

**NATURAL RESOURCES USE CONFLICTS AND THEIR SOCIO-ECONOMIC
AND ECOLOGICAL IMPLICATIONS IN MARA RIVER BASIN, TANZANIA**

BY

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ABSTRACT

Mara River Basin ecosystem is shared by Tarime, Serengeti and Musoma districts. While there is a great understanding on the availability of natural resources in the basin, less is known on the implications of natural resources use conflicts on the livelihoods and on the resource base. The overall objective of the study was to assess natural resources use conflicts and their socio-economic and ecological implications. Data were collected through PRA, discussions with key informants, questionnaire survey and field observations. Satellite imageries were used to determine land cover and land use change between 1990 and 2000. The Statistical Package for Social Science (SPSS) was used to analyze socio-economic data whereas as Content and Structural-Functional Analyses were used for qualitative data. Ecological data were analyzed through a computer Arc View GIS3.2 program. The study indicated that degradation of natural resources in the basin compelled local communities to compete for natural resources to meet their basic needs. Identified resources use conflicts were mainly conflicts among cultivators and livestock keepers. Further more the study indicated that an increase in household size was statistically significant ($P = 0.012$). Similarly, an increase in years of residence was statistically significant ($P = 0.015$) to reduce resource use conflicts. Satellite images showed land cover change from 139,540 ha of forests in 1990 to 73,867 ha for agriculture. While for crop production land use changed from 151,419 ha in 1990 to 77,927 ha for pastures in year 2000. The study concludes that the existing resources use conflicts in the study area were due to socio-economic factors where the existing weak institutions made local communities compete for natural resources without being regulated. The study recommends strengthening of local institutions and providing enabling an environment to local communities to sustain management of natural resources base in the area.

DECLARATION

I, BILLIE AGRIPPA EDMOTT do hereby declare to the Senate of the Sokoine University of Agriculture that the work presented here is my own original work, and has not been submitted nor is it concurrently being submitted for a higher degree in any other University.

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ABBREVIATIONS AND SYMBOLS

ACT	-	Anglican Church of Tanzania.
ACTS	-	African Centre of Technology Studies.
AMDP	-	Agriculture Marketing and Development Programme.
ASDP	-	Agriculture Sector Development Programme.
ASDS	-	Agriculture Sector Development Strategy.
AWF	-	African Wildlife Foundation.
DALDO	-	District Agriculture and Livestock Development Officer.
DED	-	District Executive Director.
DFID	-	Department for International Development.
ECOVIC	-	East African Communities Organization for the Management of Lake Victoria Resources.
FAN	-	Forest Action Network.
FAO	-	Food and Agriculture Organization.
IUCN	-	International Union for the Conservation of Nature.
JFM	-	Joint Forest Management.
LVEMP	-	Lake Victoria Environment Management Project.
MARAFIP	-	Mara Farmers and Irrigation Project.
MNRT	-	Ministry of Natural Resources and Tourism.
NARCO	-	National Ranching Company.
NGOs	-	Non-Government Organizations.
NTFP	-	Non-Timber Forest Products.
PADEP	-	Participatory Agriculture Development and Empowerment Programme.

RALDO	-	Regional Agriculture and Livestock Development Officer.
RNRO	-	Regional Natural Resources Officer.
RPO	-	Regional Planning Officer.
RWE	-	Regional Water Engineer.
SADCC	-	Southern African Development Coordination Conference.
SENAPA	-	Serengeti National Park Authority.
SRCP	-	Serengeti Regional Conservation Programme.
TAFORI	-	Tanzania Forestry Research Institute.
TANAPA	-	Tanzania National Park Authority.
UNCED	-	United Nations Conference on Environment and Development.
UNFPA		United Nations Fund for Population.
URT	-	United Republic of Tanzania.
UTCO	-	Usambara Tea Company.
WMAs	-	Wildlife Management Areas.
WWF	-	World Wide Fund for Nature Conservation.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Natural resources encompass both biotic and abiotic things. Biotic things include things like fisheries, forests, and wildlife. While abiotic things include among others minerals, water and land (FAO, 1993). Natural resource use conflicts occur when various categories of resource users have competing demands for the shrinking resources and attaching different values to the resource base. Resource use conflicts also may occur in settings that involve an array of socio-economic and institutional arrangement (Mayeta, 2004).

Conflicts over natural resources may bring environmental changes that may involve land and water degradation, over-exploitation of forest resources, intensive land clearing and climatic changes. These environmental changes are due to direct and indirect factors. Direct factors include overgrazing, timber harvesting, population growth, fuel wood extraction, mining, and conversion of wild land into agricultural productive systems. Indirect factors include poverty, market and policy failures, corruption and inequitable access to natural resources base (Woodwell, 1992).

Globally, the apparent trend of accelerating environmental degradation has primarily been driven by land use changes as consequences of frontier expansions and population growth (Mbwilo, 2002). These land use changes have resulted into the world's forests, grasslands and woodlands to decline. Vast areas of forests have become livestock keeping and agricultural activities to accommodate human needs. These human activities have

drastically changed the balance of natural resources availability into scarcity and consequently competition for the available limited natural resources.

