainy season between November and April. The rainfall duration, is usually very short and sometimes characterized with short period of heavy storms leading to floods. Due to the short rainfall duration, heavy water runoff and hence, poor water infiltration is common in the area leading to a less moisture reserve in soils. Rainfall ranges from 500 mm to 600 mm per annum. The rain season, is then followed by the long dry spell between the mid-April to the beginning of November, characterized by dry winds and low a humid that leads to higher evapotranspiration (URT, 2009).

Temperature

Bahi District experiences both high and low temperature. The highest temperature is 31^{o}C while the lowest is 18^{o}C. The cool dry season, begins in June and always ends up in early

September an absence of cloud cover lowers the temperature in the night but also rise the day light temperature (URT, 2009).

Winds

Winds, blow across the district from East/South to northwest of the district; the wind is usually dry contributing to the semi-arid condition of the area. The wind speed increase in July, with the strongest winds occurring on October. During driest season, the wind speed is higher as compared to wet season (URT, 2009).

Soils

The soil of Bahi district generally have a shallow depth, moderate fertility, moderate organic matter contents and moderate to poor permeability leading to a high surface runoff. Soil salinity is a serious problem that negatively affects crop growth in the area. The soil textural classes found in the district are as follows; Near to Iringa region (south west) and central part of the district, the soil is dark grey and brown sand, and sandy loams. The other part of the district is characterized by brown loamy soil to dark grey clay sands and sandy loam (URT, 2009).

Hydrology

Bahi district drainage is characterized by seasonal rivers and wetlands. There are very few permanent rivers and wetlands, such as Bubu River and Bahi wetland in the district. Both seasonal and permanent water sources in the district are very potential to the community as they provide water for domestic uses, livestock, irrigation, and act as fishing grounds. The main river in the District is Bubu, which flows from north to south-east and drains its water to Bahi swamp. During rainy season, many people around this river catch fish as one of their livelihood strategy. Like most rivers in the area, many natural dams, wetlands

and swamps in the district are seasonal. Some of these natural dams (non-salt natural dams), provide fishing ground to Bahi population surrounding them (URT, 2009).

3.1.4 Population size and growth

Bahi District was established after splitting of Dodoma Rural District into two districts. The district population is 221 645: 105 975 males and 115 670 females with a population growth rate of 1.5 percent (URT 2012). The populations in the study area are shown in Table 1.

Table 1: Population and households' distribution of villages adjacent to CFR, Bahi, Tanzania

Village	Population (2002)	Population (2009)	Population (2012)	No. of household (2012)
Mayamaya	3203	8812	9886	1159
Chenene	2342	6362	7436	720
Mkondai	1310	5240	6450	1529
Babayu	3520	8750	10 268	1580

Source: (URT, 2002; URT, 2009; URT, 2012; Village register, 2011).

The population growth rate was lower than the regional average of 2.3% indicating relatively low a population growth in the area compared to other districts in the region (Table 2).

Table 2: Population growth rate for Dodoma region districts

District	Growth rate (1988/2002	2002/2012
Dodoma	3.4	2.1
Kondoa	1.7	1.6
Mpwapwa	3.4	3.6
Chamwino	1.6	3.0
Kongwa	2.4	2.0
Bahi	2.3	1.5
Chemba	2.4	2.5

Source: (URT, 2009; URT, 2012)

Based on the above growth rate, the population of Bahi district is expected to increase from 221 645 to 332 467 in the year 2024; which still depict a low population as compared to the rest of the district in the region.

3.1.5 Ethnic groups in the district

The dominant group in the district is Wagogo, which account for more than 90% of the total population, followed by Warangi and Wasandawe, located in the northern part. Other tribes include Wasukuma located in the eastern part and the Wamasaai in the northwest.

3.1.6 Socio-economic activities

Agriculture

The district economy mainly depends on agriculture. This sector employs more than 80% of the district population. Farming by most of the households is on subsistence basis. According to URT (2009) about 378 207 ha of land, which is 70% of the total district area, are suitable for agricultural activities (arable land). The report further indicates that, out of the total arable land only 164 637 ha were under crop production. This area constitutes about 30% of total district area and 44% of total arable land.

The major crops grown in the district include Maize, Sorghum, Bulrush millet, groundnuts, sunflower, paddy, Bambara nuts, Cassava, sweet potatoes and to a lesser

extent, finger millet and grapes. Cereals like Maize, Sorghum and Bulrush millet, Finger millet, Cassava and sweet potatoes are mainly grown for food while Paddy, is for both cash and food. Other crops which are mainly grown for cash and food are groundnuts and Bambara nuts. Sunflower and Simsim are mainly grown for cash.

Irrigation farming

According to URT (2009), around 6 286 ha in Bahi district are suitable for irrigation. Areas endowed with irrigation potentials are Bahi, Mpamatwa, Chali, Mtitaa and Babayu Wards. Nevertheless, only 1 816 ha is being irrigated. The areas being irrigated are mainly located in Bahi, Mpamatwa, Chali, Chipanga and Mtitaa wards**.**

Livestock

Livestock keeping plays an important role in supporting the household's economy of the district. Based on URT (2012), the district was estimated to have 28% of its population keeping cattle, 37% keeping goats, 19% keeping sheep, and 78% keeping chickens. In addition, the survey revealed that donkey, turkey and guinea pigs are kept by less than 10% of the total households. The total population of cattle, goats and sheep in the district, was indicated by 2012 census to be 189 841; 39 470 and 7 604 respectively.

Fisheries

Fishing in Bahi district is mainly done seasonally; yet the sector has notable contribution to the individual income and that of the district as a whole. The main river for fishing in the area is river Bubu. Other rivers include Lukali, Kasela and Mkambala. In a few cases, fishing is being done throughout the year in areas with permanent swamps, located in Surunghai with an area of 290 km^2 and Nondwa 243 km^2.

Fish species found in the area are *Clarias* (Kambale), *Tilapia* (Perege), Ningu and *Sardines* (Dagaa) whereas, the main tools used in fishing are fishnets, fish traps and hook lines. The estimates of harvested fish in the district between 2001 and 2008 are as indicated in Table 3.

Table 3: Estimated harvest of fish (in tonnes) 2001/02 – 2011/12

	Fish species harvested (in tones)			
Species	**2001/02**	**2005/06**	**2007/08**	**2011/12**
Clarias (Kambale)	692.00	101.00	466.00	520.00
Tilapia (Perege)	341.00	72.00	363.50	1200.00
Ningu	2.50	0.25	0.50	15.00
Sardines (dagaa)	0.25	0.25	2.50	6.00

Source: (Bahi District Report, 2009; URT, 2012).

3.1.7 Social services

Socio- services available in the study villages include primary schools, roads which facilitate transportation of agricultural crops, secondary schools, dispensaries, and telecommunication infrastructure and information services.

3.1.8 Vegetation

The vegetation in the CFR is dominated by the miombo woodlands with arborescent genera *Brachystegia* and *Julbernardia* and some *Albizia* spp. (URT, 2009). The district is estimated to have 548 156 ha of land of which, 378 207 ha (70%) are arable land, 36 793 ha are conservation forest, of which CFR cover 29 800 ha and 133 156 ha are grazing land (URT, 2009).

3.1.9 Development actors in Bahi district

Bahi District has several development actors, who contribute to the socio-economic development activities by providing different support services. The actors are categorized in different groups like Ministries, Regional Administrative Secretariat, District Council, local institutions (i.e. Local NGOs, FBOs, CBOs, SACCOS, Schools, traditional institutions and international development agencies), all with the role of supporting the implementation of the policy, through provision of socio-economic services like health services, formal and/or informal education and capital generation.

3.2 Methods

Three types of data sets were collected, namely ecological, remotely sensed and GIS and socio-economic data.

3.2.1 Collection of ecological data

3.2.1.1 Forest inventory and sampling design

The forest inventory was carried out in 2011, data collection were based on normal inventory procedures as detailed by Phillip (1994). Systematic sampling design, with plots aligned along the transect was used, the number of plots for inventory was calculated by using the following formula (Phillip, 1994).

$$n = \frac{cv^2 t^2}{E^2} \qquad \text{……(1)}$$

Where:

n= number of sample plots

cv = coefficient of variation

E= sampling error

t= students t-value at specific level of significance.

The number of plots was determined from a pilot survey in CFR to determine coefficient of variation. Systematic sampling design with the first plot randomly laid at 500 m from the first boundary was employed, subsequent plots were laid along transects at 1600 m interval and transects were 1600 m apart. Circular nested plots of 5, 10 and 15 m were used to collect ecological data in the forest.

The number of sampling units (n) required to attaining the desired precision at sampling error (E) of 10% by using the formula given above. The total number of plots was 120 plots of size 0.07 ha (Fig. 4).

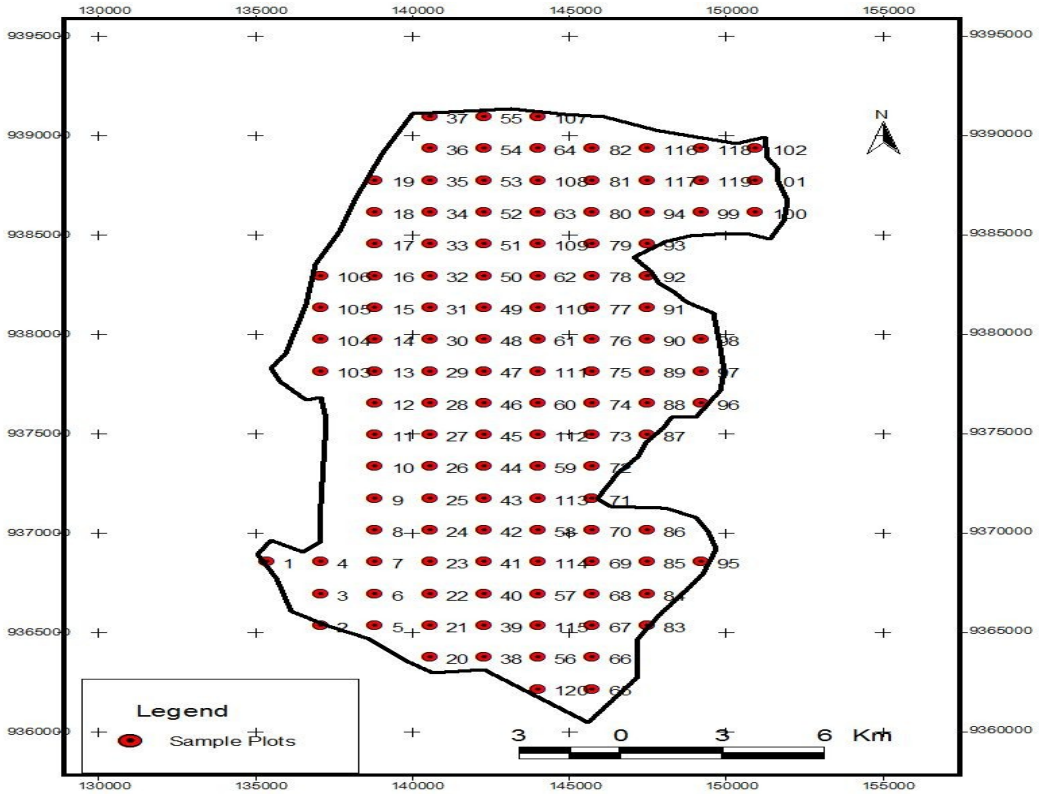

Figure 4: Layout of transects and sample plots.

3.2.1.2 Parameters measured at plot level

Data on forest stock and tree diversity were collected from established sample plots by using standard inventory techniques (Zahabu and Malimbwi, 2008; MNRT, 2005a; Phillip, 1994). The concentric plots were used had 5 m, 10m, and 15m radii in which the following parameters were measured:

(i) Within 5 m radius: all trees with dbh $\geq$ 5 cm, but < 10 cm were identified, their dbh measured.

(ii) Within 10m radius: all trees with dbh $\geq$ 10 cm but <20 cm were identified, their dbh measured.

(iii) Within 15 m radius: all trees with dbh > 20 cm were identified and measure their dbh. Tree species were identified with the help of a botanist and local people.

Human disturbances such as number of cut trees, fire scorch signs, grazing signs, presence of charcoal kilns and sawing platforms, were recorded in each plot during inventory and assessed by using t-test with reference to distance of plots from the forest boundary .

3.2.1.3 Remotely sensed and GIS data

Image selection and acquisition

Considering low cloud cover (<10%), the seasonality and phenological effects Jansen (1996), images covering the study area were collected. These comprised of images taken in 1987 (i.e. before decentralization) and 2001 (i.e. after the management of CFR was devolved to the local government). The details on the satellite images are shown in Table 4.

Table 4: Image data

Sensor	Date of acquisition	Path/Row	Spatial Resolution (m)	Remarks
Landsat TM	25-2-1987	P168r64	30x30	Before decentralization
Landsat TM	3-11-2001	P168r64	30x30	After decentralization

3.2.2 Socio-economic data collection

3.2.2.1 Sampling units

Sampling unit was the individual members chosen from a total population as respondents (Bryman, 2004). In this study, a sampling unit was a household because it was a basic unit from which information was obtained and characteristics were described that represented characteristics of entire population inhabiting Bahi District.

3.2.2.2 Sampling design

Random sampling design procedure was used for selecting households to be included in the sample and village register was used as sampling frame. Two villages (Babayu and Mayamaya) were selected purposefully from four villages adjacent to CFR. The reason for selecting these villages was their closeness to CFR. The sample size was determined according to Boyd *et al.* (1981) where the intensity of 5%, was used to determine the sample households in each village. This sample is supported by Mbeyale (2009) and Akitanda (1994) who indicated that, a sample of at least 30 units is sufficient irrespective of the population size. Table 6 shows the distribution of population, households and sample sizes in each village.

Table 5: Distribution of sample households in the study area

S/N	Village	No. of households	Population	Sample size
1.	Babayu	1580	8750	79
2.	Mayamaya	1150	8812	58
	Total	**2730**	**16 562**	**137**

Source: Village registers, (2010

3.2.2.3 Data collection methods

(i) Primary data collection

Both primary data and secondary socio-economic data were collected by using a combination of methods: Questionnaire, Participatory Rural Appraisal (PRA), and checklist for key informants interviews (Appendix 2, 3 and 4). This combination of methods, helped to triangulate and validate information collected from other methods. Data were collected in four phases of which, the first phase involved reconnaissance survey, whereby the researcher familiarized himself with the study area and selection of the study villages. Second phase involved PRA whereas the third phase involved pre-testing of questionnaires and questionnaires survey.

Pre-testing of questionnaires was conducted in Chenene village which was not included in the main study. Ten households were involved in questionnaire pre-testing. Thereafter, modifications were made ready for questionnaire administration. Fourth phase involved key informant's interviews. Secondary data collection was done throughout the study. This helped to confirm and validate the information collected from various methods.

a) Participatory Rural Appraisal

Participatory Rural Appraisal (PRA) approaches were used to open up the discussions with stakeholders in the study villages on topics of interests, through participatory

communication and analytical techniques. PRA approaches enabled the researcher and research assistants to collect data on a list of stakeholders, their interests and area of conflicting interests on forest resources, existing institutions governing forest resources use and management, types of resources use and management strategies, also PRA, were used to assess institutional performance and effect of forest cover changes on forest vegetation cover, over the last decade. The PRA tools, used to achieve this purpose were multi-stakeholders analysis, pair wise ranking and scoring, resource mapping, transect walks and trend analysis (Appendix 4).

i) Multi-stakeholders analysis

Multi-stakeholders analysis was applied to gather and analyze information on categories of stakeholders and their corresponding interests and areas of their conflicts, over forest resources in the study area (Appendix 3). Stakeholders discussion were based on those who governed forest resources utilization and management, those who facilitated conservation activities and those who benefited directly from extraction of forest resources and they were grouped into three categories as regulators, facilitators and users. Kitula (2012), indicated that, categories of key stakeholders in natural resources management, to include regulators, facilitators and users. The interests of stakeholders on forest resources were analyzed based on their stakes and roles and responsibilities, in the forest resource utilization and management. The analysis of area of conflicting interests was based on the way incompatibility interaction between and within stakeholders was enhanced over forest resources; where one of the stakeholders was damaged by the interaction while the other stakeholders, ignored the damage of this interaction (Kitula, 2012).

ii) Pair-wise ranking and scoring

These tools were used to rank the most key stakeholders, responsible institutions over forest resources and types of conflicting interests.

iii) Resource mapping

The activity encouraged participants to draw and discuss spatial distribution of forest resources in terms of harvesting, livestock grazing and conservation areas.

vi) Wealth ranking

Wealth ranking was conducted to the respondents to gain an understanding of villagers' economic status and linkage, in accessing forest resources. In each study villages, a group of four knowledgeable individuals (two men and two women), were selected with assistance from village leaders. The group discussed different characteristics of different wealth groups, and then categorized individual households, into three wealth categories as rich, middle and poor (Kitula, 2012).

v) Transect walks

During transect walks, several position points on the resources boundaries of CFR ecosystem of the study area as well as affected developmental activities, were marked using a handheld Global Positioning System (GPS). This approach was conducted on foot.

vi) Trend analysis

Participants were asked to recall and provide underlying reasons on vegetation cover changes that have taken place in the forest resources, institutional performance, resources usage and conflicting management strategies over CFR.

b) Questionnaire

A questionnaire (Appendix 2), was the main research instrument for collecting primary data from subsistence users of forest resources and it included both open and close-ended questions. The questionnaires were administered by both researchers and research assistants to the respondents.

c) Focus Group Discussions (FGDs)

The Focus Group Discussions (FGDs), involved two different groups of stakeholders including regulators (Village Governments (VGs), Village Environmental Committees (VECs) and user groups, involved in harvesting forest products, beekeeping, traditional healers and local leaders). FGDs, were conducted to obtain insights into their areas of conflicting interests, institutions governing forest resources usage and management and their performance, type of resources usage and conflicting management strategies. A checklist of questions which was used in guiding the FGDs is given in Appendix 4. Ten people in each group for each village were involved. The composition of groups in terms of gender and age was taken into account.

d) Discussion with key informants

Discussion with key informants, were aimed at obtaining information that assisted in clarifying or improving understanding of particular issues or problems that were raised in PRA exercise (Appendix 4) and checklist (Appendix 3). Mettrick (1993) key informants are people who are accessible, willing to talk and having great knowledge regarding the issues under discussion. Key informants involved:

(i) Commercial users – large and small scale harvesters of poles, timber and charcoal burners;

(ii) Regulators – District Council Officials, Ward Executive Officers and Councillors, Village Executive Officers and elders and

(iii) Facilitators – Dodoma Environmental Network (DONET), Miradi ya Gesi ya Samadi Dodoma (MIGESADO) and Afri-Care Tanzania

Questions which were asked to the stakeholders, reflected to their areas of conflicting interests in managing forest resources, resources usage and trend of the resources availability, existing institutions, degradation or sustenance of forest and to suggest possible solutions that were relevant for the management of forest resources. Checklists of questions were used to guide the interviews (Appendix 4).

(ii) Secondary data collection

Secondary data were collected through documentary reviews of both published and unpublished documents from library (text books, journals and pamphlets), village offices in the study and different websites.

3.2.3 Ecological data analysis

3.2.3.1 Analysis of forest inventory data

A combination of Geographic Information System (GIS) and a remote sensing method, and information generated from forest inventory, were used to assess the effects of the institutional changes on the resources base. For the miombo woodland forest, the total tree volume was calculated using allometric equation that was developed by Malimbwi *et al.* (2005) for miombo woodland of eastern Tanzania.

Volume

$$V = 0.000011972D^{3.191672} \quad \text{.....(2)}$$

From the collected data, it was also possible to compute other forest stand parameters such as: density, i.e. the number of stems per hectare (N) and Basal area per hectare (G). These parameters are very important in forest management as they provide useful information on forest stocking levels.

Tree diversity

Tree diversity was determined using the Shannon Wiener Index.

$$H' = -\sum_{i=1}^{s} p_i Inp_i \quad \text{.....(3)}$$

Where:

H'=Shannon-Wiener Index

P_i =is the proportion of total sample belonging to the i^{th} species ($p_i = n_i / N$)

n_i = the number of individuals of each species.

In = natural logarithm

N = total number of individuals of all species

Importance value index (IVI)

Data were quantitatively analyzed for abundance, density and frequency according to the formula given by Curtis and McIntosh (1950), cited by Evariste *et al.* (2010). Importance value index (IVI) is the sum of the relative density (RD), relative frequency (RF) and relative dominance (RDo) of a species in a community (Evariste *et al.,* 2010). The IVI value of any species in a community ranges between 0 – 300 and the sum of IVI of all species is 300. The following equation was used to calculate IVI as defined by Curts and McIntosh (1950) cited by Everiste *et al*. (2010):

IVI = (RD + RF + RDo) …… (4)

Where: IVI is the importance value index,

RD = Relative density,

RF = Relative frequency and

RDo = Relative dominance

RD is a proportion of density of a species with respect to total density of all species in percentage; it was calculated using the following equation:

$$RD\,(\%) = \frac{Density\ of\ species}{Total\ density\ of\ all\ species} x100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

And density, which represents the numerical strength of the species in the community, was calculated as:

$$Density\ (p/ha) = \frac{Tota\ln umber\ of\ individual\ species\ A}{Total\ umber\ of\ plots\ studied\ xplot\ area} x\,100 \quad \ldots\ldots\ldots\ldots\ldots(6)$$

Relative dominance (RDo), is the proportion of basal area of species in respect to total basal area of all species. Basal area is one of the chief characteristics to determine dominance. Therefore, relative dominance was determined as the relative value of basal area (Evariste *et al.,* 2010).

$$RDo\,(\%) = \frac{Combined\ basal\ area\ of\ a\ spgies}{Total\ basal\ area\ of\ all\ species} x\,100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(7)$$

The relative frequency (RF) and frequency was calculated as follows:

$$RF(\%) = \frac{Frequency\ of\ species\ A}{Sum\ of\ the\ frequency\ values\ for\ all\ species} x100 \quad \text{.....(8)}$$

and the frequency was obtained from:

$$Frequecy = \frac{Total\ umber\ of\ plots\ in\ which\ species\ A\ occured}{Total\ number\ of\ plots\ sampled} \quad \text{.....(9)}$$

3.2.3.2 Detection of forest cover changes

The analysis followed two steps i.e. satellite imagery interpretation and change detection analysis.

i) Image pre-processing

Image rectification/georeferencing

Image pre-processing, involved mainly image rectification/georeferencing and image enhancement. To ensure accurate identification of temporal changes and geometric compatibility with other sources of information, images were coded to the coordinate and mapping system of national topographic maps, which is UTM coordinate zone 36 South, Spheroid Clarke 1880, Datum Arc 1960, based on previous geo-referenced Landsat image of 1987 (Mbilinyi *et al.,* 2007).

Image rectification, was undertaken using 1st order polynomial transformation and nearest neighbourhood interpolation. The first order transformations were employed according to Kashaigili (2006) as:

$$Y_0 = a_1 + a_2 x_1 + a_3 y_1 \quad \text{.....(10)}$$

$$X_0 = b_1 + b_2 x_1 + b_3 y_1 \quad \text{.....(11)}$$

Where:

X_0 and Y_0 = the rectified coordinates (outputs)

X_1 and y_1 = source coordinates (input GP Coordinates)

a_1, a_2, a_3, b_1, b_2, b_3 = the transformation matrix coefficients or mapping polynomial coefficients.

In order to estimate the transformation matrix coefficients, enough well defined and spatially small features that are easily identified on both the map and the image were employed. These points are called ground control points (GCP). Once selected, the GCP, were then registered and used to estimate the polynomial coefficients by substitution in the mapping polynomial equation. In this study, image identification points the (GCP) normally taken at roads intersections, forest boundaries beacons, etc), were selected and matched to both the images and then digitized on screen. To confirm how well the images were overlaid on the same window and zoomed into various features at multiple locations around the scenes (Kashaigili, 2006).

Visual interpretation

In order to reinforce visual compatibility of images, a colour composite (Landsat band TM 4, 5, and 3) was prepared and its contrast was stretched using Gausian distribution function. The 3 x 3 high pass filters were applied to the colour composite to further enhance visual interpretation of linear features, i.e. rivers and vegetation features..

ii) Preliminary image classification and ground truthing

Both visual and digital image classification approaches were used using hybrid image classification, firstly, unsupervised classification was performed followed by supervised image classification using maximum likelihood classifier (MLC) (ERDAS, 1999). Unsupervised classification was done in order to have an insight into spectral groupings

that may make physical sense and also to determine how well the intended cover classes could be defined from the image. Supervised image classification involved selection of training sites (signature) on the image, which corresponded to specific forest cover classes (ERDAS, 1999).

Training field, was identified by inspecting enhanced colour composite 4, 5, 3 in which vegetation types and condition are clear and visible than other band combination (Kaufmann and Seto, 2001). The training areas were identified with the help of topographic maps and several iterations were made to improve the classification. Ground truthing, was done in order to verify and modify the initial classification in the base-map and obtain actual field information for accuracy assessment. A hand-held GPS was used to locate sampled vegetation types in the field. The pre-processed multi-spectral satellite image classes were then merged by recording. The final classification of the vegetation types resulted into the following classes namely; Closed woodland, Open woodland, Scattered woodland, Shrubs, Grassland, Water features and Settlements.

iii) Accuracy assessment

In order to assess the accuracy of the classification an error matrix was generated. This is an accuracy assessment procedure for image classification (Kashaigili and Majaliwa, 2010). To perform this analysis, a sample of the classified pixels from the thematic map, were randomly chosen using the accuracy assessment tool in ERDAS IMAGINE software and then compared visually with the reference data from inventory, topographic maps and ground truthing. A total of 120 random points were generated to determine the accuracy of the classification. From the error matrix, accuracies of each category, overall accuracy and K_{HAT} were calculated following formulae provided in Congalton (2001).

Error of omission or producer's accuracy, indicates the probability of the cell value in map 2 being the same as in map 1, was calculated as percentage of correct for a given column divided by the total for that column.

$$\text{Ommission error} = {Xii}/{X+i}\ x\,100\% \quad \text{.....(12)}$$

Where: X_{ii} = total number of correct cells in the class

X_{+i} = sum of the cell values in the column

Commission error or user's accuracy, indicates the probability of the cell value in Map 1 being the same as Map 2; this was calculated as the percentage correct for a given row divided by the total for that row.

$$\text{Commission error} = {Xii}/{Xi+}\ \text{x}\,100\% \quad \text{.....(13)}$$

Where: X_{ii} = total number of correct cells in the classes

X_{1+} = sum of the cell values in the row

The overall accuracy is the probability that a random point in the target is classified correctly in the map. It summarizes the total agreement/disagreement between the reference data and interpreted forest cover types; usually, it is the major diagonal of the matrix by the total number of sample units in the matrix (Congalton, 2001).

$$Overall\ Accuracy = {D}/{N}\ x\ \ 100\ \ \% \quad \text{.....(14)}$$

Where: D = total number of correct cells as summarized along the major diagonal

N = total number of the cells in the error matrix

K_{HAT} statistic measure the agreement or accuracy based on Kappa analysis, it is useful for comparing maps of similar categories to determine if they are significantly different. It was calculated as follows:

$$K' = \frac{N\sum_{i=1}^{r} Xii - \sum_{i=1}^{r}(Xi+*X+i)}{Ni - \sum_{i=1}^{r}(Xi+x*X+i)} \quad \text{.....(15)}$$

Where: Xii = total number of correct cells in a class (value in row i and column i)

$X+_i$ = total for row i

X+i = total for column i

N = total number of cells in the error matrix

vi) Forest cover change detection

Change detection, was performed through the overlay method based on generated vector themes of different years. Change detection, was done between dataset of 1987 and 2001 years using year 1987 as a common baseline data year for both period. The overlay was performed by intersecting feature themes so that the boundaries and attributes of the themes were combined to form derivative output theme. The attribute tables of the output theme were summarized in definition tables and results were exported in MS- Excel Package to compile areas for each information category.

Change detection analysis entails finding the type, amount and location of forest cover changes that are taking place (Kashaigili and Majaliwa, 2010). Various algorithms are available for change detection analysis and they can be grouped into two categories namely (a) pixel-to-pixel comparison of multi-temporal images before image classification and (b) post-classification comparison method (Jansen, 1996). In this study, a post-classification comparison method was used to assess forest cover changes (Fig. 4). It is the most common approach for comparing data from different sources and dates (Jansen, 1996). The advantage of post-classification comparison is that, it bypasses the difficulties associated with the analysis of images acquired at different times of the year and/or by different sensors (Kashaigili and Majaliwa, 2010).

The method has been found to be the most suitable for detecting forest cover changes (Kashaigili, 2006); as this enables estimation of the amount, location and nature of change. The only pitfall is that, the accuracy of the change maps depends on the accuracy of individual classifications and is subject to error propagation (Zhang and Foody, 2009). The approach identifies change by comparing independently classified multi-date images on pixel-by- pixel basis using a change detection matrix.

vi) Assessment of the rate of change of forest cover changes

The estimation of the rate of change for the different forest cover changes was computed based on the following formulae (Kashaigili and Majaliwa, 2010).

$$\% \, change_{year\,t} = \frac{Area_{year\,x} - Area_{year\,x+1}}{Area_{year\,x}} \text{x}100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(16)$$

$$\% \, Annual\ rate\ change_{year\,t} = \frac{Area_{year\ x} - Area_{year\,x+1}}{Area_{year\,x} \times \ t_{years}} \text{x}100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(17)$$

Where: $Area_{years\,x}$ = area of cover i at the first date.

$Area_{year\,x+1}$ = Area of cover i at the second year.

t_{years} = period in years between the first and second scene acquisition dates

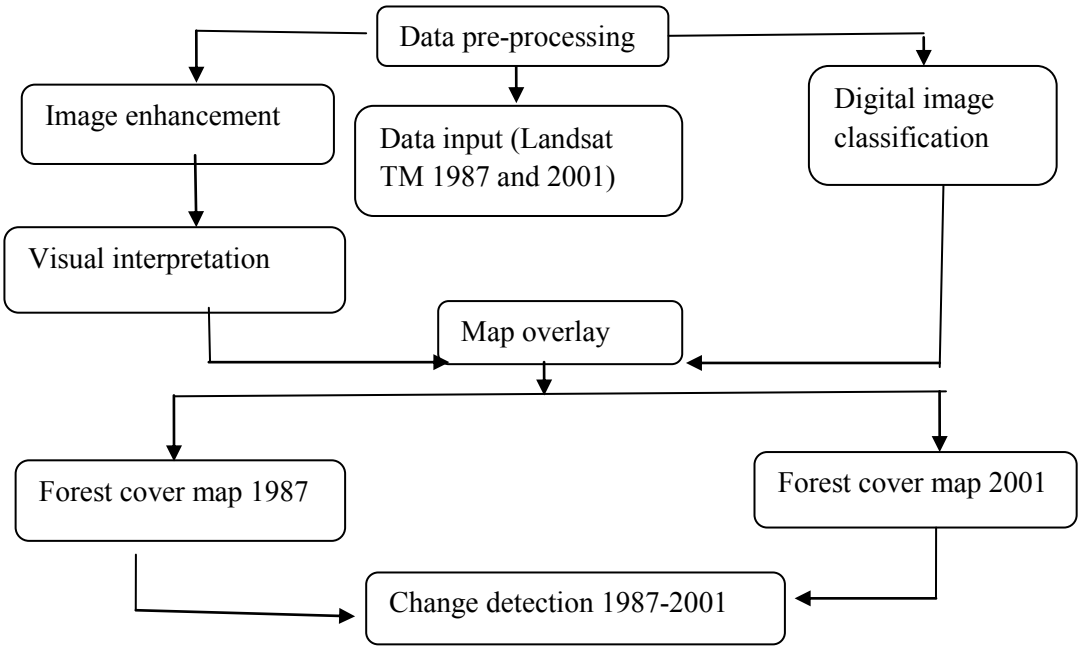

Figure 5: The image analysis flow chart (Adopted from Kashaigili, 2006).

3.2.4 Socio-economic data analysis

3.2.4.1 Analysis of performance of local governance structures

Both qualitative and quantitative methods of data analysis were employed. Qualitative analysis helped to get a deep understanding of research problem, while quantitative analysis was used for descriptive and inferential statistical analysis.

i) Qualitative data analysis

Content analysis was used to analyze qualitative information collected through PRA discussions with key informants and documentary reviews. While structural – functional analysis sought to establish relationship among social facts, and how these relate to physical realities. The qualitative data obtained during PRA exercises were communicated back to them for verification.

ii) Quantitative data analysis

Both descriptive and inferential statistical analyses were carried out for quantitative data. Significant differences between categories and villages were judged based on chi-square (χ^2) values at 5% level of significance. A statistical Package for Social Sciences (SPSS) computer software version 16 was used in analyzing the quantitative data.

3.2.4.2 Statistical analysis on effect of institutional change on forest governance

In order to assess the effects of the institutional changes on forest governance of adjacent communities at CFR, scores from local people's perceptions on effects of institutional changes on good governance, were computed following Mehta *et al.* (1998)**:**

(i) Indicator score: calculated as sum of scores of each respondent divided by number of respondents.

(ii) Principle mean score: calculated as sum of scores of indicators in each principle divided by number of indicators.

(iii) Overall governance mean score: calculated by summing all mean scores of principles and divided by number of principles.

These mean scores were used for inferential statistical analysis.

The mean score calculated (from above), ranged between 1 and 3 which is similar to the adopted likert scale. Since the objective of the study was to assess whether local peoples' perceptions differ on the effects (improved or not) of the institutional changes on forest governance. Scale 2 was selected as a cutting point. This study assumed that, all respondents that ranked the effects of institutional changes as 2 or less did not have a positive attitude towards institutional changes reform. Therefore, all values equal to or below 2, were collapsed and assigned '0' as no improvement and values above 2 were collapsed and assigned '1' as improvement. This classification applied for forest

governance. In order to assess respondents' perception of effects of the institutional change on quality of governance (improved or not) non parametric, one sample χ^2 test (Person χ^2 test) was employed. To test whether the respondent's perceptions of the effect of institutional changes on quality of forest governance (improved or not), differed between villages that had undergone institutional changes, non parametric, two- sample χ^2 test (Person χ^2 test) was employed at 5% level of significance (Pallant, 2005).

3.2.4.3 Analysis of factors influencing performance of local institutions

Logistic regression analysis, were performed to identify some factors (independent variables), which were likely to influence performance of local institutions (Y_i), governing forest resources utilization and management. Logistic regression, was used because institutional performance was recorded as a dependent variable and independent variables of any type (a mix of continuous and categorical variables) which were not uniformly distributed**.**

a) Dependent variables (Y_{i1})

The analysis, if socio-economic factors' influencing the performance of local governance structures was important, since it can show the direction of change (Balint *et al.,* 2002). Following suggestions by Kajembe and Kessy (2000), performance governing forest resources utilization and management in the study area, were composite indices of four attributes as shown in Table 7.

Table 6: Composite index table for institutional performance

Attributes	Good (3)	Satisfactory (2)	Poor (1)	Absence (0)
Rule of law				
Transparency				
Accountability				
Equity				

The composite indices were the measure of institutional structures under study to participate in management of forest resources. The attributes were drawn from good governance indicators Ostrom (1990) showed the indicator of institutional performance and community drawn indicators as shown below.

(i) Performance of key institutions governing forest resources utilization and management = f (good governance indicators) + (Ostrom indicator of institutional performance) + Community drawn indicators)

(ii) Good governance indicators = f (rule of law) + (transparency) + (accountability) + (Equity)

(iii) Ostrom indicator of institutional performance = f (rule of law)

(iv) Community drawn indicator =f(Accountability)

The composite indices were the measure of institutional structure under study to participate in management of forest resources. A Likert scale ranged from 0 to 3. The ratings were defined as 3 = good, 2 = satisfactory, 1 = poor, 0 = absent. Kisoza (2006) used composite index as an important variable in measuring institutional performance, in managing grazing land in Kilosa and Ngorongoro Conservation Area, Tanzania. Kisoza (2006) argues that, the analysis of factors in aggregate way allows a clear and objective

evaluation of institutional performance. Following this, the scores were summed up for each factor and then average score were computed for each factor, for each household and each study village. The cut point for performance was 1.5 whereby 1.5 was poor assigned '0' while from one 1.5 to 3 was good assigned '1'.

b) Independent variables influencing performance of institutions

The independent variables were the socio- economic factors which were likely to influence institutional structures to participate in the management of forest resources. In showing the relationship between dependent variables, the conceptual causal chains were adopted from Agrawal (2001) as illustrated below:

i) Performance of the first ranked key institution (Y_{i1}) governing forest resources utilization and management

Performance of the first ranked key institution (Y_{i1}) governing forest resources utilization and management.	= (socio-economic, demographic and institutional factors) + (Error)
(i) Socio-economic factors	=f (participation in forest conservation + education level + duration of residence + distance from home to the forest reserve + wealth status) + Error
(ii) Demographic factors	= f (family size + sex + marital status) + Error
(iii) Institutional factors	= f (importance of clearly defined boundaries + presence of by laws in forest conservation + restrictions on harvesting forest resources) + error

Therefore:

Performance of the first ranked key institution (Y_{i1}) governing forest resources utilization and management	= f (participation in forest conservation + education level + sex + marital status + household size + residence duration +distance from home to forest reserve + age) + Error

The following logistic regression equation was developed based on casual chains to assess factors, which are likely influencing the first ranked institutional performance under study, to participate in management of forest resources.

$$Logist\ (Y_{i1}) = In\left[\frac{Y_{i1}}{1-Y_i}\right] = b_i + b_1x_1 + b_2x_2 ... b_nx_n \quad (18)$$

Where:

Logist (Y_{i1}) = is the natural log of the odds of an event occurring

Y_{i1} is the likelihood that the first ranked institutional structure under study participate in the management of forest resources =

$1 - Y_{i1}$ = is the likelihood that the first ranked institutional structure under study constrained to participate in the management of forest resource management

X = Independent variables (socio-economic, demographic and institutional factors)

Bi = independent variable coefficients estimates from the data showing marginal effects (negative or positive) of the unit change in the

independent variable

N = Number of independent variables

ii) Performance of the second ranked key institutions (Y_{i2}) governing forest resource utilization and management

Performance of the second ranked key institution (Y_{i2}) governing forest resources utilization and management	= (socio-economic, demographic and institutional factors) + (Error)
(i) Socio-economic factors	=f (level of awareness on illegal activities + illegal access to forest products + importance of clearly defined boundaries) + Error
(ii) Environmental factor	= f (awareness on resources extinction) + Error
(iii) Institutional factors	= f (poor coordination of stakeholders in conservation activities) + error

Then following logistic regression equation, was developed based on the casual chains to assess factors which are likely influencing the second ranked institutional structure under study, to participate in the management of forest resources.

$$Logist\left(Y_{i2}\right) = In\left[\frac{Y_{i2}}{1-Y_{i2}}\right] = b_i + b_1x_1 + b_2x_2 ...b_nx_n \text{..} (19)$$

Where:

Logist (Y_{i2}) = is the natural log of the odds of an event occurring

Y_{i2} is the likelihood that the second ranked institutional structure under

study participate in the management of forest resources

$1 - Y_{i2}$ = is the likelihood that the second ranked institutional structure under study constrained to participate in the management of forest resource management

X = Independent variables (socio-economic, environmental and institutional factors)

Bi = constant term of the model

B_1-n = Independent variables coefficients estimates from the data showing marginal effects (negative or positive) of the unit change in the independent variable

N = number of independent variables

The hypotheses tested were:

(Ho): $\beta = 0$ indicating that the regression coefficients are equal to zero and therefore, no relationship between independent and dependent variables

(H_1): $\beta \neq 0$ indicating that the regression coefficients are not equal to zero and thus, there is either positive or negative relationship between independent and dependent variables.

c) Independent variables influencing the performance of the first ranked key institution (Y_{i1})

X_1 = Participation in conservation activities: Participation includes involvement of local communities in decision making and conservation of forest resources. It was assumed that a high participation of households in conservation activities likely to increase the performance of institutions. This is because participation was assumed to generate commitment within individuals. Participation of a household in conservation activities was assumed to have positive sign of the estimate (β). It is a dummy variable with value '1' assigned for yes or if the respondent had participated in conservation activities or '0' if otherwise.

X_2= Sex of respondent: Sex, has a profound influence on how men and women play in the management and conservation of natural resources. It is assumed that, the exclusion of women in the management and conservation of forest resources gives negative effect on the performance of local governance structures due to the fact that, women are known to be the main users of forest products like firewood. The expected sign for Beta value was negative (-β).

X_3 = Age of respondents in years: It is assumed that an increase in age of the respondent reduced forest encroachment because older persons are usually assumed to have accumulated enough resources to meet their livelihood needs. They are also assumed to have much wisdom to conserve and usage of forest resources and hence, positive effect on performance of local governance structures. The expected sign for Beta value was positive (+β).

X_4= Level of education of respondents (years of schooling: It is assumed that an increase in education level of the local people around the forest tended to enhance wise use of forest resources, hence, resulting into positive performance of local governance structures. The expected sign for Beta value was positive (+β).

X_5 = Average distances (in km) from homestead to forest reserve: It is assumed that, as far as the respondents' homestead to the resource base the less the occurrence of resource use encroachment. Therefore, the increase in distance to the forest reserve, had a positive effect to the performance of local governance structures. The expected sign for Beta value was positive (+β).

X_6 = Household size: It is assumed that, the high number of members in a household tended to increase the demand of the forest resources. Therefore, increase of household members has a negative effect on the performance of local governance structures. The expected sign for Beta value was negative (-β).

X_7 = Market price: It is assumed by increasing the market price of a key forest product increased the possibilities for resource degradation hence, a negative effect on the performance of local governance structures. The expected sign for Beta value was negative (-β).

X_8= Duration of residence (years): It is assumed that, the more time a person stayed in a particular area, the less the incidences in resources encroachment. This is due to the fact that, an individual who had stayed in a particular place for a long time is an immigrant to the area, hence, a positive effect on the performance of the local governance structures. The expected sign for Beta value was positive (+β).

X_9 = Marital status of respondents: There is high probability of occurrence of resources encroachment with an increase in number of married heads of households, due to increased responsibilities of heads of households to meet household demands from different resources hence, a negative effect to the performance of local governance structures. The expected sign for Beta value was negative (-β).

d) Independent variables influencing performance of the second ranked key institution (Y_{i2})

X_1 = Level of awareness on illegal activities: Level of awareness, is defined as a human's perception and cognitive reaction towards forest resources utilization and management. Level of awareness was assumed to have a positive sign of the estimateβ. This is because the increased awareness tended to increase performance of institutions as users, would know the dos and don'ts regarding resource utilization. It was conceived as dummy variable with value 1 assigned for 'yes' if a respondent, was aware that illegal activities in CFR are not allowed or 0 if otherwise.

X_2 = Illegal access to forest products: Illegal access to forest products was assumed to have a negative sign of the estimate (β). It was assumed that, illegal access to forest products tended to contribute to insufficient funds to facilitate law enforcement. This situation is likely to reduce the performance of the institutions. It was conceived as dummy variable with value 1 assigned for household, that had accessed forest products illegally or 0 if otherwise.

X_3 = Awareness to resource extinction: Awareness to resource extinction was assumed to have a negative sign of the estimate (β). It was assumed that, lack of awareness of resource extinctions tend to increase the level of negligence in participating in the

conservation activities. It was conceived as dummy variable with value 1 assigned for a household, who is unaware of resources extinction or 0 if otherwise.

X_4 = Poor coordination of stakeholders in conservation activities: Poor coordination of stakeholders, for conservation of forest resources into an integrated and harmonious operation activity in CFR, had a negative sign of the estimateβ. It was assumed that, poor coordination of stakeholders in conservation activities resulted in poor performance of institutions. This is because poor coordination of stakeholders, was associated with overlapping mandates and duplication of efforts. It was conceived as dummy variable with value of 1 assigned for households, who perceived that stakeholders in forest resources were poorly coordinated or 0 if otherwise.

X_5 = Perceived importance of clearly defined boundary in forest reserve: It was assumed that a presence of clear defined boundaries for CFR itself increased the institutional performance. Perceived importance of clearly defined boundary in forest protection was assumed to have a positive sign of the estimate (β). It is a dummy variable with value 1 assigned for 'yes' if the respondent indicated it is important having clear demarcation between CFR and other adjacent habitats or 0 if otherwise.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

4.1 Overview

This chapter, consists of five sections; the first section describes the local institutions, their role in the usage and management of forest resources, since the colonial and post-independence era; Second, discusses the effects of institutional changes on forest governance before and after decentralization of CFR; Third, analyses the conflicting interests and power relations of key stakeholders involved in the usage and management of CFR, fourth presents the effects of institutional changes on forest condition, in terms of forest cover changes, Woodstock and tree diversity, finally the last section, presents results on factors influencing the performance of local governance structures, in the management of the forest resources.

4.1.1 Formal organizations and informal institutions in the management of CFR

The formal organizations, which were identified during the Participatory Rural Appraisal (PRA) exercises, that were involved in governing the management and usage of natural resources include: Village Government (VGs), Village Environmental Committees (VECs), Dodoma Environmental Network (DONET), Miradi ya Gesi ya Samadi Dodoma (MIGESADO), and the Bahi District Council. According to Bandaragoda (2000), the formal institutions were referred as an external funded, originated outside the community and were established through written procedures. While informal institutions were referred as an internal sponsored- these originated within the community. The functions and roles of the local institutions can further be used to differentiate them into the following: structural, organizational and constraints (e.g. taboos), religious institutions (e.g. rituals

and curse). Whereby, the organizational institutions bear the structures, while the remaining institutions, are embedded within a cognitive entity of the community members and manifested as norms, values or practices and behaviour of a certain communities. The structural institutions determined the authority system in a community, which in turn, assigned the roles to a different social actors as well as obligations. This shows that, both formal and informal institutions existed in the study area, with respect to the management advices of the forest resources a view which is also shared by Saunders *et al*. (2008), Brokaw (2006) whom reported that, formal institutions arise from political decisions while informal institutions originate from socially transmitted information and are part of the culture in a society.

4.1.2 Types and roles of formal organizations

Table 7 below shows list of the formal organizations identified by the respondents in the study area. The organizations operated in the study area were mainly administrative and legal instruments of the sovereign state. They provided an administrative and organizational structure at the local level including village governments, law and order enforcement agencies, service delivery agencies and a variety of non-governmental organizations. Organizations identified in Babayu and Mayamaya villages include: village governments (VGs), Village Environmental Committees (VECs), Dodoma Environmental Network (DONET), Miradi ya Gesi ya Dodoma (MIGESADO) and Afri-Care Tanzania.

Village Governments and VECs, were mostly the two key organizations governing the management and usage of the forest resources in CFR, as pointed out by (58.4%) of the respondents (Table 7). These organizations were responsible in facilitating communication, devising rules, rules' infraction accountable on forest protection and rules compliance. NGOs in the study area played a major role in advocacy and awareness

creation, on the environmental forest resources usage and management. In the study villages, communications among stakeholders in the use and management of natural resources was facilitated by village governments. This means that government in the study villages served as a communication channel among them.

Table 7: Formal organizations existing in the study area and their relative importance

Institutions	**Number of Respondents**		
	Babayu (n=79)	**Mayamaya (n=58)**	**Total (n-137)**
VECs	58 (73.4)	22 (38.0)	80 (58.4)
VGs	49 (62)	11 (19/0)	60 (43.8)
District Council	12 (15.2)	22 (16.0)	10 (17.2)
DONET	9 (11.4)	17 (12.4)	8 (13.8)
MIGESADO	10 (12.7)	13 (9.5)	3 (5.2)
AFRI-CARE (T)	6 (7.6)	10 (7.3)	4 (6.9)

Figures in brackets indicate percentage and those outside denote number of respondents

Out of (58.4%) of the respondents who were interviewed in the study area pointed out, that VECs were the most important organizations. Other organizations considered to be important were Village governments mentioned by (43.8%) of the respondents. Others were the District Council, DONET, MIGESADO and Afri-Care Tanzania, which are based NGOs involved in environmental education and conservation. Poffenberger (2000) showed that, promoting people involvement in management of forest resources was a good strategy to achieve biodiversity conservation.