These human activities are due to the fact that global human population has increased more than seven-fold from 0.6 billion in 1700 to 4.43 billion in 1980 and according to UNFPA (2007) reported that in 2007 global human populations have increased to 6.6 billion, thus causing more pressure on limited natural resources demanded. The rapid population growth and technology development resulted into rupture of traditional natural resource management systems. As a result poor governance resulted into degradation of natural resources and consequently their scarcity (FAO, 2000a). Furthermore, Wood Well (1992) argues that the interaction of these forces are most evident in areas such as South Africa, Central America, and Sub Saharan Africa where poverty, rapid population growth and inappropriate institutions have contributed to natural resources degradation. Mayeta (2004) argued that conflicts over natural resources such as land, water and forests are ever-present throughout the world because people for their own interests everywhere compete for these natural resources to enhance their livelihoods.

Forests mean many things to different people through different uses to enhance their livelihoods. As a result sustainable use of resources has been met with conflicting interests of conservation and exploitation. Most of the rural people may be aware of the implications of resource exhaustion but due to circumstances that surround them without other alternatives for their socio-economic activities they continue to rely on forest resources for their livelihood. These activities include clearing of forested land for agriculture, charcoal burning, timber extraction, fuel wood for domestic energy, building materials, fish smoking, livestock grazing, curing of tobacco, extraction of medicinal plants, and settlement establishment (FAO, 2000a). These activities have subjected forest

resources to unsustainable utilization leading to their degradation and eventually competition among the users.

Water is a basic natural resource that sustains life and provides various social and economic needs. It is one of the most important constraints in the sustainable development of Africa's dry lands. It is a vital ingredient in agriculture, livestock husbandry, (agro) industry as well as in domestic activities (Hirsch, 1999). Yet in many societies water is taken for granted and it is assumed to be an inexhaustible natural resource. For this reason individual water users are more conscious of using water rather than conserving the resource. Presently, water resource globally is becoming scarce as a result of increasing populations of human and animals (domesticated and wild animals), deforestation, inappropriate agricultural practices and mining activities. Destruction of water sources has resulted into water source discharge to decline resulting into further limited supply (Mbuya, 2004). This situation of limited supply of water has made individual water users to compete for water to meet their basic needs (Nsolomo , 2000).

Tanzania like other developing countries depends on her natural resources such as land, forests, wildlife, fisheries, water and minerals for development. However due to increasing human population, conflicting demands for natural resource utilization has led to their degradation through over-exploitation. (Luoga *et al.*, 2000a).

For many decades Tanzania's natural resources have been controlled by the state with management policies being characterized by centralized decision-making processes (Mbwilo, 2002).

Well-defined land tenure and resource protection apply only on forest reserves that account for 30% of forested land while the remaining 70% (most miombo woodlands) are under village and general lands (formerly known as public lands) with very little protection thereby creating more opportunities for over-exploitation (Luoga *et al.*, 2000a)

The state ownership of natural resources has weakened traditional systems of resource management that have functioned for hundreds of years and consequently lead to profound changes in resource use, usually in the direction of mismanagement and over-exploitation the ultimatum of over-exploitation of natural resources is competition for the available limited resources (Monela *et al.*, 1993).

FAO (2000a) noted that forests and woodlands are perceived by the majority of Tanzanians as natural endowment and are regarded as fundamental resources to sustain their livelihoods. Forests and woodlands are devoid in some areas in Tanzania such as Mara, Mwanza, Shinyanga, Singida, Arusha and Dodoma regions because they have cleared indiscriminately to create conducive environment for livestock rearing activities as well as for agricultural purposes. FAO (2000a) further noted that deforestation in Tanzania is taking place at an estimated rate of about 91,000 hectares per annum thus leading to loss of biodiversity, climate change, loss of livelihood, and degradation of watershed. Kilahama (2003) noted that conflicts over natural resources are observed today because the size of land on which the population depends on to gain a living is fixed while the population continue to increase, thus forcing more economic activities into forested land where lack of property ownership rights always has resulted into conflicts.

In Tanzania over exploitation of forest resources has taken place in non-reserved forest land and is rapidly expanding into forest reserves due to scarcity of natural resources in the concerned areas leading to competition for resources (FAN, 2000). The author noted further that community's efforts to use natural resources sustainably have faced many challenges involving conflicting interests. Socio-economic factors such as culture, ethnicity, age and sex structure, economic activities, population dynamics, and the indigenous knowledge systems and practices of local communities have been identified as driving forces to these conflicts (FAN, 2000).