4.1.3 Types and roles of informal local institutions

A variety of local institutions directly involved in forest resources management existed in the study area (Table 8) below. Local institutions whose major functions were forest resources management include traditional healers, leaders and traditional guards, which played an indirectly but essential roles in the forest resources management through conflictive resolution, natural resource governance and a risk reduction.

Traditional beliefs and rituals which include Mahoma, Ukuwano-Gogo and Ng'huungu had a strong linkage with forest resources management, while traditional beliefs played an important role in preserving common pool resources. Since forest resources management, were reinforced through a spiritually sacred forests and trees in these areas were highly respected. The association of sacred tree species with forest conservation functions suggests that, the scientific explanations may be found for some of these traditional practices. By using indigenous knowledge encoded in traditional beliefs, and through experience, local communities were aware of which forests contributed to their well-being, so they would impose restrictions and ensured that they were adhered to, by invoking spiritual powers (Rurai, 2007).

Traditional leaders were also considered as spiritual leaders, integrated spirituality with natural resources governance, because they had legitimate powers bestowed on them by the community, social harmony and the spirit of unity was ensured and this could be exploited to include aspects of forest resource management in their activities.

Informal institutions which were examined were those drawn from the Gogo traditional institutions. The institutions identified in the two study villages are shown in Table 8 below. These could be differentiated into structural, organizational and constraining

institutions. Ghate and Negendra (2005) reported that, local institutions were considered better at providing, *inter alia*, rules related to access, harvesting and management, that could respond to conflicts more quickly and realistically and that, their monitoring and sanctioning methods are efficient. Compliance to rules was also found to be extremely important for effectiveness of an institution.

Table 8: Informal institutions existing in the study area and their relative importance

Institution type	Babayu (n=79)	Mayamaya (n=58)	Total (n=137)	Institution Category
Traditional healers	17 (21.5)	11 (19.0)	28 (20.4)	Structural
Elders	6 (7.6)	4 (6.9)	10 (7.3)	Organizational
Traditional guards	22 (27.8)	13 (22.4)	35 (25.5)	Organizational
Mahoma	9 (11.4)	7 (12.1)	16 (11.8)	Religious (Curse)
Ukuwano-Gogo	20 (25.3)	18 (31.0)	38 (27.7)	Constraint
Beekeeping group (BKGs)	5 (6.3)	5 (8.6)	10 (7.3)	Organizational

Figure in brackets indicate percentage and those outside denote number of respondents

The structural institutions were those, which determined the social fabric and services as sources of authority for the institutional supply. These are equivalent to Ostrom's (1990) constitutional choice institutions. They deeply embedded in the cognitive structures of individuals that determine the social values, norms and customs.

The organizational institutions were those, which determined the social interactions and were associated with powers of decision making structures. They played a key role in defining roles and obligations of individuals, in a society and in community mobilizations. The constraining institutions reinforced the cognitive structures of individuals and shaped the individual behaviour in relation to one's physical and social cultural environment.

Traditional healers whom embedded the magical-religious institutions and served as spiritual leaders widely believed to possess super-natural powers. The magical-religious institutions, like many other local institutions were not codified into formal records and their operations remained a guided secret by their custodian (Kisoza, 2006). Nonetheless, they were accorded with a high legitimacy by communities which were crafted to serve. The Gogo spiritual leader an Ukuwano- Gogo was identified by 27.7% of the respondents in the study area (Table 8) above. The Ukuwano-Gogo*,* is traditionally responsible in organizing the Gogo fighters and providing them with magics, believed to protect them against the enemies. These social narrations surrounding the Ukuwano- Gogo, were necessary in order to establish a legitimacy and an authority of the institutions. In order to sustain its legitimacy, the institution designers had to invoke magical-religious narratives, as a source of incentives for the acceptance and powers. Similar strategies have been observed in a number of traditional institutions, especially those, which were evolved in areas associated with a high environmental risks and uncertainties, like the high populated and pastoral areas. Other functions of the Ukuwano-Gogo, include the traditional healing and fortune telling.

Interviews with key informants had revealed that, during rituals the Gogo people under the Ukuwano-Gogo made sacrifices under sacred forests, this implied that, the local institutions were deeply imbedded in beliefs of the community members. The results also suggested that, in case of failure of formal institutions to resolving problems, the informal local institution were used to resolve them. A similar institution in Gogo tribe embedded in Mahoma, who served as a spiritual leader and main the advisor on cultural matters. The Mahoma*,* was identified by 11.8% of the respondents in Babayu and Mayamaya respectively. The Mahoma usually officiated all rituals that provided an identity to an individual in the Gogo culture.

The similarities, between the roles of the Ukuwano-Gogo and the Mahoma institutions with regards to the conservation of natural resources were based on the fact that, traditionally the Gogo territory bordered with Sandawe and Rangi. Thus, the long time interactions between these ethnic groups, resulted into institutional learning as a means of co-existing and interactions in resource usage. This implied that, these local institutions had a potential role to play in the natural resources management process in the new orbit of interactions like was the case of Babayu and Mayamaya.

Ritual institutions were reported by 59.1%. Rituals represented deeply the embedded social practices that provide a cultural background of the society. They also defined other social institutions like marriage, inter-ethnic relationship, leadership as well as an access to the natural resources. For example, key informants in the study area said that, each wife married to a Gogo, was supposed at marriage time to be given land to begin her own life for the future by her children. This pre-requisite apparently limited inter marriage between Gogo women and men from other ethnic groups. Furthermore, the identity of Gogo tribes men and their access rights to resources is associated with age-set rituals. Members belonging to a particular age-set, tended to mature together and got promoted together to the next stage of seniority during Mahoma ritual. At this stage, senior groups got promoted to elder hood and allowed to marry, own land and cattle. The ritual determines the roles and rights of individuals to access natural resources, clan wealth, and therefore, institutionalized redistribution of resources (Mayeta, 2004; Pradhan, 2006).

Most social institutions were reinforced by curse institutions, whereby powers to cast a curse were vested to the Mahom*a.* A particular age could also cast a curse to a junior aged grade. The curse was mentioned as an important institution by 11.8% of the respondents in Babayu and Mayamaya villages (Table 8) above. A curse spilled upon an individual,

implied an exclusion from the community social networks that involved the sharing of resources and other reciprocal arrangements. Cleansing of a curse involved fines in form of cattle, goats or sheep which were contributed by the family or all clan members, depending on the offences. Moreover, a curse cast upon an individual was believed to pass from one generation to another until the entire fine was paid. This ensured the higher level of conformances to the social sanctions and collective monitoring. In addition, the institution provided a mechanism for enhancing conformance to social norms, also minimized the transaction costs for a supply and a function of local institutions. The effectiveness of the curse institution in community-forest management has been reported among the Barbaig communities by Kajembe and Mbwambo (2000).

The important structural institutions mentioned in the study area, include the Council of elders (Mlaguzi), traditional guards (Ng'huungu). The structural institutions were involved in the actual operations of the institutions; therefore, most of them, were embodied in their implementing agencies or the locality where they operated (Table 8) above. The Council of elders was mentioned as an important institution in both studied villages. The important decisions in the Gogo society were taken collectively on the village opened meetings by the (Mlaguzi). The results in (Table 8) above have shown that elder's institution was mentioned by 7.7% of the respondents at Babayu and Mayamaya respectively. The elder's institution allowed everybody a right to speak and heard. The Mlaguzi system is widely practiced in Bahi District. During this study it was observed that even the formal administrative structures, both the local government and VECs authority, used traditional system when communicating with the local communities. This implied that, the local institutions were more effective in mobilizing local communities.

This differential rating of the importance of the council of elders in the two study villages Babayu and Mayamaya could be explained by the differences in the ethnic composition and cultural values held by the communities, in the two studied villages. In the case of Babayu, the council of elders was identified as an important local institution since the village was dominated by the Gogo, Sukuma and Maasai pastoralists. Key informants from pastoralists in Babayu village reported that, the council of elders handled most important decisions in their village. However, the importance of this institution has been eroded in those villages which were dominated by the farming ethnic groups. A plausible explanation for this is that, farmers in Mayamaya were multi ethnic in their composition and most of them were immigrants. Due to the removal from their areas of origin, the legitimacy of their institutions were weakened, they also lacked coherent critical mass to practice their cultures. Moreover, the immigrant farmers were more integrated into formal market system, for this reason, a need for developing and elaborating the local institutions and social-networks was to some extent weakened. Furthermore, farmers led more sedentary life and had been fully integrated into the state administrative structures, where most of the administrative decisions were made by their village government. In this case, the roles that would have been assumed by the council of elders were integrated into a formal government system.

Traditional guards *(*Ng'huungu) were mentioned as an important institution by 25.5% of the respondents (Table 8). The institution is a traditional defence groups practiced by Gogo tribes which were the indigenous tribes. Ng'huungu institution was evolved since the pre-colonial times, where aimed at repulsing tribal raiding by the neighbouring Sandawe. In its original form, the institution was employed in mobilizing a collective action and provided command structures of the defence, against invading warriors. In its present form the Ng'huungu was a revival of indigenous institutions employed to unify all

Gogo people, to defend their land and other natural resources against much powerful ethnic groups, it was also an important in a risk reduction on the natural resources such as forest fires and illegal harvesting of forest resources, traditionally Ng'huungu were organized around a spiritual leader Mahom*a.* The interplay of different social institutions had an implication on the management of the natural resources and regulations of the resource use. The structural social institutions, prescribed the roles for monitoring and an enforcement of rules governing the usage of natural resources. The institutions also provided for peer control of behaviours amongst the community members. The organizational social institutions ensured a collective decision making in the community.

It is worth mentioning that, the importance of local institutions in governing the usage of the natural resources, has come to the attention of a number of scholars, Ostrom (1990), have emphasized about the importance of considering institutional aspect in resource management. The roles of institution in natural resource management have also been made subject by Bandaragoda (2000) and an important feature in Ostrom's (2002). All these writers emphasize on the importance of understanding the local environment as in particular, the relevant institutions for proper design of natural resource management. Institutions are critical to all levels of human interactions, this owes to their role in guiding political decision-making along just and fair procedures, and for re-assuring people on predictions of future decisions. Table 9 shows ranking of formal organizations and local intuitions.

Table 9: Ranking order of key institutions governing forest resources at CFR, Tanzania

Key institutions	Scores by villages		Overall score	Ranking
	Babayu	Mayamaya		
VECs	12	8	20	1
Beekeeping groups (BKGs)	10	7	17	2
VGs	8	7	15	3
Bahi District Council	8	4	13	4
Elders	9	3	12	5
Traditional healers	6	5	11	6
DONET	3	7	10	7
Traditional guards	0	9	9	8
Mahoma	4	4	8	9
Ukuwano-Gogo	4	3	7	10
MIGESADO	2	3	5	11
AFRI-CARE (T)	NA	4	4	12

The formal and informal institutions, governing the management of forest resources as they ranked first (20 scores) and second (17 scores). The ranking is shown in Table 9.

4.2 Effects of Institutional Changes on Performance of VECs

4.2.1 Overview

This section, presents the results on effects of the institutional changes on the performance of local governance structures. The performance of the local governance structures were examined when the management of CFR was under the central government and after the decentralization in 1992, when its management was devolved to Bahi District Council.

4.2.2 Effect on rule of law

The effects of the institutional changes on rule of law, was examined by three-likert scaled items (Table 10) namely: i) VECs acts in accordance with its mandate ii) VEC acts with an integrity and commitment iii) law enforcement and adhering to rules by people.

4.2.2.1 Mandate, integrity and commitment of Village Environmental Committees

The performance of the local governance structures on rule of law, was examined whether VEC acted within its mandate, had improved and did not differ significantly ($\chi^2 = 0.321$; $p = 0.416$). At least, 53% of the respondents claimed that, it did not improve. (Table 10) indicated that, an improvement in performance of VECs in terms of mandate and their commitments in forest resources management were at a satisfactory level. Likewise, on whether VEC acted with an integrity and commitment had improved and did not differ significantly ($\chi^2 = 0.858$; $p = 0.354$). Out of 54% of the respondents reported that, VECs integrity and commitment had improved while 46% asserted that it did not improve. The integrity and commitment, was reflected from the condition of forest and law enforcement.

During FGDs and field observations, the study has learned that, after the devolution of power, illegal activities such as fire incidences, charcoal burning and timber harvesting declined as compared to the past, when the management was under the central government. This implied that, after CFR devolved to Bahi District Council, the local people became a partner and guards of forest and therefore, the law enforcement and commitments to conserve forest resources had been enhanced (Table 10). This shows that the complementarily between legal powered (Bahi District Council) and domestic powered (VECs), in terms of working together to achieve a common goal. Working together between Bahi District Council and VECs tended to strengthen the institutional legitimacy based on a bottom-up approach was often the strength of the participatory based governance authorities.

Table 10: Respondents' perception on the effect of institutional change on rule of law

Variables	Village (Institutional change	Poor	Satisfactory	Good	Mean score	$\chi 2$	p-value
VEC acts in accordance with its mandate	Babayu (BD)	30 (37.9)	8 (10.1)	-	3.00		
	Babayu (AD)	10 (12.6)	31 (39.2)	-	2.45		
	Mayamaya (BD)	19(33.0)	7 (12.0)	-	2.05		
	Mayamaya (AD)	6 (9.3)	36 (43.1)	-	2.70		
	Total	**65 (47.5)**	**72 (52.5)**	-	**2.55**	**0.321**	**0.416**
VEC act with integrity and commitment	Babayu (BD)	10 (8.3)	12 (8.4)	5 (3.65)	2.87		
	Babayu (AD)	19 (14.0)	24 (18.9)	4 (2.92)	2.23		
	Mayamaya (BD)	9 (6.4)	15(10.0)	1 (0.73)	2.67		
	Mayamaya (AD)	12(8.7)	21 (15.2)	4 (2.92)	3.93		
	Total	**52(37.8)**	**71 (51.8)**	**14 (10.2)**	**2.58**	**0.858**	**0.354**
Law enforcement and adhering to rules	Babayu (BD)	8 (5.8)	-	30 (21.9)	3.00		
	Babayu (AD)	8 (5.8)	39 (28.5)	27 (19.7)	2.87		
	Mayamaya (BD)	9 (6.6)	3 (2.2)	3 (2.2)	2.55		
	Mayamaya (AD)	-	-	-	-		
	Toatal	**25 (18.2)**	**42 (30.7)**	**60 (43.8)**	**2.10**	**58.132**	0.0001*
	Average				**2.41**	**11.381**	**0.0001***

*Significantly difference at 5% level; BD = Before decentralization, AB = After decentralization; Figures in brackets represents%

4.2.1.2 Law enforcement and compliance

The results, on the improvement of law enforcement and compliance of rule of law by the people, were significantly different (χ^2 = 58.132; p = 0.0001) (Table 10). The majority, 74.5% of the respondents asserted that, law enforcement and adherence to rules by people respectively, had improved which indicated that, the institutional changes enhanced law enforcement and people's willingness to follow rules and regulations. This was supported even by the forest conditions and a few number of cut trees (disturbances) in the forest (see section 4.3). For example, this study had found out that, 225 trees of pole size were cut in 120 plots with 0.07 ha size, in CFR. Agrawal (2005) found a significant relationship between law enforcement and forest condition for an effective forest management. IUCN (2004) reported that, among other factors, rule compliance depended on rule of law.

The three items of rule of law were combined into a single score. Respondents opinion on whether rule of law had improved differed significantly among respondents (χ^2 = 11.381; p < 0.0001) with mean score of 2.41 (Table 10). The larger number of respondents 64% had opinion that rule of law had improved against 36% who said did not improve indicated that institutional change that decentralization by devolution of power from central government to local government enhanced rule of law of the governing institutions.

During FGDs and field observation, the study learned that after devolution of power illegal activities such as fire incidences, charcoal burning and timber harvesting declined as compared to the past when the management was under the central government. This implies that after CFR devolved to Bahi District Council, local people become partner and guards of forest and therefore law enforcement and commitment to conserve forest resources had been enhanced (Table 10). This shows that complementarily between legal

powered (Bahi District Council) and domestic powered (VECs) in terms of working together to achieve a common goal. Working together between Bahi District Council and VECs tend to strengthen institutional legitimacy based on bottom-up approaches is often the strength of participatory based governance authorities.

4.2.3 Effects on transparency

Three- three - likert scaled items were used to measure the performance of the local governance structures on the effect of the institutional changes on transparency (Table 11) namely: decision making was open and a reason behind evident, information on performance is open and an appropriate form of VEC'S responsibilities was known.

4.2.3.1 Village Environmental Committees and decision making process

The performance of local governance structures on openness on decision making differed significantly (χ^2 = 32.834; p < 0.0001) (Table 11) Majority of respondents (75.2%) claimed that, openness in decision making was poor, despite the fact that, the information on decisions was supposed to be delivered during the village general meetings, in most cases, they were just told the decision without reasons behind the decision.

For example, most people referred the revenue from CFR by using a Memorandum of understanding (MoU), which was established between Bahi District Council (BDC) and the villages around the forest reserve, that was 20% of the revenues from the forest products taxes, went to the villages which participated in the management of CFR for development activities.

From key informant's interviews, it was found out that, during the allocation of funds from the District Council, all VECs chairpersons and VEOs were called and told how much money the District Council collected and how much their share were calculated.

In order to ensure transparency, the district council required that, once the disbursement was effected, the village governments had to call a village general assembly and let the people decide in which way the money should be spent i.e through the village governments and to give alternatives solutions according to the needs in the villages.

Furthermore, a photocopy of a letter showing the transfer of money, was supposed to be displayed at the village office boards. Once the money was spent, and before the next disbursement, each village was required to report to the District Council Management, how the money was spent.

From FGDs it was learned that, funds were used based on priorities set previously during the village general meetings. Therefore, upon receiving the funds, leaders allocated the funds for usage without even informing the public, neither how much they received nor how much would be spend. This implied that, leaders did not follow these procedures such as informing the public before spending the funds and displaying the information on the notice boards.

Table 11: Respondents' perception on effect of institutional change on transparency

Variables	Village (Institutional change	Poor	Satisfactory	Good	Mean score	$\chi 2$	p-value
VECs decision making is open and reason behind evident	Babayu (BD)	29 (21.2)	3 (2.2)	11 (8.0)	2.44		
	Babayu (AD)	3 (2.2)	18 (13.1)	16.1)	2.55		
	Mayamaya (BD)	21 (13.3)	-	1 (0.7)	2.86		
	Mayamaya (AD)	-	29 (21.2)	-	1.88		
	Total	**53 (38.7)**	**50 (36.5)**	**34 (24.8)**	**2.43**	**32.834**	**0.0001***
Information on performance is open and in appropriate forms	Babayu (BD)	9 (6.5)	9 (5.5)	10 (7.3)	3.00		
	Babayu (AD)	4 (2.92)	22 (15.0)	20 (14.5)	2.67		
	Mayaya (BD)	6 (4.3)	12 (8.4)	8 (5.8)	2.64		
	Mayaya (AD)	9 (6.5)	15 (10.9)	13 (9.4)	2.89		
	Total	**28 (20.4)**	**58 (42.3)**	**51 (37.3)**	**2.80**	**2.051**	**0.152**
VECs responsibilities are known	Babayu (BD)	11 (8.0)	16 (11.6)	9 (6.6)	2.87		
	Babayu (AD)	15 (11.8)	21 (15.3)	10 (7.4)	3.00		
	Mayaya (BD)	6 (3.3)	10 (7.9)	2 (1.5)	2.75		
	Mayaya (AD)	12 (8.7)	13 (9.4)	8 (5.8)	2.72		
	Total	**46 (34.2)**	**61(44.6)**	**29 (21.2)**	**2.16**	**16.790**	**0.0001***
	Average				**2.46**	**19.691**	**0.851**

*Significantly difference at 5% level; BD = Before decentralization; AD =After decentralization; Figures in brackets represents %

4.2.3.2 Information on performance is open and in appropriate form

Out of 79.6% of the respondents said that, openness on information had improved compared to 20.4% who reported that, did not improve indicating that people did receive some information from their leaders on issues related to CFR. The performance of the local governance structures on openness on information, did not differ significantly (χ^2 = 2.051; p = 0.152) (Table 11). Most of the information was delivered during village general assembly's while the VECs met every month, village general assembly met after every three months (four times a year).

Despite of the fact that minutes were available and written in Swahili (the official language in Tanzania), most people did not have the attitude of seeking information. However, respondents complained that during village general assembly's information on performance (success and failure) was not presented, rather than directives from Bahi District Council. However, the study learnt that Ward Conservation and Development Committees were not in place; therefore VECs and village leaders failed to present the performance report to their constituency.

4.2.3.3 Village Environmental Committees and their responsibilities

Knowledge on VECs responsibilities among people differed significantly (χ^2 = 16.790; p < 0.0001). Out of 65.8% of the respondents claimed that, knowledge on VECs responsibilities was significantly poor while 34.4% claimed that, the knowledge of VEC's responsibilities had improved (Table 11). The responsibilities of VECs were presented during the preparation of MoUs of which, one of the major responsibilities was patrolling forest and took actions on matters that were within their mandate.

When the scores of the three items of transparency were summed to create a single score on transparency, respondents opinions on the effects of the institutional changes on the performance of the local governance structures on transparency, did not differ significantly ($\chi^2 = 19.691$; $p = 0.815$) with mean score of 2.46 (Table 11). Out of 50.5% of the respondents claimed that, the institutional changes did not improve indicating that, the changes have improved transparency at a satisfactory level. The performance of the local governance structures did not differ significantly between management under CG and LG indicating that, both of them shared a similar performance that transparency has improved at satisfactory level.

The study has shown that, transparency had improved but not significantly. This indicated that, VEC's communicated with their constituency with the same degree of transparency which was important for the rule of law, accountability and equity (Lutz and Linder, 2004; Saunders *et al.,* 2008). From the key informants' interviews, it was learnt that, VECs reported monthly to the village governments (VG) while Bahi District Council produced monthly, quarterly, semi annual and annual reports on performance, against the management of CFR. But all the information was not communicated to local people, mainly due to an absence of Ward Conservation Development Committees (WCDCs) organs that facilitated dissemination of information such as performance reports. This indicated the lack of transparent especially at higher level.

4.2.4 Effect on accountability

Three – three likert scaled items, were used to measure the effects of the institutional changes on the performance of the local governance structures on accountability (Table 12) namely: mechanism of the dissemination of information, answerability and representatives' accountabilities or responsibilities.

4.2.4.1 Mechanism of dissemination of information

The improvement on the mechanism of dissemination of the information was significantly different among respondents ($\chi^2 = 58.134$; $p < 0.0001$). Majority of them (67.9%) said that, the mechanism for dissemination of information significantly had improved (Table 12). The major means of the disseminating information was through meetings especially village general assemblies. Since village councils failed to present the performance report due to the lack of WCDCs hence some people felt that the mechanism was not adequate.

4.2.4.2 Answerability

On the other hand, the respondents on whether answerability had improved differed significantly ($\chi^2 = 0.921$; $p = 0.015$). A substantial number of them (86.1%) said that, answerability had improved while 13.9% reported that answerability did not improve (Table 12). VECs were answerable to their constituents through report to WCDCs (upwards), while downwards, VECs were also answerable to the villagers through village governments, and based on FGDs, the study learnt that, VECs presented their reports to their constituents as required. Likewise, during village general assemblies, the village councils always present VECs reports and activities to villagers.

4.2.4.3 Representative's accountability

The performance on representative's responsibility did not differ significantly ($\chi^2 = 0.247$; $p = 0.618$), out of 82.2% of the respondents asserted that representative's accountability had improved while 16.8% not asserted (Table 12). This indicated that, VEC represented their constituents at satisfactory level.