1.2 Natural Resource Use Conflicts in Mara River Basin

Mara River Basin forms a transboundary ecosystem shared by three Districts of Tanzania (Tarime, Serengeti and Musoma) as well as the neighbouring country of Kenya. The basin supports a wide range of socio-economic activities to the diverse ethnic groups that have engaged in various land uses. The majority of the rural people in the basin depend on natural resources such as forests to meet their socio-economic needs. However only 3091 hectares out of 31 646 hectares of the basin area in Mara region have been gazetted. This situation has provided "open access" for various land uses and exerted pressure on forested land posing a serious threat to the forest resource base in the basin. According to URT (2003b), forest resource consumption shows that more than 90% of the people in the basin use wood as source of energy for domestic energy, brick burning, pottery, fish smoking, and tobacco curing. The estimate indicates that the present exploitable amount of wood in the Mara River Basin Mara region inclusive was equivalent to 528 190 m³ while the actual volume for wood cut was found to be 776 750 m³ (URT, 2003b). This is a clear indication that over-exploitation of resources does exist in the area. Over-exploitation of

resources in the basin has led into scarcity of the available forest resources. Scarcity of resources has compelled local communities to compete for water, forests and land to meet their basic socio-economic needs. The consequences for this competition have further led into conflicts to meet individual interests (WWF, 2003).

1.3 Problem Statement and Justification

Development efforts in Tanzania depend primarily depend on rural areas because 80% of the country's population lives in rural areas (URT, 2005). Rural economies are largely product of the use and management of natural resources. Poor governance on natural resources such as forests and water may retard rural development through unequal distribution of the limited natural resources among the rural people (URT, 2005). Likewise, in these rural areas people overwhelmingly depend on agriculture and natural resources for their livelihood and survival. For instance over 90% of Tanzanians rely on fuel wood from trees and other types of vegetation for domestic energy supplies thus bringing more pressure on resources demand (URT, 1998). This situation is observed in Mara River Basin where the rapidly growing population in the basin has increased the demand for natural resources resulting into competition amongst the communities. In order to arrest this situation a number of NGOs such as World Wide Fund for Nature, Vi-Agro forestry International, and Mara Farmers Irrigation Project (funded by International Fund for Agricultural Development) have been involved in the conservation and poverty alleviation programmes though without much success (Majura, M. pers.commun, 2005).

However, while there is great understanding on the extent and distribution of natural resources and the existing conflicts in Mara river basin (URT, 2003b), less is known on the

implications of natural resource use conflicts on the resource base and on the livelihoods of the local communities. Therefore this gap of information to bring about sustainable resource use management is the basis of this study.

1.4 Study Objectives

1.4.1 Overall objective

To identify and assess natural resource use conflicts and their socio-economic and ecological implications in the Mara river basin.

1.4.2 Specific objectives

Specifically the study intended to:-

- a) Identify types of natural resource use conflicts in the study area,
- b) Identify socio-economic and institutional factors underlying natural resource use conflicts in the study area,
- c) Assess the impact of natural resources use conflicts on land cover and land use changes in the study area,
- d) Assess the impact of natural resources use conflicts on livelihoods.

1.4.3 Research questions

The following questions guided the research.

- a) What are the existing natural resource use conflicts in the study area?
- b) What are the socio-economic and institutional factors underlying the existing natural resource use conflicts in the study area?
- c) What are the impacts of natural resources use conflicts on land use and cover changes in the study area?

d) What are the impacts of natural resources use conflicts on livelihoods?

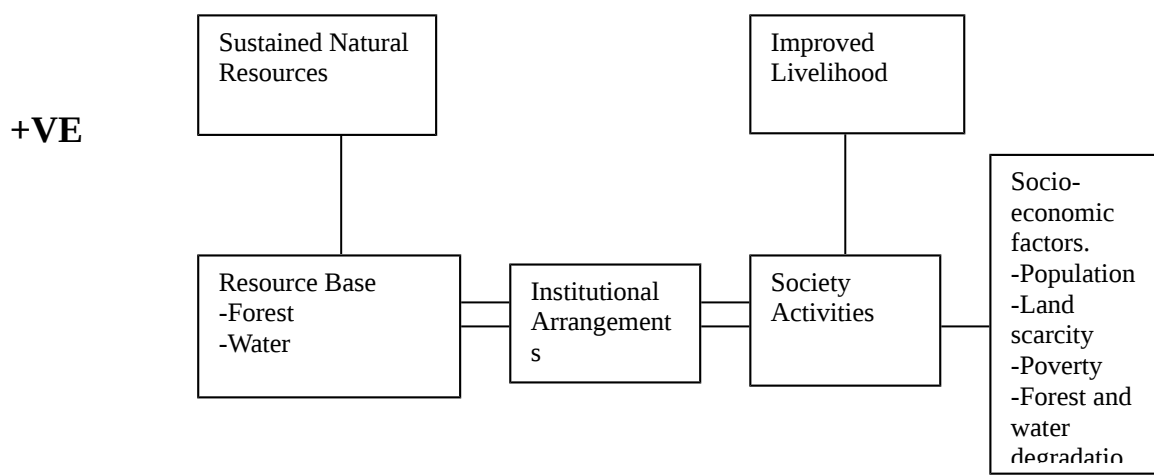
1.5 Hypothesis:

H_0 = Natural resources use conflicts have no negative impacts on the livelihoods of the local communities and on ecological values.

H_1 = Natural resources use conflicts have negative impacts on the livelihoods of the local communities and on ecological values.

1.6 Conceptual Framework

The conceptual framework underlying this study (Figure.1) indicates the interaction between the resource base and local communities' socio-economic activities such as crop production, livestock keeping, mining; beekeeping and fishing in the basin resulting into resource use competition and hence conflicts. It is equally argued that the positive outcomes (sustainable natural resource management) and the negative outcomes (resource use conflicts) are a function of institutional arrangements and socio-economic factors. It is hypothesized that socio-economic and institutional factors, lead to resource use conflicts, this is because they provide opportunities for people to over-exploit the available natural resources. Appropriate institutional arrangements tend to lead into sustainable management of natural resources and improved local people's livelihoods.



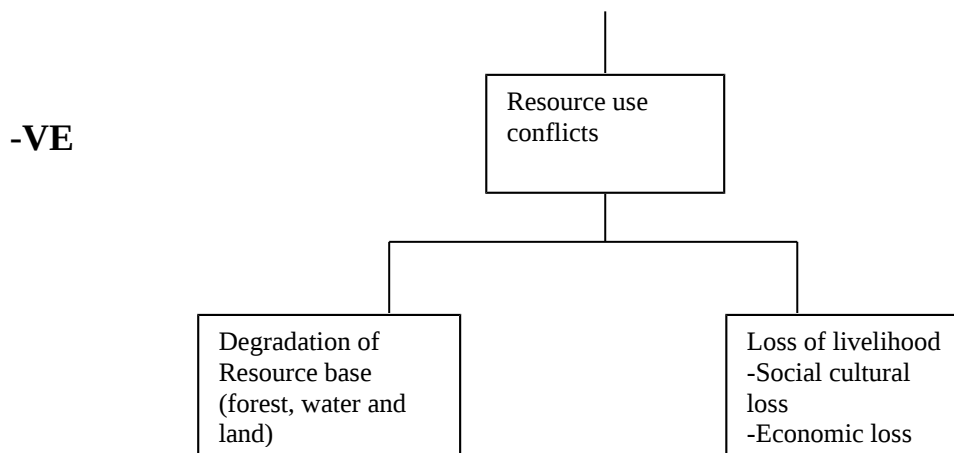


Figure 1: A conceptual framework showing natural resource use conflicts and their socio-economic and ecological implications in Mara River Basin, Tanzania.

1.7 Study Limitations

Several limitations were encountered during the study including:

1.7.1 Willingness of respondents to be interviewed.

A number of respondents were unwilling to spend their time being interviewed as they were occupied by the national election campaign. This problem was solved by the assistance of village chairmen and a well-experienced extension staff to get the required information from the heads households.

1.7.2 The problem of keeping records

Data related to land sizes, quantities of crops produced, income per household, were a big limitation because of failure of farmers' to keep records and to recall memory. The experience of agricultural extension workers was instrumental in overcoming this problem.

1.7.3 Poor accessibility

Some areas were not easily accessible due to landforms, floods and geographical locations. The problem was solved by assistance of ward executive officer and a well experience extension staff to get the required information for villages with poor accessibility.

1.7.4 Wrong perception of the study

Some respondents were not open to answering questions particularly those questions involving their welfare. For example on the number of the livestock they own. Based on experience from Kondoa in Dodoma on livestock destocking(Madundo, S. pers.comm 2005), most people were reluctant to tell the exact numbers of their livestock they owned fearing that may be the government would decide to apply a destocking policy in the area. Taking available livestock census data from the District agriculture solved the problem.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Resource Use Conflicts: An overview

Conflicts over natural resources is ubiquitous and have class dimensions putting those who own the resource against those who own nothing but whose work makes the resource productive (Mbwilo, 2002). Differences in gender, age and ethnicity may influence the use of natural resources, bringing to the fore cultural and social dimensions of conflicts (Kajembe *et al.*, 2004).

Conflicts over natural resources can take place at a variety of levels, from within the household to local, regional, societal and global scale. Conflicts occurring mainly in local context may extend to national and global levels because of their special legal relevance or as a result of efforts by local actors to influence broader decision-making processes (Oviedo, 1990).

The intensity of conflict may also vary enormously from confusion and frustration among members of a community over poorly communicated development policies (Kant and Cooke, 1999) to violent clashes between groups over resource ownership rights and responsibility. Decentralization by the Central government was done to give more power to local governments with objective of speeding-up decision making for development activities. However with a reduced Central government power in many rural areas, natural resource management decisions are increasingly influenced by the resource users, who include small-scale farmers, pastoralists, large-scale landowners, and private companies such as forestry industries, mining, hydropower, and agribusiness (Mbwilo, 2002).

De pauw (1995) contends that, resource use conflicts are on the increase in Tanzania. According to the author, the root cause for the increased conflicts over land use is the increase of human population, which has doubled over the last 25 years. The author further observes that, the main current land use conflicts at a micro-scale are situated between crop production and pastoral livestock systems. For example, Lane and Moorhead (1994) as cited by Mbwilo (2002) documented a land use conflict resulting from alienation by the government of more than 40 000 ha of prime grazing land from the Barabaig pastoralists in Hanang district to develop large-scale parastatal wheat farms. In the process, the Barabaig grazing systems collapsed and severe environmental degradation resulted. Kahuranaga (1995) pointed out increased land acquisition by large-scale farmers, using unoccupied nature of pastoral lands as pretext to set out claims. Similarly, large tracts of land in the central Maasailand were taken over by settlers and converted into beef ranches, wheat schemes and smallholder farms (Arhem, 1995).