When the scores of three accountability items were summed to produce a single accountability score, respondents said that, accountability did not differ significantly ($\chi^2 =$

1.024; p=0.312) with mean score of 2.41 (Table 12). At least 49% had said that accountability had not improved while 51% reported that institutional change on the performance the local governance structures enhanced accountability of governing bodies, to its constituents at satisfactory level.

For the effective accountability, governing bodies should be answerable to their constituents who gave them legitimacy (either earned or conferred) both upward and downward (Lockwood, 2010; Adhikari and Lovett, 2007). The study showed that, forest workers at CFR and VECs were accountable to their constituencies (downwards and upwards) though at a satisfactory level. Furthermore, VECs were exercised their powers and responsibilities as close as possible to the people and forest resources, that were affected by their decisions hence improved accountability. However, questioning and challenging was very minimal as CFR management had more powers in decision making as the owner of CFR.

The satisfactory score on accountability can be explained by the fact that, since most issues were presented and discussed at the village general assemblies, then lack of WCDC could be responsible for the satisfactory performance as the information on who and why the decision was arrived at, were not trickling down to the local people. Furthermore, since transparency can be a reason of satisfactory performance on accountability, similarly, Chingonikaya (2010) reported that accountability at Mgori CBFM to be at satisfactory level which indicated a common trend in the decentralized forest management.

Table 12: Respondents' perceptions on effect of institutional change on accountability

Variables	Village (Institutional change	Poor	Satisfactory	Good	Mean score	$\chi 2$	p-value
Mechanism of dissemination of information	Babayu (BD)	6 (7.6)	10 (12.7)	25(31.7)	2.07		
	Babayu (AD)	1 (1.3)	12 (15.2)	25 (31.6)	3.58		
	Mayamaya (BD)	5 (8.7)	3 (5.2)	26 (44.8)	2.34		
	Mayamaya (AD)	4 (6.9)	3 (5.2)	17 (29.3)	2.08		
	Total	**16 (11.9)**	**28 (20.4)**	**93 (67.9)**	**2.52**	**58.134**	**0.0001***
Answerability (upward and downward accountability)	Babayu (BD)	1 (0.7)	-	47 (34.3)	2.02		
	Babayu (AD)	-	6 (4.4)	33 (24.1)	2.07		
	Mayamaya (BD)	18 (13.1)	20 (14.6)	-	2.31		
	Mayamaya (AD)	-	11 (8.0)	1 (0.7)	2.09		
	Total	**19 (13.9)**	**37 (27.0)**	**81 (59.1)**	**2.12**	**5.921**	**0.015**
Representative's accountability	Babayu (BD)	11 (8.0)	20 (14.5)	22 (16.1)	2.77		
	Babayu (AD)	**7** (5.1)	14 (10.2)	22 (16.0)	2.85		
	Mayamaya (BD)	11 (8.0)	16 (27.6)	2 (1.5)	2.66		
	Mayamaya (AD)	5 (3.6)	-	18 (13.1)	2.02		
	Total	**23 (16.8)**	**50 (36.5)**	**64 (46.7)**	**2.58**	**0.247**	**0.618**
	Average				**2.41**	**1.024**	**0.312**

* Significantly difference at 5% leve; BD = before decentralization; AD= after decentralization; Figures in brackets represents % and figures outside denote number of respondents

4.2.5 Effects on equity

The effects of the institutional changes on the performance of equity, was examined by three items (Table 13) namely: the local people's human rights were respected, an absence of biasness in decision on a case by case and fair distribution of benefits and costs.

4.2.5.1 Local people's human rights

Respondents reported that, the performance on human rights differed significantly (χ^2 = 10.207; p= 0.001), 52.5% of the respondents reported that, the respect for human rights did not improve (Table 13).

4.2.5.2 Fair distribution of costs and benefits

Likewise, a fair distribution of benefits and costs, was significantly different (χ^2 = 18.287; p< 0.0001), 51.9% of the respondents claimed that, a fair distribution of benefits and costs had improved while 14.6% claimed not to improve (Table 13). However, the local people argued that, the benefits they got from the efforts they invested in conservation was not enough, for example people demanded to be allowed to cut firewood, grazing their livestock and cutting poles, for building their houses which was against the Memorandum of Understanding (MoUs).

Table 13: Respondents' perception on institutional change on equity

Variables	Village (institutional change	Poor	Satisfactory	Good	Mean score	$\chi 2$	p-value
Local people's human rights are respected	Babayu (BD)	3 (2.1)	7 (3.6)	33 (24.0)	3.00		
	Babayu (AD)	14 (10.2)	20 (14.6)	11 (8.0)	2.88		
	Mayamaya (BD)	2 (1.6)	5 (3.6)	8 (5.8)	2.89		
	Mayamaya (AD)	-	18 (13.1)	20 (14.6)	2.75		
	Total	**21 (13.4)**	**50 (36.5)**	**72 (52.5)**	**2.88**	**10.207**	**0.001***
Fair distribution of costs and benefits	Babayu (BD)	**-**	7 (5.1)	20 (14.5)	2.90		
	Babayu (AD)	12 (8.8)	14 (7.3)	22 (16.0)	2.41		
	Mayamaya (BD)	-	11 (8.0)	14 (10.2)	2.75		
	Mayamaya (AD)	8 (5.8)	8 (5.8)	15 (10.9)	2.81		
	Total	**20 (14.6)**	**40 (29.2)**	**71 (51.9)**	**2.72**	**16.790**	**0.0001***
Absence of biasness in decision case by case	Babayu (BD)	9 (6.5)	6 (3.38)	13 (9.4)	2.78		
	Mayamaya (AD)	4 (2.92)	12 (8.76)	30 (21.8)	2.30		
	Mayamaya (BD)	6 (4.3)	8 (5.84)	12 (8.7)	2.64		
	Mayamaya (AD)	9 (6.5)	13 (9.49)	15 (10.8)	2.93		
	Total	**28 (20.4)**	**39 (28.4)**	**70 (50.2)**	**2.66**	**18.376**	**0.0001***
	Average				**2.73**	**1.740**	**0.188**

* Significantly difference at 5% level; BD = before decentralization; AD= after decentralization; Figures in brackets represents %

In responding to the above claims, the DED urged that the issues was not the 20% of money collected from forest products taxes, but was on how to rise the money collected by creating more sources of funding concerning money for fines, the DED argued that, all fines usually went direct to the central government treasury. Hence, relocating fines to the local people was completely unrealistic.

According to District Forest Officer (DFO), who feared that, allowing people to cut firewood, poles and grazing their livestock would motivate people do other illegal activities. Lockwood (2010), Prasai (2006), Adhikari and Lovett (2007) and Kajembe *et al.* (2009) argued that, a fair distribution does not necessarily mean equity in benefit sharing as this might jeopardize the objective of forest reserve management. However, the authority should be in position to justify its decisions and actions, on distributions of benefits in order to create a harmony with the local people.

4.2.5.3 Absence of biasness on decision

Respondents views, on the absence of biasness in decision on cases differed significantly ($\chi^2 = 16.790$; $p < 0.0001$), 50.2% of them claimed that, an absence of biasness on decision on cases had improved while 20.4% claimed that absence of biasness did not improve (Table 13), generally, there was an evidence of biasness in treating cases of offenders. All offences committed should be handed over to Bahi District Council (BDC).

According to the legal power vested to Bahi District Council in the management of CFR and depending on the nature of the offence, BDC had the right to fine the offenders according to the Forest Act No 14 of 2002 or send an offender to the court for prosecution. However, local people complained that, in most cases they were not told the outcome of the cases, especially the ones which they had been involved. From key informants'

interviews it was observed that, most of the major issues were supposed to be presented and discussed at WCDC, which currently was not in place, also since most of the witnesses at the court were villagers themselves, then the feedback at the village level, was almost instant and automatic. When the scores of the three items of equity were summed to produce a single score, respondents' views on the equity did not differ significantly ($\chi^2 = 1.749$; $p = 0.188$) with mean score of 2.73. 51.2% of them claimed that, equity had improved while 20.8% claimed had not improved indicating that institutional change improved equity at satisfactory level (Table 13).

Equity requires the authority to respect human, civil and political rights without forgetting the local people's rights. In addition, the authorities should account for the distribution of benefit and cost resulting from their decisions and actions for both current and future generations (Lockwood, 2010). One of the major factors accounting for the success of decentralization is continuous flow of tangible benefits and its fair distribution by balancing wealth status, gender and contribution of members in the forest management activities. The fundamental aim of decentralization in Tanzania was to bring the government closer in the interests by enhancing efficiency and democratic accountability. Transfer of power and resources to the local level, will help to empower communities to work together to define and resolve their problems (Stockmayer, 1999).

4.2.6 Effects of the institutional changes on the performance of Beekeeping Groups

Table 14 gives results on the performance of beekeeping groups (BKGs) in governing managements and usage of forest resources in CFR. The study has revealed that, the mean value of all four attributes including rule of law, transparency, accountability and equity was 1.2. This value was below 1.5 which was the cut point, indicating that, the performance of BKGs was poor. With the use of all four attributes into one component,

the index reflected the general community members' perception about the effectiveness of BKGs, in the management of forest resources.

The communities' opinion about good, satisfactory or poor performance determined the ability of BKGs in governing the forest resources in the study area. It was found that, BKGs performed fairly well in the rule of law (devising rules). Poor performance of BKGs, was revealed in transparency in terms of openness in decision making and known responsibilities), accountability in (terms of answerability, representative's responsibility), equity (in terms of a fair distribution of benefits and costs).

Table 14: Performance of BKGs at CFR, Bahi, Tanzania

Attributes	Opinion by village Babayu (n=79)	Mayamaya (n=58)	Mean IP
Rule of law	1.3	1.4	1.4
Transparency	1.2	1.2	1.2
Accountability	1.2	1.3	1.3
Equity	1.3	1.3	1.3

Key: Overall average scores ≥ 1.5 = good performance while < 1.5 =poor performance; IP = institutional performance

4.2.6.1 Rule of law

i) Rule of law with regards to the law enforcement and compliance

Findings have revealed that, BKGs in CFR was assisted by DONET to develop and operationalize beekeeping based plans and by-laws. This was due to the fact that, when BKGs was initiated, the objective was to promote forest conservation and help VECs secure legal rights, to execute forest management activities. Respondent's opinions with reference to performance of BKGs to monitor rules compliance by community members are summarized in Table 15. The study has revealed that, the ability of BKGs to monitor rules compliance did not differ significantly ($\chi 2 = 7.326$; $p=0.292$ (Table 15). Most

respondents were for the opinion that, BKGs performed poorly in monitoring rules for compliance as opposed to involvement and participation of the local people, living near CFR is crucial (URT, 1998a).

Agrawal and Gupta (2005) and Lalika and Machang'u (2007) observed that, in participatory resource management situations, the sustainability of the resource depends upon the existence of rules governing the CPRs. Community opinions, regarding the ability of BKGs assisting VECs in maintaining law enforcement and compliance, governing the use and management of CFR was not significantly different with 43.8% of the respondents perceived that, BKGs perform poorly in assisting VECs in maintaining law enforcement and compliance.

Table 15: Respondent's perception on the law enforcement and compliance at CFR, Bahi, Tanzania

Village name	Opinion			
	Poor	Satisfactory	Good	Total
Babayu (n=79)	35 (44.3)	30 (37.9)	14 (17.7)	79 (100)
Mayamaya (n= 58)	25 (43.1)	20 (34.4)	13 (22.4)	58 (100)
Total	60 (43.8)	50 (36.5)	27 (19.7)	137 (100)
Statistical test		$\chi^2 = 7.326$; p=0.292 NS		

Figures in brackets indicate percentages and those outside denote actual number of respondents; NS = Not significant ($p<0.05$)

ii) Rule of law with regards to its mandate, integrity and commitments

Respondent's perception on whether BKGs acted within its mandate, integrity and commitments was not significantly different with $\chi^2 = 7.953$; p=0.242 (Table 16). It was found out that the performance of BKGs in dealing within its mandate, integrity and commitments was perceived poor by 54.7% of the respondents as opposed to 8.1% who ranked it good. BKGs were responsible with people who harvested honey traditionally and

illegal harvesting of poles in CFR. Any person found harvesting honey by using traditional methods or cutting poles without a permit or license, had to be penalizes. Displinary measures that were taken to those who violated the rules, were either fining; confiscation of poles and working gears; send to court of law or both.

Table 16: Respondent's perception with reference to BKGs on its mandate, integrity and commitment at CFR, Bahi, Tanzania

Village name	Opinion			
	Poor	Satisfactory	Good	Total
Babayu (n=79)	40 (50.9)	30 (38.0)	9 (11.1)	79 (100)
Mayamaya (n= 58)	35 (60.3)	21 (36.2)	2 (3.5)	58 (100)
Total (N = 137)	75 (54.7)	51 (37.2)	11 (8.1)	137 (100)
Statistical test		χ^2 = 7.953; p=0.242 NS		

Figures in brackets indicate percentages and those outside denote actual number of respondents; NS = Not significant ($p<0.05$)

It was found out that, in most cases BKGs collaborated with illegal harvesters of honey and pole harvesters since they received bribes from them indicating that, they acted as power brokers. According to Langlands (2005) corrupt practices in forest sector tend to work against the interests of the poor, misuse of public power for private gain which led into a corruption and this implied that, a failure of good governance. Corruption is associated with negative impacts on welfare of local communities and natural resources status.

4.2.6.2 Transparency

Respondents' perception on openness in decision making differed significantly ($\chi 2$ = 5.931; p=0.431). Majority of them (59.8%) claimed that, openness in decision making was poor, despite the fact that, the information on decisions was supposed to be delivered

during village general meetings. In most cases they were just told the decisions without reasons behind the decisions (Table 17).

Table 17: Respondent's perception with reference to openness to decision making at CFR, Bahi, Tanzania

Village name	Opinion			
	Poor	Satisfactory	Good	Total
Babayu (n=79)	45 (56.6)	20 (25.7)	14 (17.7)	79 (100)
Mayamaya (n= 58)	37 (63.8)	20 (34.5)	1(1.7)	58 (100)
Total (N = 137)	82 (59.8)	40 (29.2)	15 (11.O)	137 (100)
Statistical test	$\chi^2 = 5.931$; p=0.431 NS			

Figures in brackets indicate percentages and those outside denote actual number of respondents; NS = Not significant ($p<0.05$)

Mbwambo (2012), working on the impact of decentralized forest management on livelihoods in Tanzania reported that most villagers were neither aware on decisions made of forest resources, implied that poor transparency was an inherent problem in management of forest resources.

4.2.6.3 Accountability of BKGs

A number of scores of forest poles harvested from 2000 to 2010 was used as an indicator to assess accountability of BKGs on forest conservation in the study area**.** Respondents' opinions with reference to accountability of BKGs are shown in (Table 18). Community's opinions with regard to KBGs to deal with answerability, mechanism of dissemination of information and representative's accountability, was not statistically significant difference with $\chi^2 = 4.755$; p=0.574. Most of the respondents (58.4%) had the opinion that, accountability of BKGs on CFR was poor as opposed to 4.4% who perceived it good. The study has revealed that, BKGs in collaboration with VECs supervised harvesting of poles

jointly. The estimated legal harvesting of poles in CFR between 2000 to 2010 was 3652 scores and yielded Tshs. 22.8 million in the government license revenue (URT, 2006).

Table 18: Respondent's perception with reference to accountability of BKGs on conservation of forest at CFR, Bahi, Tanzania

Village name	Opinion			
	Poor	Satisfactory	Good	Total
Babayu (n=79)	45 (57.0)	25 (31.7)	9 (11.3)	79 (100)
Mayamaya (n= 58)	35 (60.3)	21 (36.2)	2 (3.5)	58 (100)
Total (N = 137)	80 (58.4)	51 (37.2)	6 (4.4)	137 (100)
Statistical test		$\chi^2 = 4.755$; p=0.574 NS		

Figures in brackets indicate percentages and those outside denote actual number of respondents; NS = Not significant ($p<0.05$)

This suggested an annual harvesting of approximately 365 scores and bringing in 2.19 million annually from licenses fees. Households survey in villages adjacent to CFR indicated an annual harvest of about 8 000 scores for a greater than the official estimate. The harvest was worth about 48 million annually. This implied that pole cutters harvested more than the amount stipulated in the permit indicating that, there was inadequate accountability by officials entrusted with the task of conservation of CFR.

4.2.6.4 Equity

Respondent's perception on human rights, fair distribution of benefits and costs did not differ significantly ($\chi 2 = 11.576$; p=0.171), 58.4% of them claimed that, human rights had improved (Table 19) indicated that human rights had improved at a satisfactory level.

Table 19: Equity with reference to human rights and distribution of benefits and costs at CFR, Bahi, Tanzania

Village name	Opinion			
	Poor	Satisfactory	Good	Total
Babayu (n=79)	5 (6.3)	60 (75.9)	14 (17.8)	79 (100)
Mayamaya (n= 58)	25 (43.2)	20 (34.4)	13 (22.4)	58 (100)
Total (N = 137)	30 (21.9)	80 (58.4)	27 (19.7)	137 (100)
Statistical test	$\chi^2 = 11.576$; p=0.171 NS			

Figures in brackets indicate percentages and those outside denote actual number of respondents; NS = Not significant ($p<0.05$)

Human rights require authorities to respect human, civil and political rights without forgetting local people's rights. In addition, the authorities should account for the distribution of benefits and costs resulting from their decisions and actions, for both current and future generation (Lockwood, 2010). One of the major successes accounting for involving people in management of forest resources is continuous flow of tangible benefits and fair distribution by balancing the wealth status, gender and contribution of members in the forest management activities. Akida and Blomly (2008) reported that the management costs imposed to communities outweigh the benefit therefore it was not surprising to hear local people complaining that, returns from their efforts were minimal.

4.3 Conflicting Interests and Power Relations of Key Stakeholders

4.3.1 Types of Stakeholders Involved in the Management of CFR

The study identified various types of stakeholders who were involved either directly or indirectly, in the usage and management of CFR. By combining interests and powers using a matrix diagram, stakeholders involved in the use and management of CFR were grouped into three categories namely regulators, facilitators and users (Table 20). The main conflictive interests among key stakeholders are presented in (Table 21).

These stakeholders were at the national level, regional secretariat, district, village level and NGOs operating at the district level. At the national level, Forestry and Beekeeping Division and Tanzania Forestry Research Institute (TAFORI), played a major role in policy making and research respectively. Apart from these key players at the district council also operated in the same area through different offices such as District Natural Resources Office (DNRO), others are Prisons and National Service Army (JKT) Makutopora, NGOs which include: DONET, MIGESADO and CARE Tanzania and lastly communities and individuals around CFR.

Baran and Jentunen (2004) argued that, the identification of stakeholders provides an understanding on how interests in the use and management of forest resources can be mitigated. This is contributed by the fact that forest resources contained a variety of stakeholders from different sectors, generally, it was noted that, regulators were interested and powerful on issues such as executive, issuing permits and administrative. Facilitators on the other hand, were responsible in facilitating advocacy, research, awareness raising and financial support. Commercial users were mainly important on the trade of timber and charcoal from the forest reserve while subsistence users harvested forest resources for domestic consumption. The implications of the results above can be explained by using different categories of stakeholders in the study area. In the traditional management, local communities in the villages often used self-control mechanism with minimal follow-ups, to conserve forest resources and control conflicts among the forest users.

Table 20: Categories of stakeholders, their interests and power relations in CFR

Stakeholder	Category	Interests and power of stakeholder
The Forestry and Beekeeping Division (FBD)	Regulator	Executive power, issuing permit to increase revenues (royalties),
The regional secretariat	Regulator	Advocacy on sustainable use of forest resources
Bahi District Council	Regulator	Management and administrative role, tax collection from forest products
Village Environmental Committees (VECs)	Regulator	Law enforcement
Village governments (VG)	Regulator	Law enforcement
Tanzania Forestry Research Institute (TAFORI)	Facilitator	Research (Permanent Trial plots)
DONET	Facilitator	Provide environmental education
MIGESADO	Facilitator	Provide environmental education
CARE Tanzania	Facilitator	Funding of development activities
Prisons (Msalato and Isanga)	Users	Subsistence use
J.KT (Makutopora)	Users	Subsistence use
Community	Users	Subsistence use
Individuals (Business men)	Users	Subsistence and commercial use

On the other hand, resource users are not static in terms of ideas, values and perceptions on forest resources, but they changed over time depending on external factors (Kitula, 2012). In the study area, external intervention and modernization had challenged the cultural beliefs and taboos related to the use and management of forest resources. The resource users related themselves to a wider world life of modernization in different ways, which made resource users to become very heterogeneous. The effectiveness of these stakeholders in the management of forest resources depended very much on how the stakeholders addressed the local problems and fit in the local settings characterized by people with different power, historical backgrounds. The emphasis here is that, the external stakeholders should not be fit for all; rather they should be specific to cases because the process of stakeholders was variable in different cases. As Otsuki (2007) puts it, external stakeholders on sustainable development, should be site specific because human agency cannot be separated from historical, social and political contexts.

4.3.2 Areas of conflicting interests of key stakeholders

Six areas of stakeholders' conflicting interests over forest resources were identified and are given in Table 21. In this study, most areas of conflicting interests of key stakeholders were defined in relation to forest resources managements. These results compare well with the findings by Luoga *et al.* (2000) and Sjaastad *et al.* (2003) who found in their studies that, the use of forest resources in Tanzania have resulted in conflicting interests among stakeholders. According to Barrow *et al.* (2002), understanding areas of conflicting interests of stakeholders is important, in developing strategies for sustainable management of forest resources. This is particular important when forest resources have commercial values.

Table 21: Areas of conflicting interests of key stakeholders at CFR, Bahi, Tanzania

Areas of conflicting interests	Key stakeholders conflicting interests
a. Competition in harvesting forest resources	- Pole harvesters, timber harvesters, charcoal burners and traditional healers
b. Bee-keeping versus demand for commercial harvesting of forest products	- Bee-keepers, pole harvesters, charcoal burners, timber harvesters, bee-keeping groups (BKGs)
c. Environmental conservation versus commercial needs of users	- Poles harvesters, FBD, VECs
d. Inequitable benefit sharing	- Central government, Bahi District Council and VECs
f. Competition in proposing village by-laws	- VECs, VG and Bahi District Council
g. Competition in revenue collection	- Central government, Bahi District Council and VECs
h. Need to grazing versus water and forest degradation	- Pastoralists, beekeepers, traditional healers and district council

4.3.2.1 Competition in harvesting forest resources

Table 23 and 24 show that, forest activities of charcoal burning, poles cutting and timber harvesting, were mostly done by males as opposed to females because they were considered as labour intensive and they were mostly performed for commercial reasons. Firewood collection was considered as a female task and most firewood collectors were women. These results could be explained that, forest activities in the study area were divided according to gender roles in the household activities, a view that is also shared by Kessy (1998).

Competition in harvesting forest resources was a central area of conflicting interests between pole harvesters, timber, charcoal burners, firewood collectors and traditional healers (Table 21). A logical explanation for this was that, tree species preferred for poles and timber were also preferred for charcoal burning, firewood and medicines (Table 22).