Land use conflicts arise also at the interface between urban and rural areas (De Pauw, 1995). This is at present mainly the case in some highly settled areas, such as Kilimanjaro, where the legitimate need for expansion are hampered by very high population density and land shortage in the surrounding rural areas.

Barlowe (1986) pointed out that, competition among individuals and among land users also has its impacts on land resource supplies. The author urged that in the competition that takes place between individual operators and between uses, resource normally go to those operators and users that offer the highest price and enjoy the greatest prospectus for their remunerative use. This fact of resources always moving to its highest and best use is

generally operative, but it does not operate as smoothly and perfectly as it might (Barlowe, 1986). Many land uses are not compatible, and operators frequently have different combinations of interests and objectives that cause them to assign different weights to the private and social benefits associated with alternative land uses. Conflicts of interest are a frequent result (Barlowe, 1986).

The use of natural resources is susceptible to conflicts for a number of reasons. First, natural resources are embedded in an environment or interconnected space where actions by one individual or group may generate effect far-site. Second, natural resources are also embedded in a shared social space where complex and unequal relations are established among a wide range of social actors such as agro export producers, small-scale farmers, ethnic minorities, government agencies. As in other fields with political dimensions, those actors with greatest access to power, also control and influence natural resource decisions in their favour (Buckles and Rusnak, 1999).

Thirdly, natural resources are subject to increased scarcity due a rapid environmental change, increasing demand and their unequal distribution (Homer-Dixon and Blitt, 1998). Environmental change may involve land and water degradation, overexploitation of wildlife and aquatic resources, extensive land clearing, drainage or climate change. Increasing demands have multiple social and economic dimensions, including population growth, changing consumption patterns, trade liberalization, rural enterprise development and changes in technology and land use. Natural resource scarcity may also result from unequal distribution of resources among individuals and social groups or ambiguities in the definition of rights to common property resources. As noted by Holmer-Dixon and

Blitt (1998), the effects of environmental scarcity such as “constrained agricultural output, constrained economic production, migration and disrupted institutions, can either singly or in combination, produce or exacerbate conflicts among groups”.

Fourth, natural resources are used by people in ways that are defined symbolically. Land, water, and forests are not just material resources people compete over, but are also part of a particular way of life (farmers, fishers, loggers and pastoralists), an ethnic identity, and a set of gender and age roles. These symbolic dimensions of natural resources lend themselves to ideological, social and political struggles that have enormous practical significance for the management of natural resources and the process of conflict management (Mbwilo, 2002). Other conflicts may arise from the nature of institutional arrangements of a particular area or country.

Because of these dimensions of natural resources management, specific natural resource conflicts usually have multiple causes, some proximate, others underlying or contributing. A pluralistic approach that recognize the multiple perspective of the stakeholders and the simultaneous effects of diverse causes in natural resource conflicts is needed to understand the initial situation and identify strategies for promoting change.

2.2 Conflicts: Definition, Types, and Underlying Causes

2.2.1 Definitions of conflicts

Understanding conflicts within natural resources conservation increases the sociological body of knowledge on how conflicts are generated and resolved by local communities (Mayetta, 2004). Conflict theorists have argued that societies are in constant state of

change in which conflicts are permanent features and are viewed as a pervasive and inevitable feature of the social system (Mvena et al., 2004). Conflict does not necessarily imply outright violence; rather it includes tensions, hostility, competition and disagreement over goals and values.

Mayetta (2004), argues that conflict is opposite of cooperation and peace and is commonly associated with violence. Conflicts are crucial not only for social change but also for the continuous creation of societies. Therefore, conflicts should not only be viewed as dysfunctional relationship between individuals and communities that should be avoided at all cost, but also as an opportunity for constructive change and growth. However, this does not mean that conflicts do not often have tragic consequences for people and societies. Conflicts are accompanied by suffering, destruction, fear, pain, separation, and/or death. The term also encompasses not only the observable aspects of the opposing forces but also the underlying tension. According to Lewis (1997), the term also refers to any situation in which there is a clash of interests or ideas. Usually, the interests and needs are incompatible amongst users and sometimes these interests and needs are addressed in natural resource policies and/or programmes (FAO, 2000a). Lewis (1997) argues further that many of these conflicts are counterproductive and destructive, leading to bad results and hostile relationships. In the context of conservation, the term suggests that there is a group (s) whose interests are opposed to those of conservation institutions and authorities. When conflicts arise from the use of resources by different users, they are referred to as resource use conflicts. As such, they are referred to as disagreement and disputes over access to and control over use of resources (FAO, 2000b; Mayeta, 2004).