Table 22: List of species with multiple uses in CFR, Bahi, Tanzania

Fuel energy	Structural	Medicinal	Food or fruits
Acacia sp	*Pterocarpus*	*Combretum* spp.	*Syzygum* spp.
Combretum spp.	*angolensis*	*Zanha africana*	*Vitex* spp.
Zanha africana	*Brachystegia* spp.	*Grewia* spp.	*Grewia* spp.
Grewia spp.	*Albizia* spp.	*Erythrina abyssinica*	*Strychnos* sp.
Syzygium spp.	*Milletia lasiatha*	*Bridelia micranth*	*Myrianthus holstii*
Maerua sp.	*Dalbegia*	*Canarium* sp.	*Xylomas monospora*
Strychnos sp.	*melanoxylon*	*Leonitis* sp.	*Manilkara mochisia*
Ziziphus mucronata	*Xylomas monospora*	*Myrianthus holstii*	*Adansonia digitata*
Myrianthus holstii	*Burkea africana*	*Drypetes* spp.	*Balanites aegyptiaca*
Albizia spp.	*Bridelia micrantha*	*Xylomas monospora*	*Dodones viscose*
Dichrostachys cinera	*Vitex* spp.	*Acacia nilotica*	*Rinores* sp.
Ekerbegia capenses	*Trichilia emetica*	*Xeroderris*	
Manilkara mochisia	*Sterculia* spp.	*stuhlmannii*	
Dodonea viscose	*Xeroderris*	*Ekerbegia capenses*	
Commiphora spp.	*stulmannii*	*Dombeya* spp.	
Dombeya spp.	*Alphloia theiformis*	*Euphobia* sp.	
Dalbegia spp.	*Xylomas stulmannii*		
Balanites aegyptiaca	*Ekerbegia capenses*		
Pterocapus angolensi			
Dalbegia melanoxlon			

Table 23: Forest activities by sex based on information from FGDs at CFR, Tanzania

Villages	Forest activities	Sex involved
Babayu	Timber harvesting	Males
	Poles harvesting	Males
	Charcoal burning	Males
	Firewood collection	Females; very few males
Mayamaya	Timber harvesting	Males
	Poles harvesting	Males
	Charcoal burning	Males
	Firewood collection	Females; very few males

Table 24: Forest activities by sex based on information from household survey at CFR, Tanzania

Resource	Babayu N = 79		Mayamaya n = 58		Overall N =137	χ^2	P
	Male	Female	Male	Female			
Poles	13 (16.5)	11 (13.9)	12 (20.7)	0 (0)	45 (32.8)	31.556	0.000*
Timber	6 (7.6)	5 (6.3)	10 (17.2)	3 (5.2)	24 (17.5)	14.423	0.013*
Charcoal	8 (10.1)	4 (5.1)	7 (12.1)	0 (0)	19 (32.8)	24.302	0.000*
Firewood	13 (16.5)	14 (17.2	11 (18.9)	12 (20.7)	52 (38.0)	42.079	0.000*

Figures in brackets indicate percentages and those outside denote actual number of respondents *significantly difference at $p<0.05$

Traditional healers mentioned that *Zanha africana* was harvested to cure diabetes. These results compare well with the findings by Mander and Breton (2006) emphasized that, miombo trees were widely used for medication. Some tree species including *Combretum molle, Grewia bicolor, Xeroderris stuhlmanii, Vitex* spp; *Pterocarpus angolensis, Dalbegia melanoxylon,* were harvested from miombo woodland forests for medicinal purposes they were also valuable for timber, poles and charcoal burning. These results support the findings by Luoga *et al.* (2000) who observed that, more than 80% of species that are used for charcoal production have other competitive uses. Arnold *et al.* (2006) reported harvesters of firewood, pole, timber and charcoal burners are always competing for same tree species for economic reasons.

4.3.2.2 Unsustainable removal of forest resources versus forest management

Unsustainable harvesting of forest resources was a central area of conflicting interests between regulators and facilitators versus users (Table 21). Regulators including Bahi District Council, Forestry and Bee-keeping Division (FBD) and Village Environmental Committees (VECs), were involved in conservation of CFR. It was further observed that, Dodoma Environmental Network (DONET) and Miradi ya Gesi ya Samadi Dodoma (MIGESADO), had facilitated the Bahi District Staff and villagers around CFR to form VECs and management plans for CFR. This shows that, conservation of forest resources could not be exclusively dealt with regulators and users without a support from facilitators.

4.3.2.3 Beekeeping versus demand for commercial harvesting of forest products

Deforestation of forest resources was a central area of conflicting interests between beekeepers versus pole harvesters, timber and charcoal burners (Table 21). The distribution of beekeepers and annual harvest of honey is given in (Table 25) indicates that, households involved in beekeeping were not significant different across the study villages with (χ^2 = 2.083; p = 0.837). Beekeeping was mostly undertaken by male as opposed to female due to hard tasks associated with the activity.

Table 25: Distribution of beekeepers and annual harvest of honey at CFR, Tanzania

Village name	Involved in beekeeping		Amount of honey harvested (litre) per household per year
	Yes	No	
Babayu (n= 79)	17 (21.5)	62 (78.5)	27
Mayamaya (n= 58)	9 (15.5)	49 (84.5)	9
Total (N = 137)		26 (18.9) 111(81.0)	36
Statistical test	$\chi^2 = 2.083$; p = 0.837 NS		
Average litre/hh/year			18

Figures in brackets indicate percentages and those outside denote actual number of respondents; NS = not significant (p > 0.05).

Beekeepers 18.9%, were interested with CFR because the ecosystem provided bee forage, hives and places for hanging hives. Beekeepers complained that, unsustainable poles harvesting, timber harvesting and charcoal burning, were associated with deforestation of forest resources in CFR. This situation was mentioned as major factor that had contributed in reducing bee forage, shade and places for hanging hives. Estimates indicate that, 18 litres of honey per household were harvested during 2010/2011. This amount, was observed to be a little when compared to about 25 litres of honey per household, that were harvested in 10 years ago indicated in URT (2009) that, forest resources deforestation negatively affected a wide range of socio-economic and environmental processes.

The study established that beekeeping by using traditional technologies had caused deforestation around the villages, thereby, triggered conflicting interests between beekeepers versus pole harvesters, timber and charcoal burners (Table 21).

The construction of bark and log beehives, were mainly dependent on tree barks removal and logs harvesting. Around 56 modern beehives and 438 traditional hives were reported in CFR (URT, 2009).This show that, in the study area most of beehives were made of logs

or tree barks, suggesting that a lot of trees preferred for poles, timber and charcoal were felled or debarked to make beehives. Removal of tree barks in the long run resulted into dying up of the whole tree, an observation that is reported by Liwenga and Masao (2009).

The study revealed has that, District Council Forest Officers, DONET, MIGESADO and Afri-Care Tanzania, were interested in raising awareness to beekeepers to adopt modern methods, for biodiversity conservation and livelihood improvements. However, haphazard honey collection was still ongoing in the study area. Honey collection by felling down trees by using smokers to chase away bees was common phenomena. Honey found in tree holes was free for any one and was harvested during the day. They used axe, for cutting and chopping trees with honey in holes and smoker for chasing away bees during harvesting. This situation was complained by forest officers, DONET, MIGESADO and Afri-Care Tanzania as it increased rate of deforestation and incidences of fires. Two types of forest fires caused by traditional honey harvesting were reported in Babayu village. Discussion with beekeeping groups revealed that, lack of effective beekeeping extension services was a major reason, which had contributed in many of beekeepers to continue using traditional methods.

4.3.2.4 Environmental conservation versus needs for commercial harvesting of forest products

The distribution of pole harvesters from different sources (Table 26) indicates that, households involved in pole harvesting were not significant difference across the study villages with $\chi^2 = 5.921$; $p = 0.015$. Pole harvesting mainly was undertaken by males as opposed to females due to hard task associated with the activity. Majority (61.1%) reported that, the main source of poles harvested was CFR.

Discussion held with village Environmental committees (VECs) revealed that, for a long time communities residing adjacent to CFR including Babayu and Mayamaya, had been relying on commercial harvesting of poles (milunda) for their survival. This was due to the fact that, the area is semi- arid and hence no enough rainfall for farming, similar results have been reported by URT (2009) that, most parts of Bahi districts experienced a low rainfall and hence unsuitable for agriculture.

Table 26: Variables expressing interests for commercial harvesting of poles at CFR, Bahi, Tanzania

Location for poles	Villages		Overall	Mean score
	Babayu (n = 79)	Mayamaya (n=58)	(n = 137)	
Farms	0 (0.00)	0 (0.00)	0 (0.00)	3.84
Woodlands	23 (39.7)	35 (44.30)	58 (42.34)	4.08
Forest Reserve	35 (60.3)	44 (55.70)	79 (61.1)	2.62
Statistical test	$\chi^2 = 5.921$;	p = 0.015		3.49

Figures in brackets indicate percentages and those outside denote actual number of respondents; NS = not significant ($p > 0.05$).

A ban for harvesting poles (milunda) was issued by the government of Tanzania since 2004, after realization that, unsustainable commercial harvesting of poles had threatened CFR. Surrounding communities were permitted to harvest poles for subsistence purposes only. This situation coincided with the needs for conservation of forest reserve with the commercial needs of users. These presented conflicting interests between Bahi District Council, DONET, MIGESADO and VECs against commercial users of poles, regarding the strict conservation interests that aimed to protect nature by prohibiting human utilization of the ecosystem (Table 21). According to Kajembe *et al.* (2004), conflicting interests between stakeholders that rise in this form, demonstrates a force for a positive social change; whereby, a society is adapting to a new political, economic and physical environment.

4.3.2.5 Inequitable benefit sharing

The results in Table 21 have shown that, benefit sharing was a central area of conflicting interests between Village Environmental Committees (VECs), Bahi District Council and Central government. The VECs in Babayu and Mayamaya villages were complained for a poor transparency on benefit sharing from conservation of CFR although they had an access to forest resources for subsistence use. This situation had caused VECs to be demoralized to organize patrols in CFR.

4.3.2.6 Illegal activities versus law enforcement

The study also had revealed that, illegal harvesting of forest products from CFR, were major areas of conflicting interests' between Bahi District Council Forest Officers, VECs against pole harvesters, charcoal burners and timber harvesters (Table 21). This was due to the fact that, illegal harvesting of forest products were associated with either confiscation of working gears and forest products, fining or both, arguments are also indicated in the URT (2002) and URT (2003).

4.3.2.7 Competition in proposing village by-laws and management plans

It was revealed that, at village level, VECs were subordinates to Village Governments (VGs) and were among the VGs committees on matters related to natural resource management as well as management of CFR respectively. It was found that in the study villages where there were both forest workers and VECs, there were conflictive relations about the power of the VECs in revenue collection and proposing by-laws (Table 21). A plausible explanation reason for this was that, both of them claimed to have the rights in revenue collection from forest resources and proposing by-laws. This shows that, an overlapping mandate regarding resource management had caused conflicting interests

between District Council, VECs and Central Government. These findings are similar to Kajembe *et al.* (2004) and Brokaw (2006).

4.3.2.8 Competition in revenue collection

The relationship between Central Government, District Council and VECs from forest resources was conflictive (Table 21) The Central Government, was highly interested in revenue collection from its natural resources including CFR. The revenue was important to run development activities in the country. It was found that, Bahi District Council lacked a direct control over CFR and it was owned by Central Government, also, the management of CFR was under Bahi District Council.

According to key informants' interviews, the district council workers complained that they lacked direct control over the commercial users and were controlled directly by the FBD. This situation was considered by the District Council as a measure to deny district revenue and the same time caused conflicts with VECs, which were responsible with patrols against illegal activities.

4.3.2.9 Need for grazing livestock versus water and forest degradation

Table 21 shows that, pastoralists had conflicting interests with traditional healers, beekeepers and District Council Forest Officers due to grazing livestock in the forest reserve. The distribution of pastoralists interested to grazing their livestock in CFR is given in (Table 27) which indicates that, households involved in livestock keeping were significantly different across the villages with $\chi^2 = 117.630$; $p < 0.001$.

Table 27: Percentage households grazing livestock in CFR, Bahi, Tanzania

Villages	Households grazing in CFR	Statistical test χ^2	p- value
Babayu (n = 79)	43 (60.6)		
Mayamaya (n = 58)	28 (39.4)	117.630	<0.001*
Overall (N=137)	71 (52.8)		

Figures in brackets indicate percentages and those outside denote actual number of respondents statistically significant ($p<0.05$)

Out of 52% of the respondents claimed that, they grazed their livestock in CFR. Grazing of livestock in CFR was blamed by other users for causing degradation of water bodies and forest resources. Furthermore, livestock grazing was a central area for conflicting interests between traditional healers, District Council Forest Officers and VECs (Table 21). Tradition healers complained that, over grazing in forest reserve had resulted in disappearance of some herbal species, while district council and VECs complained on degradation of water bodies and forest resources in the reserve. These results are in line with FAO (2007) argued that, continued grazing in forests reduces the ability of those forests to regenerate.

4.3.3 Power relations among stakeholders on management of CFR

Figure 6 shows the relations between stakeholders in the use and management of CFR and adjoining communities. Results show that, stakeholders' relations took the form of strong relation, weak, relation cut off and open conflicts.

These results indicated that, although the District Commissioner had the executive powers of government within the district and supported by District Administrative Secretary (DAS), but had weak relations with the district council staff. This is contributed by the administrative hierarchy whereby, the district council staff were responsible to the District Executive Director (DED) in performing their duties. This implied that, the DED had the

institutional powers to coordinate development activities to the district. The results in Figure 6 shows further that, the district council staff had strong relations with councillors, WEOs and VEOs. These results could be interpreted that, their relationship was associated with the administrative hierarchy and institutional powers, also, these stakeholders, had domination powers whereby, the local level officials, were subordinates to the district council leaders. These local leaders officials were vested with some institutional powers in supervising projects, implemented and service delivery activities that had an effect on forest resources. On the other hand, the Councillors represented the communities to the district council. The facilitators DONET, MIGESADO, and AFRI-CARE (T), had a strategic power for advocacy and awareness creation (Figure 6) facilitated the establishment of VECs, which were given some institutional powers in supervising forest resources such as patrolling and resolving some problems, related to the illegal harvesting of forest resources. This indicates that, facilitators had strategic powers over the management of forest resources. The existence of multiple force fields explains that, powers and relations were diversified and that, for example, the relations between users and regulators cannot be reduced to a general vertical model, also at the local level, the socio-economic divisions and powers dynamics that, were important differed according to the resources at stake.

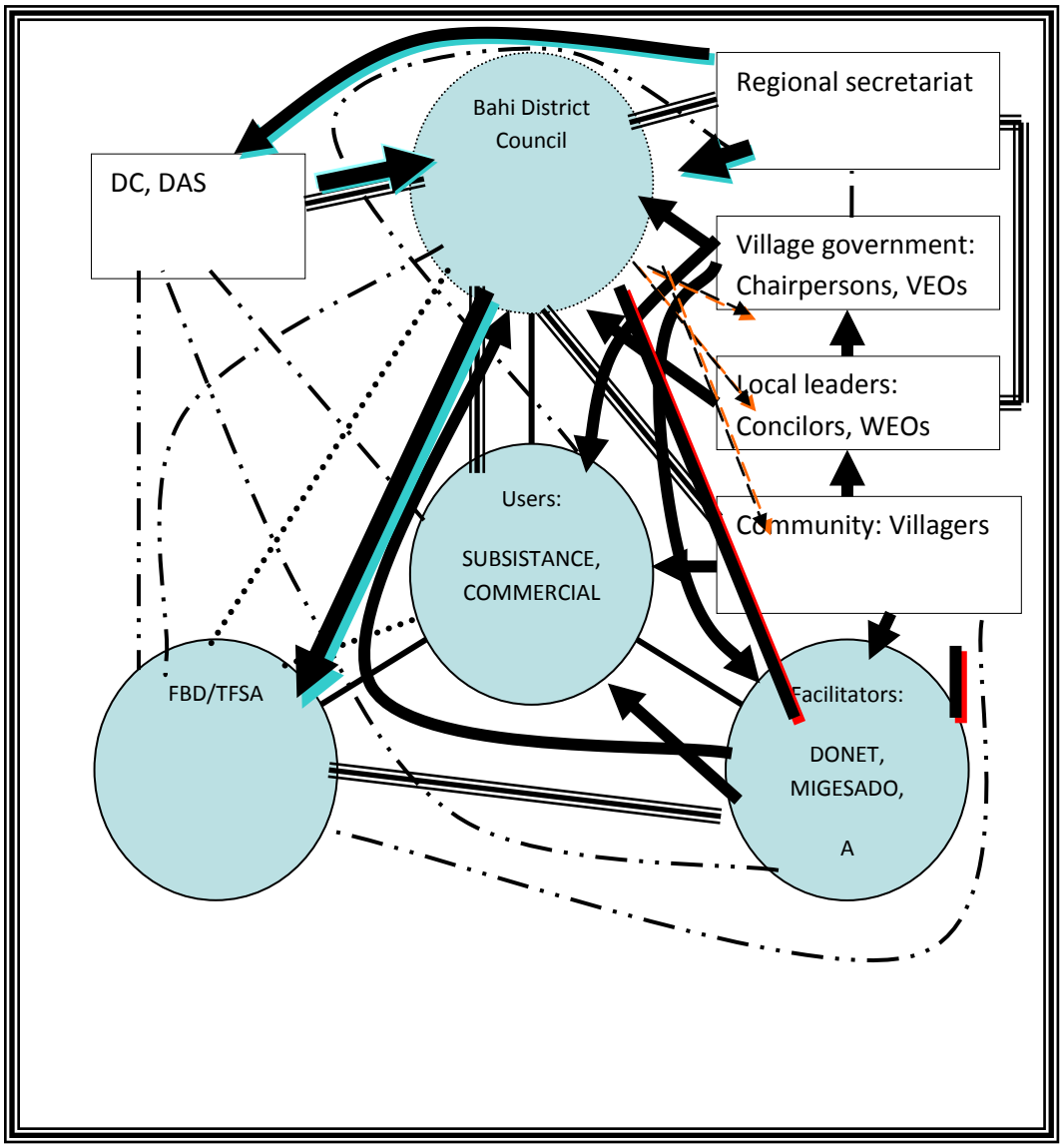

Figure 6: Power relations among stakeholders of CFR, Bahi, Tanzania.

Key: Strong relationship ➡ Weak relationship ═══ Relation cut-off — · ·
Conflicts ..... Executive power ➡ Strategic power ▬
Institutional power - - - - ➡

The different force fields and the modes of social political ordering had the consequences for the resulting forms of governance, power relations and a space for action for the different parties involved. In some force fields, people had much room for manoeuvre and were in powerful position vis-à-vis others in relation to certain resources, while others had a little individual influence (Maganga, 2002; Nuijten, 2005 and Edmott, 2008). The relationships between District Council and FBD with regards to revenues were conflictive

because the central government collected all revenues while the management of the forest was under the District Council.

The study also has revealed that, commercial users had conflictive relations with District Forest Officers (DFO). Commercial harvesting of forest products required a license and a permit for transportation. Forest officers at check points, were responsible in controlling and monitoring forest products trade. The results also indicated that, there was a weak relation between Regional Secretariats with the District Council staff; this was contributed by the administrative hierarchy whereby the District Council staffs were responsible to the District Executive Director (DED), in performing their duties and responsibilities. This implied that, the DED had the institutional powers to coordinate development activities of the district.

4.4 Effects of Institutional Change on Forest Cover, Wood Stocks and Tree Diversity

4.4.1 Forest cover changes between 1987 - 2001

The overall forest cover changes from 1987 – 2001, are shown in (Table 28). The forest cover maps for CFR for 1987 – 2001 produced from Landsat TM images are displayed in (Fig.7 and 8) respectively.

Table 28: Net area change of forest cover types in CFR, Bahi, Tanzania

Forest cover types	Area cover (ha)		Area cover change (ha)	% cover change	% rate of change
	1987	2001	1987 -2001		
Closed woodland	8229.25	10 805.39	2576.14	6.08	0.50
Grassland	1008.98	1094.67	85.65	0.28	0.02
Open woodland	13 640.71	15 168.35	1527.64	4.93	0.40
Settlement	878.96	238.10	-640.86	-2.09	-0.16
Shrubs	2287.96	1462.74	-825.22	-2.62	-0.20
Water	173.85	23.18	-150.67	-0.48	-0.03
Scattered woodland	3889.27	1957.31	-1871.96	-6.10	0.50

Table 29: Land cover change detection matrix from 1987 – 2001 at CFR, Tanzania

Forest cover type	Area changes (ha)	% change
Open woodland to closed woodland	2 576.14	8.4
Grassland to shrubs	910.87	3.0
Shrubs to scattered woodland	946.00	3.1
Water bodies to grassland	65.42	0.2
Settlement to grassland	555.21	1.8
Scattered woodland to open woodland	344.32	1.1
Shrubs to grassland	739.57	2.4
Open woodland to shrubs	702.40	2.3
Unchanged woodland forest	23 929.21	77.7
Total	**30 769**	**100**

The results have shown that, between 1987 – 2001 forest cover types in the study area, experienced net gain that was either uniform or unidirectional, suggesting that a combination of factors were involved MEA (2005), and Luoga *et al.* (2005) in their studies observed that , a multitude of factors may underlay forest cover changes, also, the results suggest that, satellite remote sensing in combination with GIS was useful tool, to use to estimate the area of coverage for sustainable management of forest resources, a view that is also shared Saunders *et al.* (2010) used satellite imagery for ascertaining socio-economic factors, associated with forest resources vegetation cover in Tanzania.

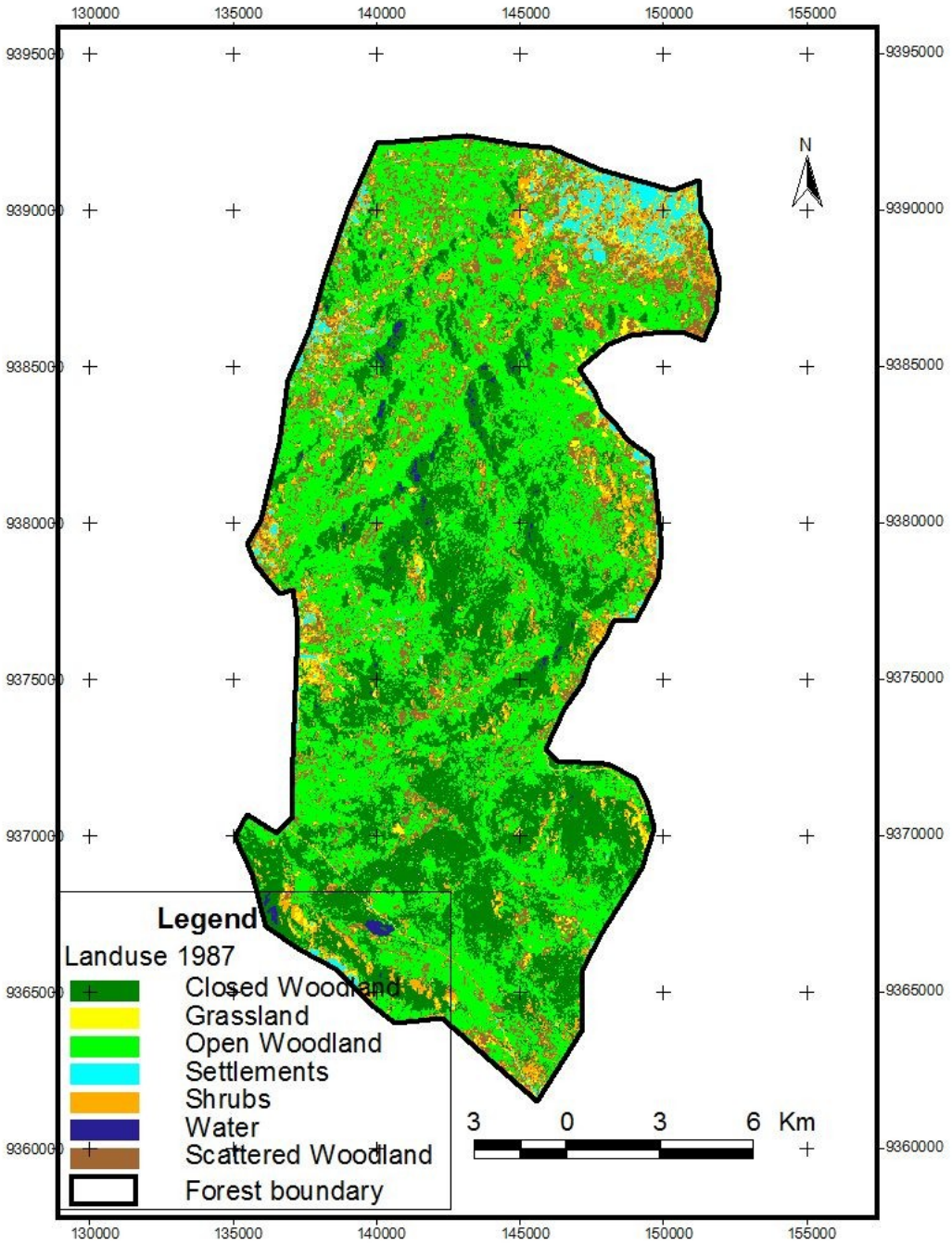

Figure 7: Forest cover map of CFR for the year 1987.