2.2.2 Types of natural resource use conflicts

Conflicts differ from site to site due to differences in the conflict generating factors such as population pressure, economic activities, institutional arrangements, changing value system and policies, poverty and general awareness on the part of both the users and regulators greatly influence the nature and intensity of these conflicts. Types of conflicts have been briefly described below:

2.2.2.1 Conflicts among users

Conflicts of these types do happen when there are immigrants from outside who are less concerned with the conservation and sustainability of the resource base due to economic prospects. Studies done elsewhere (Luoga *et al.*, 2004) in the country have shown that local communities from the same village are less involved in these conflicts compared to immigrants whose interests are economic based. Studies further reported that these conflicts are not serious among users from the same village because the culprits will be caught by fellow villagers showing a concern on the degradation of the resource base which supports their basic socio-economic basic needs. For example, in Kwizu, villagers caught fellow villagers who grazed animals in the forests, correctly showing concern that the forest will be degraded in the long run (Mvena *et al.*, 2004). However, the absence of active authority after degazettement in 1980 created a power vacuum. The village government, which was the rightful owner, could not get its by-laws in-acted by the Minister responsible for Local Governments, making it impossible for punishing whoever breaks them.

2.2.2.2 Conflicts between regulators and users

These are conflicts that exist for example between the forest sector and local communities who are termed as violators of rules and regulations. Communities normally view regulators as favouring undue protectionism of the resources they consider to have inherited from their ancestors. The legal, policy and institutional arrangements have ignored the needs and interests of local people.

West and Brechin (1991) as cited by Wanjau, (1999) reported that relocation of Maasai from different parks in East Africa restricted their grazing land to the drier areas and denied them access to sacred sites. This affected their culture and their potential for further economic development. On the negative social impact, the author further reported that Ik-tribe, previously a successful hunter-gatherer society, were evicted from Kedepo valley in Uganda and allowed to stay in a marginal land where they are now suffering social disintegration, starvation and overcrowding. This situation has created enmity between the regulators and the users (Wanjau, 1999).

2.2.2.3 Conflicts between regulators

These conflicts normally may involve regulators of the same resource at different authority levels. This is created by interferences in the administration of the resource. In Tanzania examples include existing misunderstandings between staff of the Ministry of Natural Resources and staff of the District councils over tax revenues accruing from forest products each one claiming to be the rightful collector. Studies conducted in Amani forest reserve report that change of procedure/office for issuing permits in Amani forest reserve from District council to catchment forest office was perceived as a threat that local

government was competing with Central Government (Shemwetta *et al.*, 2004). Other cases were reported involving contradictions between organizations with interests in the forest. For example, Tanzania Forest Research Institute (TAFORI) indicated concern on uncontrolled cutting of trees in Amani Botanical Garden by the National Malaria Institute, since some of the trees were for the research purposes. Amani Nature Reserve also had land lease problems with Usambara Tea Company (UTCO), TAFORI and Mlingano Roman Catholic Church.

2.2.2.4 Inter-ethnic conflicts

These kinds of conflicts do occur when two groups of different socio-economic activities do share the same resource; whereby every group is trying to satisfy its side for betterment their living standards. In the process each side tries to compete and own rights for the limited resource. The most predominant ethnic conflicts in Tanzania involve the Maasai pastoralists and the cultivators (Kisoza *et al.*, 2004). The conflicts occur when livestock cause damage to crops. Each side expresses different views on the issue of crop damages. The interests of the pastoralists is to make sure that pastures are available and their livestock are not starved while the other group which constitute the cultivators, their objective is get more harvest from the crop fields. The study conducted in Kilosa by Kisoza *et al.* (2004), reported that charges on crop damage is not in favour of the pastoralists because farmers tend to over charge the compensation compared to the real value of the crop losses. They also pointed out that the farmers are deliberately cultivating crop plots in the cattle routes in order to leap compensation money from the herders. These misunderstandings based on cultural values have ended up into conflicts of interests.

2.2.2.5 Inter-village conflicts

The inter-village conflicts normally involve boundaries disputes. This may happen due to lack of proper demarcation and in the process to get more shares of resources to fulfil the village requirements and eventually conflicts do emerge. Also these conflicts do occur due to the interest of each village in relation to the area under conflicts and the nature of ownership status. Kisoza *et al.*, (2004), reported that the conflicts involved boundaries disputes between the title deed holder Maasai villages and the neighbouring cultivators' villagers. The authors argued that, the cultivators have a customary claim on their respective areas and are challenging the boundaries recognised on the title deed issued by the Commissioner of Lands to the pastoral villages. Most of the disputed border areas in most cases are the river valleys and wetlands, which are key resources to both pastoralists and cultivators during dry seasons. These areas are utilised to produce off-season crops by cultivators during dry seasons. The pastoralists also depend on these valleys as dry-season grazing areas.