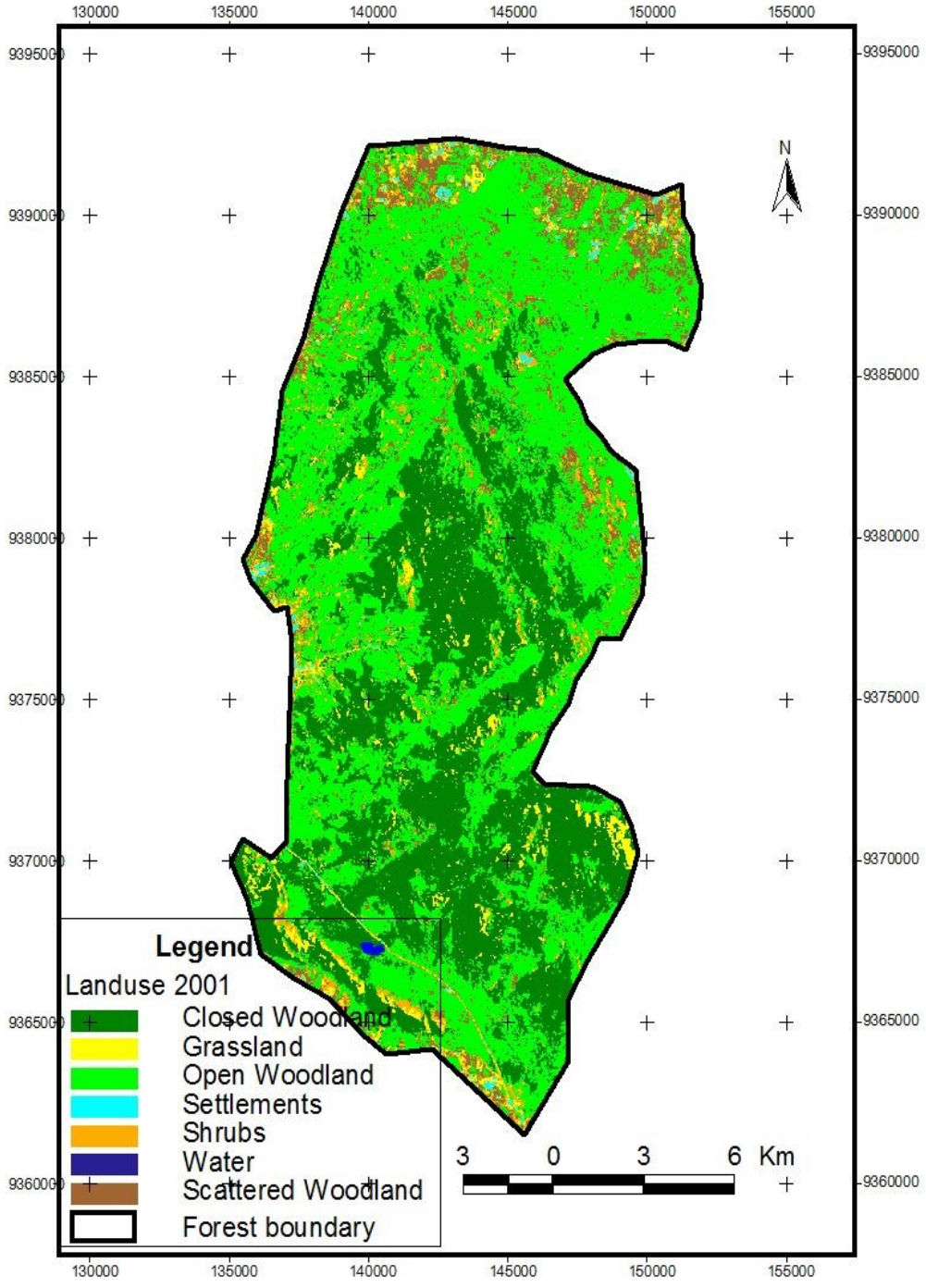

Figure 8: Forest cover map of CFR for the year 2001.

The study has revealed that, from 1987 – 2001 closed woodland indicated a net gain 2 576.14 ha at the rate of 0.50% per annum (Table 28).

During this period, open woodland were converted to closed woodland (1527.64 ha equivalent to 0.4%), water bodies (150.67 ha equivalent to -.03%) were converted to grassland. Shrubs (825.22 ha equivalent to -0.2%) were converted to open woodland (Table 28). These changes are linked well with institutional changes in the management of CFR before and after decentralization. The improvement in forest cover after decentralization, was due to adherence to rule of compliance and enforcement in CFR had been enhanced through patrol by villagers, forest officers or jointly (see section 4.1.3.1 for detailed discussion), Again, the observed changes of water bodies to grassland (Table 29 and 30) linked well with conflicting demand between District council Forest Officers, who needed to conserve forest resources against the desire of pastoralists to encroach forest for grazing (see section 4.2.1.9). Nearly 43% of respondents indicated that, they were grazing their livestock in CFR in the study area. This was due to the fact that, in the forest reserve there was enough grasses and water to feed their livestock.

The interests of Forest Officers to conserve forest resources, which largely coincided with the interests of users in grazing livestock, were observed to contribute to the change of water bodies to grassland (Table 28 and 29). The study observed that, in spite of the government efforts to conserve forest resources by prohibiting harvesting of poles and timber for commercial purposes, illegal activities continued. According to key informants' interviews it was reported that some people in Mayamaya villages had been involved in illegal commercial harvesting of poles in the study area. A possible reason for this was that the village was located outside inspection gate and hence illegal transportation of poles by using unofficial ways were used by the villagers. The illegal harvesting of forest resources, could be explained by the growing human pressure that has led to a competition in harvesting and utilization of forest resources to meet households requirements. These

results support the findings by MEA (2005) that, population growth is associated with land use changes.

Table 29 show that, between 1987 – 2001 open woodland was converted to a closed woodland (2 576 ha equivalent to 8.4%) indicating an improvement in forest cover after decentralization. This change, is linked well with institutional changes (decentralization) from state control of CFR to local government management, which implied that, disturbances in terms of tree cutting and other human activities during central government management, was very high and that, villagers did not comply with the rules and regulations designed for management of CFR. After decentralization people adhered to rules and regulations which was a sign of cooperation with regulations. Rules compliance and enforcement in CFR after decentralization had been enhanced through patrols by villagers and District Forest Offices. Mohamed (2006) reported that, involvement of people in management of forest resources reduced fire occurrences and illegal activities leading to an improved forest condition.

Results in Table 29 shows that, from 1987 – 2001 the area covered by water bodies was converted to grassland (65 ha equivalent to 0.2%), these changes linked well with an increase sedimentation level, along the river channel as well as conflicting demands between pastoralists, who needed to graze their livestock in CFR versus interests of VECs and forest workers, to restrict using forest reserve for grazing livestock. The study has revealed that, livestock grazing accelerated problems of siltation, sedimentation and run-off from the land. The consequence of increased sedimentation and run-off from the land was the raise of ground level, which in turn blocked the river water flow. This situation led into a diversion of water course and stimulated grassland, 52% of respondents reported that, water bodies had decreased in some parts of the river due to sediments deposition

from erosion. This shows that, grazing livestock in CFR were a major source of soil erosion. These findings compare well with the results by URT (2009) indicating that, water bodies were negatively affected by receiving silt from erosion.

4.4.2 Accuracy assessment of classification by error matrix

The results of accuracy assessment are summarized in error matrix from which statistics and indices that indicate accuracy of individual classes and of the whole map were derived (Table 30). The accuracy assessment yielded a high level of accuracy between the classified and observed data. The overall accuracy was 87.31% with a Kappa value of 0.81, which represented reasonable agreement (Congalton, 2001). These results were consistent with other accuracy assessment done elsewhere. Mongo (2013) reported an overall accuracy classification of 85.6% with a Kappa value of 0.79 in Bereku Forest Reserve, Babati, Tanzania, only 1.7% lower than this study's results. Thomlinson *et al.* (1999) recommended a minimum level of at least 85%, which is almost the same with this study's results

Table 30: Classification accuracy error matrix for the 2001 forest vegetation map

Class name	Reference Totals	Classified Totals	Number correct	Producer's accuracy (%)	User's accuracy (%)
Closed woodland	54	50	46	92.00	85.19
Grassland	15	12	16	75.00	80.00
Open woodland	16	17	12	70.58	75.00
Settlement	8	9	6	66.67	75.00
Shrubs	24	25	20	80.00	83.30
Water	2	2	2	100.00	100.00
Scattered woodland	1	1	1	100.00	100.00
Total	**120**	**116**	**103**		
Overall accuracy assessment					**87.31**
Overall Kappa Statistics					**0.81**

From the results, an accuracy assessment for the detailed vegetation cover classes showed good producer's and user's accuracies (Table 30). The lowest accuracy was 66.67% with 6 out of 9 points classified correctly. The low value could be due to mixed pixels classified as settlement. The user's accuracy for different forest vegetation classes was highest in closed woodland cover with a value of 85.19% implying that, there was 85.19% chance of finding closed woodland correctly classified in the study area. The Kappa statistics was high denoting good to perfect agreement. Accuracy assessment provides a powerful mechanism for evaluation of the spatial data but it is important to consider, both the producer's and user's accuracy, since the use of a single value could be misleading (Mongo, 2013).

4.4.2 Woodstock and tree diversity

4.4.2.1 Current status of wood-stock in CFR

Table 31 shows number of stems per hectare, basal area per hectare, and volume per hectare for CFR determined in 2011.

Table 31: Standing crop parameters for CFR, Bahi, Tanzania

Parameters	Total
N (stems ha^{-1})	199
G (Basal area ha^{-1})	1.71
V (Volume ha^{-1})	6.46
Shannon's Index	4.0

Number of stems per hectare

The inventory carried out in 2011 revealed that, an average number of stems per hectare (N) from 178 – 221 stems ha^{-1} with an overall mean of 199 stems ha^{-1} (Table 31).

Backeus *et al.* (2006) pointed out that, density of miombo woodlands ranges from 71 – 1 041. The reported tree density in this study is not in line with other miombo woodlands reported by different authors. Lupala (2009) observed 981 stems ha^{-1} in Bereku Forest Reserve while Chingonikaya (2010) observed 599 stems ha^{-1} in Mgori Forest Reserve.

The observed low stocking in CFR, can be attributed to the past management practices, which allowed massive harvesting of poles, bush fires and overgrazing. The woodland seems to be dominated by regeneration that consisted of sprout from coppicing stumps, vegetative re-growth from roots and suckers. The distribution of number of stems by diameter classes is presented in (Fig. 9)

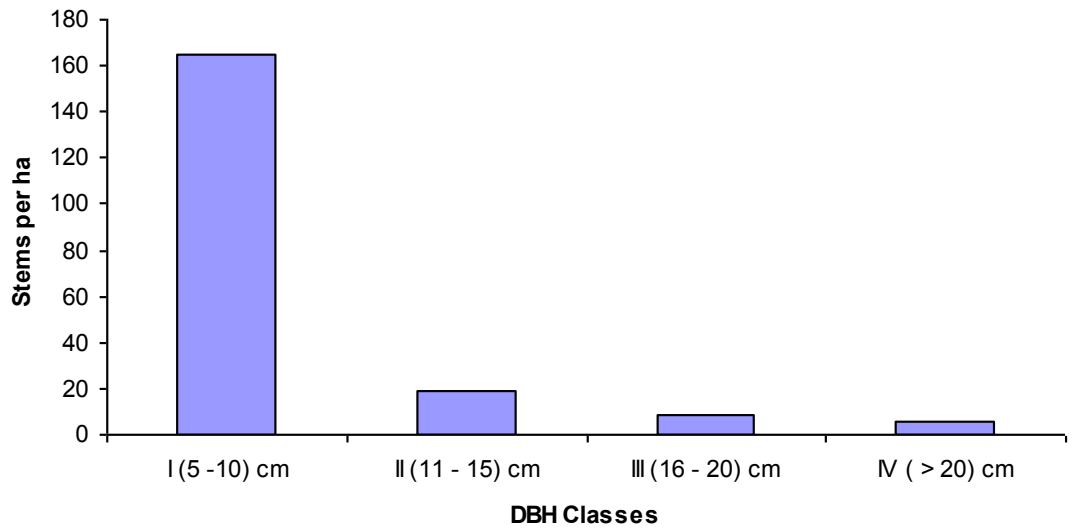

Figure 9: Number of stems ha- distribution by diameter classes for CFR.

The distribution indicates the negative exponential curve (reversed J), as natural forest with an active regeneration. There were a few individuals towards the large diameter classes that is, trees with DBH more than 20 cm. The size class is suggestive of health

population, with population being dominated by juvenile class (Phillip, 1994; Kajembe *et al.,* 2009).

There were considerable a high number of small trees and a low number of trees from large diameter class, diameter classes 11 – 15 cm and > 20 cm in CFR. A low number of a large diameter trees can be explained from the over exploitation of large diameters of the woodland before institutional changes. The past over exploitation exerted enormous disturbances in the woodland whilst, the current management sought as mitigation. The existing management is likely to be the key to the recovery of woodland as shown by domination of juvenile tree species. Elsewhere disturbances in miombo woodlands reported to be the cause of increased regeneration potential (Malimbwi, 2003; Lupala, 2009 and Syampungani, 2008). This also implies that, woodlands have a high resilience capacity after temporary disturbances.

Miombo woodland trees invest large resources in different kinds of stress adaptations (e.g. drought, nutrient poor soil and fire), which provide security during catastrophic events (Malambo and Syampungani, 2008). Normally the woodland tree density increases with increasing rainfall and moisture availability in the soil (Munishi *et al.,* 2011). But the presence of seasonal water logging and later fires may reduce the stocking density of the woodland.

Volume per hectare

In this study the observed volume per hectare ranges from 5.27 – 7.64 m^3ha^{-1} with an overall mean of 6.46 m^3ha^{-1} (Table 31). This mean volume was very low compared to other studies. Lupala (2009) observed 64 m3ha-1 in Bereku Forest Reserve while Chingonikaya (2010) observed 65.99 m^3ha^{-1} and Isango (2007) reported 65.7 m^3ha^{-1} in

Mgori Forest Reserve and Iringa woodlands reserves respectively. (Fig. 10) shows the distribution of volume by diameter classes. The distribution exhibited irregular shape contrally to what was expected for a natural forest indicating over harvesting before the institutional change. Previous history of the management of CFR can explain this observation. For example between 1970s and 1990, there was a commercial exploitation of poles (milunda) which was stopped in 1992. Other disturbances contributed to this situation were forest fires, charcoal making, overgrazing and pit sawing activities. (Fig. 10) shows that diameter classes 11 – 15 cm and 16 -20 cm have low volume per hectare. These classes have trees of merchantable sizes suitable size for poles and charcoal making and therefore were subjected to selective harvesting.

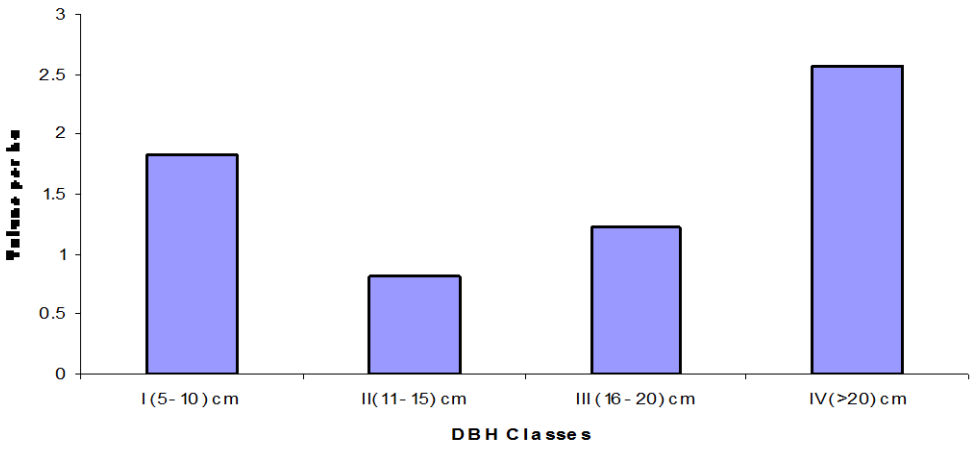

Figure 10: Volume ha-1 distribution by diameter classes for CFR.

While, it is difficult to make a clear relationship between regeneration and exploitation and other disturbances, most mature miombo woodland forest are unlike to recover from commercial exploitation, which involved a massive harvesting for long period (Syampungani, 2008). According to the theory of landscape dynamics, when the disturbance interval is comparable to recovery time and large proportions of the land is

affected, the system will be stable but exhibit large variations (Turner *et al.,* 1993). Othmann (2005) reported a low recovery rates in central Africa dry miombo woodland due to disturbances caused by timber exploitation, forest fires and overgrazing in the forest woodland.

4.4.2.2 Tree species composition and diversity

Table 32, presents tree species diversity index, composition and richness for CFR for inventory survey of 2011.

Table 32: Species richness, number of genera, number of families and Shannon Wierner Index of diversity

Parameters	Total
Number of different tree species	94
Number of genera	68
Number of families	35
Shannon- Wierner Index of diversity	4.0

Species richness and composition

A total of 35 plant families, 68 genera and 94 tree species, were recorded in the study area. With respect to relative importance (IVI) of the woody species, the dominant species *were Brachystegia speciformis, B. boehmii, Xeroderris stuhlmannii, Adansonia digitata, Albizia Versicolor* and Julbernadia globiflora (Table 33).

Table 33: Relative frequency, density, dominance and IVI of most important species at CFR, Bahi, Tanzania

Species	RD_O	RF	RD	IVI	IVI%	H'
Brachystegia specformis	10.124	20.000	7.667	37.792	14	0.196
Brachystegi boehmii	10.460	14.166	5.431	30.058	10	0.158
Xeroderris stulhmannii	6.449	10.000	3.833	20.283	7	0.125
Adansonis digitata	3.500	8.333	3.194	15.028	7	0.110
Albizia versicolor	1.614	9.166	3.514	14.295	3	0.117
Brachystegia globiflora	2.221	6.666	2.555	11.444	3	0.093

The dominance conforms well to the typical miombo woodland (Campbell et al., 2007; Lupala, 2009 and Giliba *et al.,* 2011). Six species contributed almost half of the total IVI (Fig. 11).

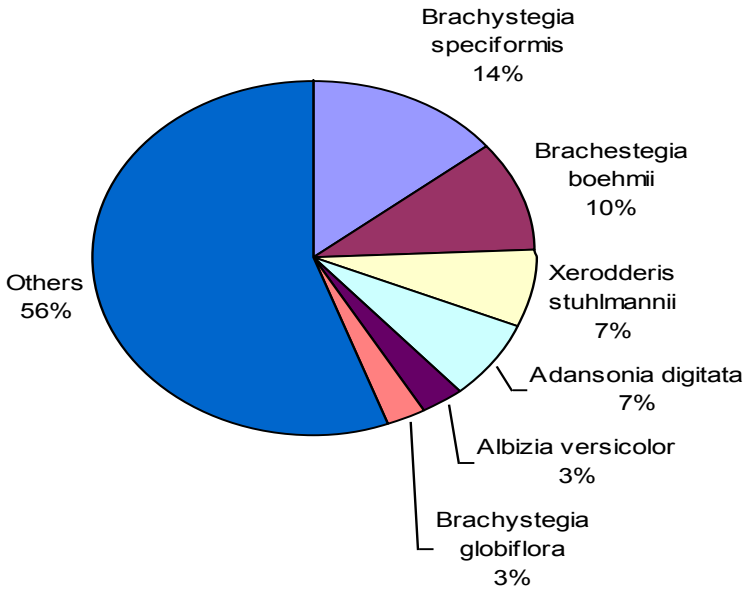

Figure 11: Proportion of important tree species in terms of IVI percent in CFR.

Species diversity

The Shannon-Wierner Index of diversity (H') observed in this study, was 4.0 out of 5 possible (Krebs, 1989) (Table 32) which is high compared to other studies in miombo

woodlands in Tanzania. Zahabu (2001) observed H' of 2.9 and 3.13 in public land and general land) and government (state) forest reserve, for miombo woodlands at Kitulangalo area respectively. Later, in the same forest, Zahabu and Malimbwi (2008) found H' values to be 3.2 and 3.3 for the government forest reserve, SUA training forest reserve and the general land respectively. Reasons provided for this increase of H' was that, disturbances in general land enabled miombo species to regenerate.

In Tanzania forests, species diversity is influenced by species structure and composition (Mbwambo, 2012) hence; changes in structure and composition significantly affect species diversity. According to Malambo and Syampungani (2008) mature natural forest, are associated with more stable plant community due to less variation in species richness and abundance. The findings based on calculated Shannon-Wierner index (H') which indicated more tree species diversity in CFR than other miombo woodlands of Tanzania. Similar tendancy was observed by Lupala (2009) who found Shannon diversity index of 3.8 for Bereku miombo woodland of Babati, Tanzania, which was recovering from temporary disturbance create more tree species diversity than others. The study, provided interesting findings, because the extent of tree diversity in the woodland implies resilient (Lupala, 2009). Particularly, Shannon diversity index, increase with the number of species in the community and in practice, for biological communities this index does not exceed 5 (Krebs, 1989).

The higher number of taxa was found in the sub-family Caesalpinioideae with identified tree species *B. specifornis, Brachystegia. boehmii, Julbernadia globiflora, B. longifolia and B. microphyla, B. bussei* (Fig. 12) These tree species normally characterize miombo woodland ecosystems.

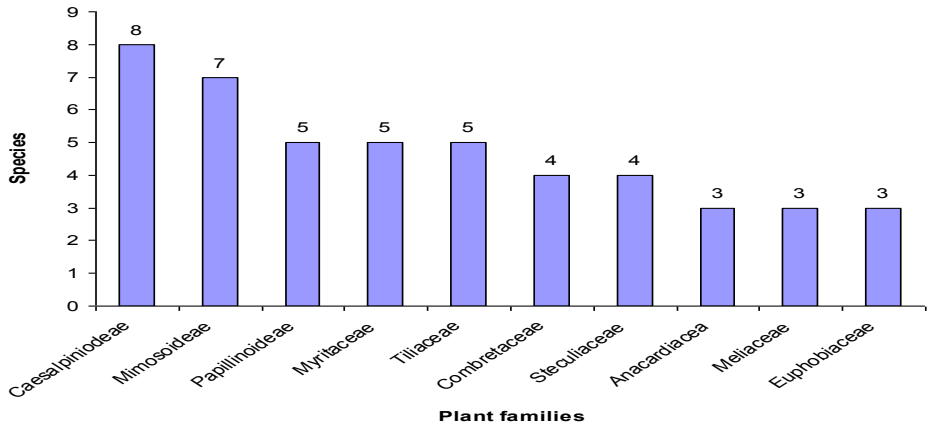

Figure 12: Number of tree species from family of most abundant species at CFR.

The genus of these tree species which include *Brachysteegia* and *Julbernadia* from the family Fabaceae, sub-family Caesalpinioideae, might have made CFR floristically rich (Table 34). According to Höberg and Nylund (1981) in Campbell *et al*. (2007), *Brachystegia speciformis,* has the ability to out compete other decidious tree species on infertile, porous soils. This characteristic feature is probably linked to its extensive ectomycorrhizal (Kanschik and Becker, 2001). This is a fungus, which forms symbiotic relationship with tree species through gaining essential organic substances, from the tree in turn helps the tree to take-up water, mineral salts and metabolic. It can also fight off parasites, predators and nematodes and soil pathogens. The interesting results are also found in the analyzing for most dominating genera in CFR. The genera with highest number of tree species were found to be *Brachystegia* (6 species), *Albizia* (4 species), *Acacia* (4 species), *Grewia* (4 species) and *Combretum* (3 species). These results are in line with the study by Njana (2009) in Urumwa Forest Reserve who observed the same genera with highest number of species.