2.2.2.6 Conflicts of village versus government agencies

The conflicts between villages and the government agencies involve border disputes. This might be between registered pastoral villages and the government agencies established by parliament articles. These kinds of conflicts have been reported by Mkeya (1994) that conflicts do exist between the communities and Mount Meru Forest Reserve in Arusha. The author reports that due to land scarcity, local communities tend to encroach into the forest reserve to expand their agro-pastoralism activities to meet the basic needs of their expanding families. Kisoza *et al.* (2004) reported that Mkata ranch under the "National Ranching Corporation" (NARCO) is claiming about 4 000 ha now occupied by

Twatwatwa village. However, the Twatwatwa village has a right of occupancy to lands under village jurisdiction. The NARCO authorities claim that there is a double allocation of the same piece of land. However, the tenure status of lands owned by NARCO is not clear; there is no confirmation if NARCO has a right of occupancy to lands under its company jurisdiction. Another conflict was reported by Kajembe *et al.* (2004) between Mikumi National Park and Kiduhi pastoral village. The National Park has encroached about 7 km of the village lands where it has established a buffer zone without involving the village government. The encroaching of communal village lands by public agencies is likely to intensify resource degradation and conflicts between pastoralists and crop cultivators.

2.2.3 Socio-economic factors underlying natural resources use conflicts

Resources use conflicts occur in settings that involve an array of culture, economic, and political arrangements that have some bearing on the outcomes of the conflict process (Kumar, 1998; cited In Mayetta, 2004). Causes of most conflicts are common to all natural resources sectors. However few are specific related to particular areas and type of natural resources.

Socio-economic factors have been reported to influence resource use conflicts in different situations. For instance, socio-economic status of the communities bordering wildlife-protected areas has been reported to be one of the underlying factors for resource use conflicts in Tanzania (Shemwetta and Kideghesho, 2000). Land for wildlife conservation purposes has not given tangible benefits to the local communities surrounding the protected areas compared to other land uses. The failure of wildlife to compete effectively

with other land uses in sustaining the livelihood of the adjacent communities exacerbates these problems. As result, local people look at wildlife as a liability rather than economic and social assets to support their socio-economic needs, thus making wildlife conservation efforts to be perceived as a contradictory to the socio-economic needs of the local communities. Conflicts also surface when local traditional practices are no longer viewed as legitimate or consistent with national policies, or when entities external to a community are able to pursue their interests, while ignoring the needs and imperatives of local people (Anderson *et al.*, 1996).

Of particular significance are the links between wildlife and the basic needs of wildlife dependent communities, such as nutrition, food security, off-farm employment, energy and the integration of wildlife in overall resource management and community development. Desloges and Gauthier (1996) documented a list of other factors that contribute to emergence of conflicts at the local level. Particular constellation of these factors often has a determining influence on the nature of conflicts that arise, who is involved, who manages them and how they will be managed. These include cultural, ethnic and religious diversity, the policy, legal and institutional context and economic factors. The degradation of the physical environment has been associated with change in population structure and demand for natural resources by the increasing population, resulting into deterioration of the productive capacity of the ecosystems, which is basic for the production of renewable of natural resources. This in turn has resulted into escalation of conflicts.

Borrini-Feyerabend (1997) noted that, population dynamics affects the degree and rate of the use of natural resources. Conversely, the presence or absence of available natural

resources is a determinant of local population size and density, and of the movement of people into and out of a territory. The authors added further that in the rural areas of developing countries rapid population growth may mean that (i) More people need more wood for fuel and housing, so more trees have to be cut down and forests tend to decline in size; (ii) More people need more land to grow crops; (iii) Increased population may also mean that more people need more food and must take too many fish from lakes and streams or too much game from the forests; (iv) More people need more water for agriculture, drinking and cooking, and for their own sanitation.

All these factors have a significant impact, whether positive or negative, on access and use of natural resources by resource users, thus creating conflicts as individuals compete for scarce resources. Whatever their nature or origin, the actors involved, the stakes, the environment in which they occur, whether they are acknowledged or remain latent, conflicts that are not adequately handled have a negative, often devastating impact, socially, economically and environmentally. It is thus important for communities and agencies to acknowledge conflicts and to learn how to address conflicts situations.

Some of the socio-economic factors contributing to natural resource use conflicts are briefly described below.

2.2.3.1 Population growth

Increase of population pose a threat to achieving the imposed restrictions due to high demand on the resources to meet the basic needs of human beings. In rural areas, population growth always increases the demand for more agricultural land. Resources

decrease over time due to increasing human population resulting into competition for the scarce and limited resources. Kilahama (2003) reported that the population of Tanzania has increased from less than 10 million in 1961 to over 33.5 million in 2002. This portrays an increase of about 23.5 million people in about 40 years or at average of 587500 people per year. This poses challenges for more food and other social services to meet the basic needs of human beings. The study by Moe *et al.* (1988) as cited by Mkeya (1994) showed that expansion of socio-economic activities into the formerly unoccupied areas in Lake Manyara-Tarangire-Simanjiro ecosystems in Tanzania could be associated with expanded human population. Population growth creates a greater demand for socio-economic activities to meet basic household needs. This situation creates high demand for human needs and it has been the major driving force for conflicts in rural areas (Mpofu, 1990).

2.2.3.2 Economic activities

Economic activities constitute the second major type of drivers of conflicts in relation to the use of forest resources. The significance of economic activities have a bearing on intensity of conflicts especially economic activities undertaken by both residents and outsiders. The geographical position of any place can make resource use conflict increase due to its accessibility for economic activities and vice versa. For instance the geographical position of Kitulangalo and Magombera-Lukoga being close to major cities of Morogoro and Dar es Salaam where there is a big demand for charcoal is a major factor on conflicts involving charcoal production in the two areas (Kihyo and Kajembe, 2000; Mvena *et al.*, 2004).