4.4.3 Human disturbances and tree species exploitation

Table 34 presents disturbances in terms of cut stumps, fire signs, grazing signs, charcoal kilns and pit sawing platforms. Disturbances decreases with increasing distance from the

forest boundaries. Most disturbances were observed in plots near forest boundaries which were closer to the villages adjacent to CFR. The forest condition at 6 – 10 km away from the boundary had a few disturbances as compared to plots at distances of 1-5 km, indicating more disturbances from human activities.

Table 34: Human disturbances at CFR, Bahi, Tanzania

S/N	Number of plots	Distance from forest boundary (km)	Parameters				
			Cut stumps	Fire signs	Grazing signs	Charcoal kilns	Pit sawing platforms
1	70	1-5	153	7	36	15	7
2	50	6 -10	72	2	25	8	2
Total	120		225	9	63	25	9
t-test			0.362	1.977	0.292.	2.358	2.042
p-value			0.720	0.051	0.772	0.020*	0.044*

Regardless of high plant diversity in CFR, valuable timber species have been harvested illegally to the extent that, it was very occasional to encounter mature stems in the forest during forest inventory. Tree species affected include: *Pterocarpus angolensis, Albizia versicolor, Dalbegia melanoxylon, Albizia* and *Brachystegia* species. This was evident in the in the number of cut stumps observed, indicating stems were cut. Presence of charcoal kilns and sawing platforms in the forest also, justifies illegal harvesting of the mentioned tree species. This is in line with other studies conducted in miombo woodlands. Furthermore, the presence of cut stumps and old earth kilns is crucial activity in the study area. Species frequently used for charcoal were *combretum* and *Brachystegia* species. A study in western Tanzania by Abdallah and Monella (2007) reported that, charcoal production venture was growing high because it was taken as a part time job to supplement farmers' income.

4.4.4 Causes of forest pressure at CFR

From PRA it was found that, forest pressures in the study area comprised of proximity causes (wood harvesting, grazing, forest fires, charcoal making and fuelwood); however, the underlying causes (demographic, economic, policy and institutional factors, technological and cultural factors) were not mentioned to contribute directly to forest degradation. Among the proximity causes which were identified during PRA, were pit sawing which involved selective logging, commercial pole harvesting, charcoal making, fuelwood collection, grazing and traditional honey harvesting. From the scores, it was revealed that pole cutting accounted for major forest destruction, followed by grazing and charcoal making (Table 35).

Table 35: Matrix index for causes of forest pressure at CFR, Bahi, Tanzania

Causes	Index
Pit sawing	1.4
Commercial pole cutting	4.0
Charcoal making	2.8
Fuelwood	2.3
Grazing	3.5
Traditional honey harvesting (fires)	1.5
Mean	2.5

Fuelwood, was also observed to be an upcoming pressure in CFR, similarly traditional honey harvesting posed a very litle pressure to the forest due to introduction of modern beekeeping, in the villages as an alternative income generation activity. However, given the current trends, these pressures are likely to decrease in future due to a current forest management under Bahi District Council. Banana and Gombya-Ssembajjwe (2004) found out in Uganda proximate caused a contribution to forest loss, were pit sawing, charcoal making and fuelwood. Mafupa (2005) reported who reported the impact of human disturbances in Igombe River Forest Reserve, Tanzania found that pit sawing; charcoal making and forest fires caused a contribution to forest loss.

4.5 Factors Influencing Performance of Local Institutions in the Study Area

4.5.1 Factors influencing performance of VECs

The results of logistic regression analysis indicating that the model chi-square value of 75.2% was significant ($p<0.05$), implying that, the independent variables affected very well the dependent variable. The model -2 Log Likelihood value of 153.519 indicating that, there was a high fit between the model and data. The Negelkerke R^2 value of 0.62, suggested that, 62% variations in VECs performance was due to independent variables in the model. The overall percentage of the correct prediction was 75.5% which showed a better goodness of fit. Results in Table 36 shows that the Wald statistics were non-zero values, implying that, there were interactions between the dependent and independent variables (Powers and Xie, 2000). Based on these results, the performance of VECs was influenced by the independent variables at 5% level of significance.

Table 36: Perception on factors influencing performance of VECs at CFR, Bahi, Tanzania

Socio-economic factors X_i	Coefficients (a)		Negelkerke $R^2 = 0.62$			
	B	SE	Wald	Df	Sig.	Exp(β)
Participation	+3.459	1,041	11.051	1	0.000*	33.813
Age of a respondent	+0.548	0.657	0.697	1	0.404 ns	1.730
Sex of a respondent	+0.505	0.605	1.697	1	0.404 ns	1.657
Marital status	+0.793	0.602	1.737	1	0.188 ns	2.210
Duration of residence	+0.763	0.400	3.643	1	0.056 ns	2.144
Education level	-2.234	0.692	11.380	1	0.000*	6.568
Household size	+1.155	0.519	4.949	1	0.026 ns	3.173
Distance from home to forest reserve	+1.194	0.371	10.356	1	0.001*	3.301
Wealth (income)	+1.353	0.446	9.207	1	0.002*	3.860
(Constant)	+1.108	0.198	31.402	1	0.000*	3.029

A Dependent variable; Performance level index of VECs (Y_{i1}); β = Beta weight; SE = Standard error of the estimate; * statistically significant ($p<0.05$); ns = not statistically significant ($p<0.05$); N =number of cases = 137

The results showed that, the performance of VECs was likely to be increased by factors including participation in forest conservation, education level, distance from home to the forest reserve and wealth/income. Performance of VECs was likely to be constrained by age, sex, marital status and duration of residence.

4.5.1.1 Participation in forest conservation activities

Results in Table 36 indicate that, participation in forest conservation was statistically significant ($p=0.001$) and had a positive coefficient, with the odds ratio of 31.784. The positive coefficient implied that, one unit increase in household participation increased the likelihood of performance of VECs, in managing forest resources in the study area by a factor of 31.784. A plausible explanation for this was that, when households increased their willingness to participate in forest conservation their level of commitment to make natural resources sustained was likely to increase, also, when households increased their willingness to participate in forest conservation their feeling of ownership for their natural resources was likely to increase and they became more directly responsible for them. This in turn, facilitated an implementation of forest management plans and therefore, increased performance of VECs. These results concur with findings by Brokaw (2006), Paul *et al.* (2007) and Saunders *et al.* (2010) that, participation of local user communities is important for promoting conservation and management of CPRs.

In the study area, the participation of a household in forest conservation was reported be voluntary. Nearly 52% of the respondents had participated in forest conservation as

opposed to 48% who did not. Some of them had volunteered in planting trees in degraded areas in collaboration with VECs, BKGs and Village government (VGs). These groups were observed to be important in participation for conservation of forest resources. This shows the groups formed in the study area, were for economic development and social cohesion. This in turn increased the efforts of VECs and led to a better performance.

4.5.1.2 Age of respondents

Table 36 shows that, the age of respondents was not significant (p=0.404) and had a positive regression coefficient of +0.548 with odds ratio of 0.667. The positive regression coefficient implied that, one unit of an increase in age of a person increased the likelihood of performance by a factor of 0.667. Respondents interviewed had an average age of 50.4 years. Table 37 has revealed that, the productive age groups constituted the majority of respondents as opposed to the old age group (above 55) tended to be wise with the interest of conserving the forest resources for the future generations. These results are in line with findings by Kajembe and Mwihomeke (2001) that productive age groups were involved in many development activities aiming at creating economic benefits out of the forest and this, had influenced illegal and forest degradation.

Table 37: Distribution of age of respondents in the study area

Age group	Villages		
	Babayu	**Mayamaya**	**Total**
< 18 years	27 (34.2)	20 (34.5)	47 (34.3)
Between 18 – 60	39 (49.4)	30 (51.7)	69 (50.4)
> 60	13 (16.4)	8 (13.8)	21 (15.3)
Total	**79 (100)**	**58 (100)**	**137 (100)**

Figures in brackets indicate percentages and those outside denote actual number of respondents

4.5.1.3 Sex of the respondents

Sex of the respondents was not significant (p= 0.404) and had a positive regression coefficient with odds ratio of 1.697 (Table 36). The positive regression coefficient implied that one unit of an increase of men increased the likelihood of the odds ratio of performance by a factor of 1.697. This was due to the fact, that harvesting resources in CFR entailed a set of gender roles played by both men and women. Usually, men constrained the performance of VECs because they were involved in illegal charcoal burning, timber and pole harvesting; while women were responsible for firewood collection for cooking food. Out of 137 respondents 98 (71.5%) were men as opposed to 39 (28.5%) who were females. This implied that, men were responsible in the increasing rate of deforestation. Kessy (1998), in his study, found similar findings that division of labour at household level is segregated by sex, as females were responsible for household tasks including cooking and taking care of children while males were involved in commercial activities.

4.5.1.4 Marital status of the respondents

Marital status, was not significant (p=0.188) and had a positive regression coefficient of +0.793 with odds ratio of 1.737 (Table 36) above. The positive coefficient indicates that the likelihood of performance of VECs constrained as the number of married households increased. The plausible explanation was that married households had a more commitment for their families hence, less time was devoted in awareness training on environmental conservation, also married couples were likely to have more obligations that met the demand of their children which led them to undertake illegal activities, eventually led to poor performance of VECs. Similar findings were reported by Mitinje *et al.* (2007).

4.5.1.5 Duration of residence

Duration of residence of the respondent had the positive regression coefficient and was not statistically significant (p=0.056) with odds ratio of 3.643 (Table 36). Although the relationship was not significant, an increased of years of stay constrained the likely hood of performance of VECs in the study area by a factor of 3.643. The duration of residence was associated with an adaptation to the area and became knowledgeable, on resource distribution and increased dependency on forest resources for livelihood improvement. The study has revealed that, an increased in number of years had made local people to increase dependency on forest resources and got employed by outsiders to the harvesting, as local people seemed to be familiar with the forest resources distribution and adapted to the environment. This shows that, local people did much of the commercial harvesting of poles, timber and charcoal burning and provided a little support to VECs in the forest protection and hence poor performance. These results tallies with findings by Feka and Manzano (2008) indicating that in Cameroon harvesting of forest resources is associated with residence duration.

4.5.1.6 Education level

The education level of respondents, was significant ($p<0.0001$) and had a negative regression coefficient of -2.234 and odds ratio of 11.380 (Table 36). These results implied that, the likelihood of the performance of VECs increased as the education level of them increased. Probably, educated people had developed more livelihood options and understood the environmental problems. This shows that, people with formal education tended to adhere to the rules and regulations regarding resources usage and management, therefore, were less likely to engage in illegal activities as reported by Kitula (2012) that, education plays a big role in realization of sustainable utilization and management of natural resources. The study observed that, out of (61.3%) of the respondents interviewed

had attained primary education while respondents with no formal education accounted 38.3% (Table 38) below.

Table 38: Education level of respondents at CFR, Bahi, Tanzania

Education level	Villages		Overall (N = 137)
	Babayu (n = 79)	Mayamaya (n =58)	
Formal education	52 (65.8)	32 (55.2)	84 (61.3)
No formal education	27 (34.2)	26 (44.8)	53 (38.7
Total	79 (100)	58 (100)	137 (100)

Figures in brackets indicate percentages and those outside denote actual number of respondent

Table 36 shows that, the education level of respondents was statistically significant (p=0.000) and had a negative regression coefficient of -2.234 and odds ratio of 6.558. This implied that, an increase in education decreased the environmental problems in the forest reserve by the factor of 6.558. This is an indication that, people with higher education had more livelihood options compared to less educated people, therefore, were less likely to cause forest destruction. The study has observed that, majority of them had attained primary education and some with no formal education. This level of education was not enough to enable someone to have a job in town with highly paid salary. Hence, most of them after completing primary education stayed in the village and depend on forest resources hence increase forest resource degradation.

4.5.1.7 Household size

Household size of respondents, had a positive sign of regression coefficient and was not statistically significant (p=0.026) odds ratio of 4.949 (Table 36). A positive regression coefficient implied that, the decrease in household size was likely to increase performance of VECs in the study area by a factor of 4.949. The plausible explanation for this was that a large household size could increase work force if land and other factors are not

constraining. This situation increased the likelihood of the involvement in forest encroachment and illegal activities and therefore, provided a little support to VECs in the conservation of forest resources. This situation reduced the performance of VECs. Such implications have been confirmed by Kitula (2012) who reported that, household size increase, tended to worsen forest resources as people exploited the forest beyond the management objectives.

4.5.1.8 Distance from home to forest reserve

Results have shown that, the distance from home to the forest reserve was statistically significant (p=0.001) and had a positive regression coefficient with odds ratio of 10.356 (Table 36). This implied that, one unit of an increase of distance from home to the forest reserve, increased the likelihood of the performance of VECs by a factor of 10.356. The study has established that, increase in distance from home to the forest reserve, has led to reduce dependency of the local people on forest resources. Most of the disturbances were observed in plots which were near to the villages as compared to plots which were far away from the villages, an observation that is also reported by Kitula (2012).

4.5.1.9 Wealth category (income) of the respondents

The results have shown that, the wealth category (income) of respondents was significant (P=0.002) and a positive regression coefficient with odds ratio of 9.207 (Table 36). The positive regression coefficient implied that, rich people were in better position to harvest forest resources illegally (Table 39). This could be explained by the fact that, wealthier people used money as a strategic power to have more access to forest resources illegally which suggested that, powerful individuals were more likely to violate rules and regulations regarding to an access and sustainable management. In their studies Brokaw

(2006), Prasai (2006) and Mbeyale (2009) found similar findings that people with a high income in a society are more powerful in accessing CPRs than members of low status.

Table 39: Opinions regarding wealth group with access to forest resources at CFR, Bahi, Tanzania

Villages	Wealth groups				
	Poor	Middle	Rich	χ^2	P
Babayu	24 (30.4)	50 (63.3)	5 (7.3)		
Mayamaya	16 (27.5)	35 (60.3)	7 (12.2)	6.665	0.755 NS
Overall (N=137)	40 (29.2)	85 (62.0)	12 (8.8)		

Figures in brackets indicate percentages and those outside denote actual number of respondents; NS = not statistically significant (p> 0.05)

4.5.2 Factors influencing performance of BKGs

Table 40 summarizes the results on socio-economic, environmental and institutional factors that were entered into logistic regression analysis. The results of the logistic regression analysis indicated that, the model Chi-square value of 72.300 was significant ($p<0.05$) indicating that, the independent variables affected very much the dependent variable. The model -2 Log Likelihood value of 75.962 indicated that, there was a high fit between the model and data. The Negelkerke R^2 value of 0.638, suggested that, 63.8% variations in BKGs performance the correct predictions was 86.7% which showed a better goodness of fit.

4.5.2.1 Level of awareness on illegal activities

The level of awareness of respondents, had a positive sign coefficient and was not statistically significant (p=0.337) with odds ratio of 2.350 (Table 40). The positive regression coefficient implied that, by increasing the level of awareness by one unit was likely to increase the performance by a factor of 2.350.

Table 40: Perception on factor influencing the performance of BKGs at CFR, Bahi, Tanzania

Socio-economic, environmental and institutional factors X_i	Coefficients (a) 0.62				Negelkerke R^2 =	
	B	SE	Wald	Df	Sig.	Exp(β)
Level of awareness on illegal activities	+0.855	0.891	0.920	1	0.337 ns	2.350
Illegal access to forest products	-2.979	0.971	9.410	1	0.002*	0.051
Awareness to resource extinction	-0.729	0.793	0.845	1	0358 ns	1.657
Poor coordination of stakeholders in forest conservation	-0.784	0.766	1.049	1	0.306 ns	0.482
Perceived importance of clearly defined boundaries	+3.521	0.819	18.481	1	0.000*	33.813

A Dependent variable; Performance level index of BKGs (Y_{i2}); β = Beta weight; SE = Standard error of the estimate; * statistically significant ($p<0.05$); ns = not statistically significant ($p<0.05$); N =number of cases = 137

These results suggest that, when people were aware about illegal harvesting of forest resources for commercial purposes, due to the traditional norms, honey harvesting was not allowed their level of participation in management of forest resources is likely to increase. This was because high level of awareness tended to change attitude, behaviours and beliefs of the households towards wise usage of CPRs.

Beekeeping groups (BKGs), were responsible in awareness rising for a sustainable management of forest resources, 68% of respondents had indicated to attend awareness training, on the importance of conserving forest resources in CFR. This means that successful institutions depended on the level of community awareness regarding resource utilization and management (Kitula, 2012). In spite of this awareness, there were still illegal activities in CFR, which was largely contributed by the lack of natural forest in public lands that offered a multi-usage as CFR did.

4.5.2.2 Illegal access to forest products

The study has revealed that, illegal access to forest products was significant (p=0.002) and had a negative regression coefficient of -2.976 with odds ratio of 0.051 (Table 40). The negative regression coefficient implied that, the likelihood of performance of BKGs decreased as illegal access to forest products increased by a factor of 0.051. This means that, illegal access to forest products had a direct relation with insufficient funds available for conserving forests. Key informants interviewed revealed that, BKGs were constrained by the budget to purchase modern equipments and harvesting gears, also, petrol, for supporting VECs for patrolling illegal harvesting in CFR. This suggested that, inadequate funding to BKGs had resulted in poor performance. Milledge *et al.* (2007) argued that, institutional effectiveness is constrained by insufficient funds to enable critical monitoring of rule of compliance by community and protection of CPRs.

4.5.2.3 Awareness on resource extinction

The study has revealed that, the awareness of respondents about the resource extinction was not statistically significant (p=0.358) and had a negative regression coefficient with odds ratio of 0.482 (Table 40). The negative regression coefficient implied that, the likelihood of performance of BKGs decreased as the level of awareness about resource degradation increased by a factor of 0.482. A logical explanation for this was that, increased level of awareness of households about resource extinctions was likely to result into increased level of negligence in providing support to BKGs, in the conservation activities. This means that, unsustainable harvesting of forest resources increased when households believed that, forest resources were there to stay.

Slightly over half (56%) of the respondents had beliefs that, forest resources were there to stay as opposed to 44% who mentioned that unsustainable harvesting could result into

degradation. This shows that current information about quality and quantity of forest resources available in CFR was lacking. Masalu (2009) reported that outdated and insufficient knowledge of resources hamper planning process on sustainable use of forest resources. This was due to the fact that, processes affecting forest resources were accelerating, leaving many negative impacts undetected. This in turn negatively affected performance of BKGs.

4.5.2.4 Poor coordination of stakeholders in conservation

The respondents opinions that, stakeholders in forest resources were poorly coordinated in conservation activities had a negative sign of regression coefficient and was not, statistically significant (p=0.306) with odds ratio of 0.456 (Table 40). The negative regression coefficient implied that, one unit increase of this variable was likely to decrease the performance of BKGs by a factor of 0.456. Nearly 80% of respondents perceived that, the stakeholders in CFR were poorly coordinated in conservation activities. This means that, the management of the forest resources was too sectoral that had focused on a specific resource including forest, agriculture and wildlife. This situation, had increased conflictive relations due to unclear directives over issuing permits and license, over forest resources and thereby constraining the performance of BKGs. Institutions perform poor when stakeholders are fragmented in coordinating their actions as argued by Ostrom (1990).

4.5.2.5 Perceived importance of clearly defined boundary in forest protection

Respondents perception that, a clearly defined boundaries was important in forest protection, was statistically significant (p=0.000) and had a positive sign of regression coefficient with odds ratio of 33.813 (Table 40). The positive regression coefficient implied that one unit increase in the household's perception that a clearly defined

boundary was important in forest protection increased the likelihood of performance of BKGs by a factor of 33.813. A probable explanation for this was that, when people increased their understanding on the importance of physical boundary, their willingness to take part in protecting forest resources was likely to increase. This in turn increased the performance of BKGs.

The study has revealed that, there had been instances when community members detected poachers of forest products and illegal activities in CFR and they subsequently reported the matters to BKGs members. Without negligence, BKGs apprehended poachers and people who had encroached forest reserve for farming, this show that, the increased understanding of physical boundary had increased the willingness of household to participate in forest protection. This in turn, increased the effort of BKGs and led to a better performance. This suggests that, the community empowerment was important strategy as it made people responsible for forest management, a review that is also shared by URT (1998a) and Saunders *et al.* (2010) reported further that, the presence of a clearly defined boundary for the CPRs itself is likely to increase commitments of local communities in management of forest resources.

4.6 General Discussion and Synthesis

This study predicted that:

Institutional changes will improve forest resource condition and the performance of local institutions leading to sustainable forest resources management

Based on the conceptual framework (Section 1.8), the study has aimed at establishing relationship (vertical) between institutional changes and forest conditions and the performance of local institutions. This relationship is presented in (See section 4.1)

However, based on the results, it was clear, and there is a relationship between the components (i.e. forest condition and performance of local institutions), which have profound implications on a sustainable management of CFR and institutional change in the general. These relationships form the base of this section on general discussion and synthesis.

Drawing from earlier Common Pool Resources theory, it is clear that, the commons cannot be managed sustainably without involvement of local communities as stakeholders (Ostrom, 1990). The theory argued that, resources held in common would inevitably be degraded through over use because individuals would have no incentive, to reduce their own uses while others continued without limit (Ostrom, 1990; Mbeyale, 2009), consequently, putting resources under state or private ownership was the solution for "tragedy of the common" (Hardin, 1968). However, failure of state to manage resources sustainably calls for a need to search for suitable management regimes (Mbeyale, 2009). After 21 years of the polarized article "tragedy of the commons" by Hardin (1968), many studies show that, the commons can be managed sustainably in many ways other than privatization or government control (Ostrom, 1990; Agrawal, 2001).

Several countries, including Tanzania recently, have been implementing institutional changes by involving local communities in the management of natural resources including forests (URT, 1998a). In order to involve the local people in the management of forest resources, institutional change gave all or some of the user rights to them as motivation, to manage the resources sustainably (Meinzen-Dick *et al.,* 2001).

Granting some user rights to local communities through recognizing ownership rights to the community and promotion of community participation, improves forest condition and

performance of local governance structures (Lutz and Linder, 2004). The common assumption, underlying the relationship between decentralization and sustainable management, is the central government to relinquish their management responsibilities and powers to local government levels, local leaders or community institutions, to provide incentives for people to invest resources and time, in forest management if they can benefit from them (WRI, 2003).

The achievement of this purpose, is based on a number of assumptions: on the efficiency aspect it is assumed that, participation in decision making and management of local resources allows the local communities, who bear the costs of resource use to make the decision themselves, instead of putting the decision in hands of somebody else (Ribbot, 1999). In addition, since the local people live in or around the resource areas, the administrative and management costs can be reduced and local skills and knowledge could be used. Furthermore, decentralization by devolution increases the efficiency of coordination and flexibility among state agencies in development and conservation, planning and implementation (Agrawal and Ostrom, 1999). As of equity aspect, it is assumed that participation can increase equity through more equal distribution of benefits (Ribbot, 1999). Overall, in order for decentralization by devolution to improve sustainability, equity and efficiency in forest management, it is assumed, that local people have voice in and control of significant decision making and they take the role formerly taken by the state (Meinzen-Dick *et al.,* 2001). Lastly, decentralization by devolution in Tanzania strived to improve forest condition and performance of local governance structures (URT, 1998a).

4.6.1 Formal and informal institutions

Results in section (4.1 Tables 7, 8 and 9) indicated both formal and informal institutions existed in the governing and usage of forest resources in the study area. Furthermore, the study has established that formal institutions were more responsible as opposed to informal ones in governing forest resources utilization and management. Local institutions after decentralization of CFR had shown an improvement in forest management as predicted in the conceptual framework in section 1.8 that local institutions will lead, to a sustainable management and utilization of forest resources.

Linking with the Common Pool Resources (CPRs) theory, Olson (1971) and Sletten *et al.* (2008) urged that, there must be coercion or some other special device to make individuals act towards a common interest otherwise; rational, self-interested individuals will not act towards a common or group interest. The local institutions provided a mechanism of enhancing conformance to social norms, also minimized social costs for a supply of local institutions. Sumaila *et al.* (2003) put forward that the interests of clan heads and chiefs in management of forest resources in terms of their capacity to provide goods and services that are important for both ecological and socio-economic benefits. Decision made by local institutions related to success of resources, distribution of benefits and responsibilities are deeply rooted in socio-cultural mechanisms such as customary laws and council of tribe elders (Marfo, 2006) Therefore, for the case of CFR study revealed that local governance institutions had improved as a result of improvement in law enforcement and existence of institutional arrangement that support rule of law.

4.6.2 Effects of institutional changes on forest governance

The study has indicated that, the performance of local institutions in managing forest resources, had improved after decentralization of CFR as hypothesized in the conceptual

framework in section 1.8 that a good forest governance in terms of rule of law, transparency, accountability and equity could led to a sustainable forest management and utilization. Results in (Section 4.2 Tables 10, 11, 12, 13) have revealed that, rule of law, transparency; accountability and equity had improved as a result of improvement in the law enforcement and people's adherence, to rules and regulation through a collective law enforcement and the existence of institutional arrangement that, supported rule of law, transparency, accountability and equity. Forest governance, has improved at a satisfactory level as a result of lack of openness on matters related to CFR, such as financial issues and an absence of WCDC which were important organs, for facilitating communications and connections between CFR management and local communities. Therefore, the study has concluded that, quality of forest governance had improved at a satisfactory level after decentralization of CFR under BDC.

Linking with CPRs theory, CFR management contributed to the said improvement in forest condition (see Table 28 and 29). Reduced disturbance was a result of law enforcement and rules compliance. Forest governance especially law enforcement and rule compliance were found to be positively correlated with good forest condition (Blomley *et al.,* 2008; Blomley and Ramadhani, 2006). Lugandu (2010) argued that participation under decentralization improved forest condition due to enhanced law enforcement which minimized illegal activities. This underscores the importance of well-designed institutional changes in forest management in Tanzania. According to FAO (2010), regulatory framework (in this case policy that established CFR and MoU) and acceptable rule compliance procedures are important for successful institutional changes. Therefore, earned forest governance based on decentralization approaches is often the strength for sustainable forest management.

4.6.3 Conflicting interests and power relations of stakeholders

The study has shown that, the competition in harvesting forest resources was a central area of conflicting interests between poles harvesters and timber, charcoal burners, firewood collectors and traditional healers (See section 4.3 Tables 20, 21, 22, 23, and 24). The study has established that, various stakeholders were operating in CFR. Stakeholders used forest resources for a number of applications including harvesting of forest products, beekeeping, conservation area and research. These multiple uses were sometimes not mutually compatible and had resulted in conflicting interests and power relations (Section 4.3.3, Fig. 6). Conflicting interests and power relations among stakeholders were routed to the institutional and economic standpoints which were among causes of negative changes in forest condition. This goes in line with the predicted conceptual framework (Section 1.8) which indicates that, poor governance structures in terms of rule of law, transparency, accountability and equity could result into a pressure on forest resources and consequently, leading to unsuitable forest management and utilization.

Drawing from Common Pool Resources (CPRs) theory it is clear that commons cannot be managed sustainably without the involvement of local communities as stakeholders (Ostrom, 1990). The effectiveness of stakeholders in management of forest resources depend very much on how the stakeholders addressed the local problems and fit in the local settings characterized by people with different power and historical backgrounds. Otsuki (2007) puts it, stakeholders on sustainable development should be site specific because human agency cannot be separated from historical, social and political contexts. According to Brokaw (2006) understanding the power of different groups of stakeholders involved in the management of forest resources help to arrive at compromises and put off conflicting ideas. Wiese (2007) put forward the argument that struggle for power over

natural resource management can be studied on as a continuum covering intra-personal, inter-personal, inter-group and ideological level.

In CFR conflicting interests among stakeholders existed, were regarding the use and management of forest resources. These conflictive interests resulted from sectoral management approach. Therefore, a need for multi-sectoral forum is important for harmonizing existing conflicting interests and avoiding new ones.

4.6.4 Effects of institutional changes on forest cover, wood stocks and tree diversity

This study has shown that, there was a positive change in forest condition (Section 4.4.2 Table 28 and 29) and (Fig. 7 and 8). The general improvement in forest cover implies that there is an improvement in the resource governance after decentralization of CFR, as predicted in the conceptual framework (Section 1.8), that, good governance will lead to a sustainable forest management and utilization leading to an improved forest cover.

On the other hand, wood stock parameters had shown that, there was low parameters in standing stock parameters implied that the forest was under high human disturbances in the past and hence, was recovering from past disturbances. (See section 4.4.2, (Table 31) and (Fig. 9 and 10). Likewise, forest governance (in terms of good governance) had also improved as a result of institutional changes. Standing stock parameters was recovering showing high regeneration, reduced disturbances (anthropogenic) (See Tables 34 and 35) as a result the local government at CFR management contributed to the said improved standing crop parameters. The reduced disturbance was a result of law enforcement and rules compliance. Forest governance especially the law enforcement and rule compliance were found to be correlated to good forest conditions as predicted in the conceptual frame work (Section 1.8).

Tree species composition and diversity (Section 4.4.3 Tables 32, 33) (Fig. 11 and 12) disclose that CFR was rich in tree species and diversity 94 tree species were identified and Shannon Wierner Index of Diversity of 4.0 after decentralization of CFR. This implied that, CFR was recovering from disturbances are characterized by high tree diversity. Thus, the study linked well with the predicted in conceptual framework (Section 1.8) that, good governance is one of the best ways for sustainable management of forest resources.

Linking with theories of forest dynamics which predict that highest biotic diversity, is achieved when a community is subjected to moderate disturbance CFR indicated more species diversity as a result of recovering from temporary disturbances, such disturbance allow the community to recruit young ones and persistence of species that would otherwise be excluded (Hobbie *et al.,* 1993). Strict rules and regulations on control over resources may improve forest resources condition but may also reduce benefits from resources by poor people (Lund and Treue, 2008). Indeed, forest condition at CFR had improved on the expenses of the local people's livelihoods. Local people have born the cost of conservation through deprived access to forest resources. This implies that the primary objective of institutional changes that allowed decentralization is to improve forest condition and community livelihoods is a second priority. Regulatory framework that allow individual or group to manage the forest in a way that can both support forest condition and community livelihoods are important for success of institutional changes (FAO, 2010).

Therefore, the major challenge facing most protected areas including CFR is how to balance between conservation and utilization. Most of the benefits from protected areas are not enough to be regarded as alternative livelihood strategies to improve people's livelihoods (Vyamana, 2009).

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

5.1.1 Effect of institutional change on performance of local institutions

Both formal and informal institutions existed in the governing forest resources utilization and management in the study area. The study has established that formal institutions were more responsible as opposed to the informal ones in governing natural resources utilization and management. It has also been revealed that, local governance institutions had improved as a result of improvement in law enforcement and existence of institutional arrangement that supported rule of law, transparency, accountability and equity improved at a satisfactory level as a result of lack of openness on matters, related to CFR such as financial issues and an absence of WCDC, which were important organs for facilitating communication between Bahi District Council and local communities. Therefore, the study concludes that, the quality of local governance structures had improved after decentralization of CFR.

5.1.2 Forest condition and conflicting interests of key stakeholders

The study has established that various stakeholders were operating in CFR management. Stakeholders used forest resources for number of uses including harvesting of forest products, beekeeping, conservation and research. These multiple uses were sometime not mutually compatible and had resulted in conflicting interests between and among stakeholders. Stakeholders' conflicting interests were routed in institutional and economic standpoints which were among causes of disturbances in forest vegetation cover in CFR. The changes involved selective cutting of trees, grazing livestock in forest reserve leading conversion of water bodies to grassland due to siltation and sedimentation of river

channel. The study concluded that, the conflicting interests in resource use were a major constraint to ensure sustainable management of CFR.

5.1.3 Effect of institutional change on forest cover, wood stock and tree diversity

Forest cover revealed improvement after decentralization. Persistence of illegal activities such as tree harvesting, forest fires, charcoal burning and livestock grazing in CFR, were responsible for forest disturbances. The general improvement in forest cover after decentralization imply that under certain circumstances the local government could manage forest resources better than state control, under central government. The recorded standing stocks parameters were, low due to past disturbances which contributed to high tree diversity. The tree diversity observed was within the range as reported by different authors in dry miombo woodland forests. There were a little harvesting indicated that, people complied with rule and regulations. Therefore, the study concludes that institutional changes that follow decentralization of CFR were one of the best ways, for a sustainable management of forest resources.

5.1.4 Factors influencing performance of local institutions

Logistic regression analysis indicated that, performance of VECs in managing forest resources was hampered by factors including duration of residence, household size, education level, distance from home to the forest reserve and wealth (income).

Results from logistic regression analysis also have shown that, the performance of VECs was significantly influenced by education level, household size, and distance from home to the forest reserve, while the desire for economic gain, age, wealth and sex of respondents significantly and influenced the performance of VECs.

To sum up, it can be concluded that, by improving forest condition, the performance of local governance structures cannot be mutually achieved or enforced, and under some circumstance they may be at odd. However, for a sustainable management of any forest reserve to be achieved, there must be a trade-off between conservation and development.

5.2 Recommendations

From the preceded conclusion, the following recommendations were made:

5.2.1 Effect of institutional changes on the performance of local institutions

There is a potential for improvement on the performance of local institutions. The study therefore recommends the following:

(i) There was a need, to institute devolution of power with sufficient human and financial resources, and to have an appropriate management which will empower communities surrounding the reserve through JFM agreements.

(ii) The importance of awareness rising on good governance education should be given to all stakeholders who were involved in the management and utilization of forest resources.

(iii) The extremely poor financial and human resource for the central government and local governments indicated that, a clear need for involving local people in safeguarding the forest resources.

(iv) The dimensions of good governance such as accountability, rule of law, transparency and equitability have to be strengthened. More support is needed

from stakeholders such as donors, district council and central government for development of these dimensions.

(v) More studies are encouraged to be done to value and monitor different ecological processes. This is due to the fact that most of the production forest reserves especially in Dodoma region are not yet valued and monitored ecologically.

5.2.2 Forest condition and conflicting interests of key stakeholders

Most of the conflicting interests existed in the study area, were regarding the use and management of forest resources resulted from sectoral management approach. Therefore, a need for organising multi-sectoral consultative forum at least, once every two years to ensure a suitable management of forest resources in CFR is important, for harmonizing existing conflicting interests and avoiding new ones, resulting from sectoral management approach. The framework will provide opportunities for involvement of stakeholders at all levels, to set out strategic objectives as well as developing integrated programmes and policies to implement those objectives. The forum will be an arena for facilitating active participation of stakeholders, for creating high levels of awareness and understanding of various issues, which face ecosystem in CFR. It is important that, the forum should have the steering committee and thematic groups. The steering committee could be made up from the chairs of each of the topic groups. In this way the coordination and integration would be facilitated to ensure suitable management of forest resources at CFR.

5.2.3 Effect of institutional changes on forest cover, wood-stock and tree diversity

The study recommended that, institutional change that allowed decentralization by devolution in forest management in Tanzania, is among promising strategy for an

improvement of forest condition, to accurately estimate its effects and therefore, forest dynamics, further periodical monitoring (at least after five years) is recommended. This should involve an establishment of permanent sample plots which will provide a basis, for the future monitoring of forest dynamics and evaluation of the impact of institutional changes on forest resources condition.

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APPENDICES

Appendix 1: Composition and responsibilities of parties in management of CFR and Memorandum of Understanding (MoU) between BDC and Villages adjacent to the Forest Reserve

Level	Organ	Composition	Power and responsibilities
Village community	Village assembly	All villagers	• Nominate members of advisory board • Approve MoU and VECs • Decide on cost/benefit sharing
Village government	VECs	As described in local government law that established village government for VEC OR VNRC	• Preparing VNRMP and MoU • Implementation of MoU and VECs • Take recommendations to WCDC
CFR Management team	WCDC	• 8 Members made up of chairpersons of VECs • 2 members made-up from representative of local community to the WCDC • CFR forest officer (non voting member	• Supervise VECs • Conflict resolution • Decide on implementation of VECs and MoU • Decide on cost/benefit sharing • Take recommendation to advisory committee
Bahi District Council forming advisory board	Major stakeholders	• 3 officers representing the DED (DNRO, DFO, DALDO) • 3 Local institutions (BKGs, DONET, MIGESADO) • CFR Forest officer	• Approving CFR Plans and reports of implementation (GMP, VNRMP) • • Conflict resolution

Source: BDC, 2005: VNRMP = Village Natural Resource Management Plan; MoU = Memorandum of Understanding; VECs = Village Environmental Committees; WCDC= Ward Conservation Development Committee; DONET= Dodoma Environmental Network, MIGESADO= Miradi ya Samadi Dodoma; GMP= General Management Plan; DNRO = District Natural Resources Officer, DALDO =District Agriculture and Livestock Development Officer; DED= District Executive District Officer.

Appendix 2: Household questionnaire

1.0 General information for household in addressing local governance structures

1.1 Village name……

1.2 Ward ……

1.3 Division ……..……

1.4 District ……

1.5. Date of interview……

A: General information questions

Household characteristics:

1.6 Age of respondent ……. Years

1.7 Sex of head of the household Male ……Female ……..……

1.8. Marital status (Tick appropriate answer)

S/n	Marital status	Code
I	Single	1
Ii	Married	2
Iii	Divorced	3
Iv	Widowed	4

1.9. Duration of residence in the village …… (years)

1.10. Education level (Tick appropriate answer)

S/n	Education level and years of schooling	Code
I	No formal education	1
Ii	Primary education	2
iii	Secondary education	3
iv	Others (specify)	4

1.11. What is your religion?

1. Christianity
2. Islam
3. Traditional
4. Other, (specify)

1.12. What is your ethnic group ……

1.13. Household composition (Tick appropriate answer)

Age (years)	Female	Male	Total	Code
< 18				
18- 60				
> 60				

1.14 What are the major sources of household income?

S/n	Source of household income	Code
I	Fishing	1
Ii	Crop production	2
Iii	Livestock production	3
Iv	Logging timber	4
V	Both crop and livestock production	5
Vi	Petty business	6
Vii	Others (specify)	7

1.15 Does your household have land in this year? Yes/ No
1.16. If yes how many acres ……..
1.17. How did you acquire the land you have?
1. Bought
2. Rented
3. Allocated by village government
4. Leased
5. Inherited
1.18. What is the total agricultural land you own (ha) ……..
1.19 If no in 1.17 give reasons……
……

B: Utilization of forest resources

2.1 Do you have accessibility to the forest?
2.2 How long does it take you to go to the forest?
2.3 Do you get any benefits from the forest? Yes or No
2.4 Which benefits do members of your household get from the forest reserve?

(Tick appropriate answer).

S/ N	Benefits (Uses)	Code	Distance	Price	Quantity
I	Timber	1			
Ii	Firewood	2			
iii	Charcoal	3			
Iv	Poles	4			
V	Vegetables	5			
vi	Wild animals	6			
vii	Ropes	7			
viii	Withies	8			
Ix	Medicinal plants	9			
X	Water	10			
Xi	Others (Specify	11			

2.5 Do you cell some of collected forest products?
2.6 If yes give the average quantity sold per person and their respective price
2.7 Is there any fairness in accessing forest product among poor and rich people?
2.8 Are both men and women having equal chance in accessing forest products?
2.9 What is the present condition of the forest?

C: Information on governance structures during pre-colonial era and central government era

3.1 Were there any local governance structures that exist in the village?
Yes or No

3.2 If yes, what were the formal and informal local governance structures which existed in the study area? .....

3.3 What were the roles and embedded power of formal local governance structure which existed in the study area? ……

3.4 Were both men and women involving on management of forest resource? Yes or No

3.5 If no why? ……

3.6 What is your opinion on the performance of governance structure during central government era in terms of the following characteristics?

Characteristics				
	Good (3)	**Satisfactory (2)**	**Poor (1)**	**Absence (0)**
Accountability				
Transparency				
Equity				
Rule of law				

D: Information on governance structures during local government era:

4.1 Are there any local governance structures that exist in the village?
Yes or No

4.2 If yes, what are formal and informal local governance structures which exist in the study area? .....

4.3 What are the roles and embedded power of formal local governance structure which exists in the study area? ……

4.4 Are both men and women involving on management of forest resource? Yes or No

4.5 If no why? ……

4.6 What is your opinion on the performance of governance structure during local government era in terms of the following characteristics?

Characteristics				
	Good (3)	**Satisfactory (2)**	**Poor (2)**	**Absence (0)**
Accountability				
Transparency				
Equity				
Rule of law				

Dimensions of good governance
Sub-dimensions of good governance used for assessing governance in villages adjacent to CFR, Bahi, Tanzania.

Dimension of good governance	**Sub dimensions**	**Rank 0,1, 2, 3**
Accountability	Mechanism of dissermination of information	
	Answerability (upward and downward) accountability	
	Representative's accountability	
Transparency	Decision making process is open and reason behind evident	
	Information on performance is open and in appropriate form	
	Responsibilities are known	
Equity	Local people's human rights	
	Fair distribution of benefits and costs	
	Absence of biasness in decision case by case	
Rule of law	Acts within mandates	
	Acts with integrity	
	Acts with commitments	
	Law enforcement and adhering to rules	

Good (3), Satisfactory (2), Poor (1) Absence (0)

E: Information on stakeholders

5.1 Which stakeholders are involved in management of CFR? (List them in order of importance)

5.2 Which role of each stakeholder play in the2of CFR

Appendix 3: Checklist for key informants

Central government, District council and village officials

(i) Main natural resources available.

(ii) Forest resources utilization and underlying causes.

(iii) Existing forest governance for regulating forest resource utilization and management

(iv) Institutions involved in forest management before and after decentralization (governments/ committees), (formal / informal).

(v) Power relations among stakeholders (Central government, local government, community) in the management of CFR.

(vi) Equity in accessing forest products.

(vii) Socio-economic factors which enable or constrain the performance of local governance structures in the provision of forest benefits.

(viii) Suggestion on community participation in (decision making, implementation, evaluation and cost benefit sharing).

(ix) Are there any tree planting efforts in the area?

(x) Is tree planting a factor in reducing pressure on CFR?

(xi) Use of improved cook stoves in the area

(xii) What do you think should be done in order that consefficiency?

Appendix 4: Summary of PRA technique

Issue	**PRA technique**
Forest condition	Time line and historical institutional profile
The key forest products	matrix parewise ranking
Existing governance local structures	Venn diagramming
Best governance local structures existed during pre colonial era, central government era	Venn diagramming
Best local governance structures (among existing during local and central government era)	Venn diagramming
Categories of stakeholders, corresponding interests and areas of conflicting interests	Matrix Pairwise ranking and scoring, multi-stakeholders analysis

Appendix 5: List of Species

Species code	Local name	Botanica name
1	Mdoledole	*Acacia albida*
2	Mkambala	*Acacia nigrescens*
3	Mfuku	*Acacia nilitica*
4	Mkungugu	*Acacia tortilis*
5	Mbuyu	*Adansonia digitata*
6	Mhogolo	*Albizia amara*
7	Mtanga	*Albizia gummifera*
8	Mkenge	*Albizia schimperiana*
9	Mchenje	*Albizia antumesiana*
10	Mkenge	*Albizia versicolor*
11	Mjulusi	*Alchornea cordifolia*
12	Mnyakisege	*Allophylus abyssinica*
13	Mpoum	*Aphloia theiformis*
14	Mbumanzuki	*Apodytes dimidiata*
15	Mduguyu	*Balanites aegyptica*
16	Mfora	*Baphiopsis stuhlmannii*
17	Mgandu	*Berchemia discolor*
18	Mtumba	*Boscia salicifolia*
19	Msani	*Brachestegia boehmii*
20	Myombo	*Brachystegia bussei*
21	Myombo-Mzabo	*Julibenadia globiflora*
22	Mbonha	*Brachystegia longifolia*
23	Mtelela	*Brachystegia microphylla*
24	Myombo- Mguji	*Brachystegia speciformis*
25	Mwisa	*Bridelia micrantha*
26	Mbefu	*Bussea masaiensis*
27	Mvunvu	*Cadaba farinosa*

Species code	Local name	Botanica name
28	Mbafu	*Canarium schweinfurthii*
29	Mkakatika	*Cassia abbreviata*
30	Mlyangungu	*Ceratotheca sesamoides*
31	Mlama	*Combretum molle*
32	Msungusungu	*Combretum pentagonum*
33	Msonvugo	*Commiphora africana*
34	Mgombogombo	*Commiphora eminii*
35	Mdawi	*Cordia sinensis*
36	Mdejedeje	*Cordia ovalis*
37	Mgwata	*Cordyla africana*
38	Msese	*Cornus volkensis*
39	Mpingo	*Dalbegia melanoxylon*
40	Mjiha	*Dalbegia nitidula*
41	Mtunduru	*Dichrostachys cinerea*
42	Mhali	*Dodonea viscosa*
43	Mtati	*Dombeya rotundifolia*
44	Mvumba	*Ekerbegia capenses*
45	Mnyaninyani	*Embelia schimperi*
46	Mbilisi	*Erythrina abyssinica*
47	Mdaa	*Euclea divinorum*
48	Mhangali	*Euphobia candelabrum*
49	Mkole	*Grewia bicolor.*
50	Mkole	*Grewia similis*
51	Mkole	*Grewia tenax*
52	Mkole	*Grewia platyclada*
53	Mkole	*Grewia sp.*
54	Sukaushe	*Gymnosporia bukobiana*
55	Mkawachuwa	*Heeria reticulata*
56	Myombo	*Julbernadia globiflora*

Species code	Local name	Botanica name
57	Muwundu	*Lannea schemperi*
58	Msanzauki	*Leonotis sp.*
59	Lwito	*Maeru sp.*
60	Mkonze	*Manilkara mochisia*
61	Mguoguo	*Markamia obstusifolia*
62	Msinga	*Microglossa syringifolia*
63	Mfusa	*Myrianthus arboreus*
64	Mwakidunda	*Obyris compressa*
65	Mfulu	*Opilia celtidifolia*
66	Mwinomwino	*Pavetta schurinniana*
67	Kikongo	*Polyphaeria sp.*
68	Mtwango	*Polythia sp.*
69	Munung'anung'a	*Psychotria sp.*
70	Mpagata	*Pterocapus angolensis*
71	Mzebele	*Rhus vulgaris*
72	Mnyakiguni	*Rinorea sp.*
73	Mbwejele	*Sclerocarya birrea*
74	Mwambang'ombe	*Sclopia sp.*
75	Mzuyuyu	*Scolopia riparia*
76	Mnyongola	*Steganotaenia araliacea*
77	Mlunzemheme	*Sterculia africana*
78	Mbuibui	*Sterculia quingueloba*
79	Mtongatonga	*Strychinos cocculoides*
80	Mpande	*Strychnos heterodoxa*
81	Munhulwa	*Strychnos innocua*
82	Mkumbulu	*Synsepalum cersasiferum*
83	Mhulo	*Syzygium cordatum*
84	Mchovozi	*Syzygium guineense*
85	Mpululu	*Terminalia sericea*

Species code	**Local name**	**Botanica name**
86	Mgolimetse	*Trichilia emetica*
87	Mpulu	*Vitex doniana*
88	Mnyinga	*Xerodderis stuhlmannii*
89	Mhwala	*Xylomas monospora*
90	Mwanganya	*Zanha africana*
91	Mhangana	*Zanthoxylum gillettii*
92	Munyangwe	*Ziziphus mucronata*
93	Msegedya	
94	Mswaga	