2.2.3.3 Legal provision

The legal provisions within a particular resource base, define the rights, responsibilities, and limits to a certain resource. Legal provisions include the rights/duties of different members as stipulated boundaries. For example, men in Nkundoo village dealt with the management of water flowing from the forest while women and children performed firewood collection. Failure by a member of a community to understand the legal provisions normally creates conflicts (Mvena *et al.*, 2004).

2.2.3.4 Shifting in the value system

The shift of value system among generations (intergenerational dimensions) is also seen as factor (Mvena *et al.*, 2004). There has been a shift in the value system based on age difference and changing times. The case of local medicine for example, with the setting up of many dispensaries and pharmacy stores, has greatly lost the importance it used to have. Young generation prefer conventional medicine rather than medicinal plants hence there is less conflicts on this forest product. In the same category, younger generation may not respect old traditions, challenging that they are out dated, and hence attempt to harvest from sacred forests. This has a tendency to bring about inter-generational conflicts.

2.2.3.5 Changes in government policy

Government often pronounce and implement policy changes without any consultation and due regard to the stakeholders such as local communities and this can easily ferment conflicts. A study conducted at Magobera-Lukoga, in Kilombero district indicates that after degazettement of a forest reserve and lack of follow-up measures resulted into a

power vacuum and the ensuing conflicts. Another conflict is observed at Kitulangalo where local communities still perceive the entire 2638 ha, as their common property and do not wholly comprehend the ownership of the 500 ha leased to Sokoine University of Agriculture. Comprehensive consultations with the local users of the resource are needed to alleviate these conflicts (Kihyo and Kajembe, 2000).

2.2.3.6 Inadequate staffing and working gear

Lack of adequate staff within forest sector, which in essence hampers monitoring of institutions and public education on conservation matters. This results into a lot of conflicts. This issue, in its extreme case, causes many forests to be effectively open access. This is evidenced by cases of Magombera-Lukoga and Kitulangalo forest outside the SUA training forest (Kihyo and Kajembe, 2000).

2.2.3.7 Ignorance of local people and regulators

Lack of knowledge on the realities of conservation, by both the local community and regulators leads into misunderstanding of each other. Low level of education, especially on environmental issues, greatly fuel conflicts. The local communities may not understand the concept of conservation within the context of national interests/programmes/agendas. Infact many farmers most of the time consider all forests near them as open access, e.g. Magombera-Lukoga. The government officials on the hand may also be ignorant of the realities at the local levels (Mvena *et al.*, 2004).

2.2.3.8 Poverty of local communities

The majority of rural poor in the developing countries rely on forests and woodlands for their livelihood because of low income and lack of other alternative means to support their subsistence life. For instance, socio economic pressure resulting from rural growing population in Brazil is the exploitation to generate income (Rowel *et al.*, 1992). Over time, the situation results into scarcity and eventually into competition for the limited resources. Lack of alternative cash crops lead people to seek income generation from the forest through charcoal burning and timber harvesting. The author further noted that efforts by the government to prevent local residents from these activities were seen as a threat to their social and economic well being this further escalated more conflicts.

Destitution is of the most important drivers of conflicts in the use of natural resources. This is particularly the case where local communities have no reliable sources of income. Most communities adjacent to forest sector in Tanzania rank agriculture as the backbone of their income. Due to low and unstable prices of agricultural products and also unreliable rainfall, farmers are forced to rely on other sources of income. Communities living in proximity to natural resources such as forests and wildlife will continue to rely (illegally or legally) on them for their livelihoods and for economic survival (Kaboggoza, 2000).

2.2.4 Implications of institutional arrangements in natural resource use conflicts

In the past years, natural resources development activities in most tropical countries have met with a lot of problems. According to FAO (1985), the problems were associated with (i) lack of awareness and political will; (ii) low economic incentives; (iii) inadequate institutional arrangements.

Institutions are structures that humans impose on human interactions that make and shape the performance of the societies. They provide sets of rules governing the relationships both among its members and between members and non-members. Cultural rules and codes of conduct are institutions as far as they can constrain the relationship between different individuals and/or groups (Mbwilo, 2002). Kajembe et al. (2004) argues further that all institutions regardless of being political or cultural entities are aimed at conserving the natural resources for sustainable utilization. Kajembe et al. (2004) argues that these institutions share a set of characteristics such as systems of rules, decision-making procedures and programmes that give rise to social guidance of interactions among the role players. Institutions are designed to have both policies and legislation authority and enforcement structures that govern and underpin various responsibilities and rights to the stakeholders (IUCN, 2000). Institutional arrangements often play a role in solving natural resources problems, such as in the creation of limited–entry regimes to avoid the ravages of unstable harvesting of renewable resources (Mayetta, 2004).

Inappropriate institutional arrangements in a society can result into unsustainable resource use management and a failure to regulate human interactions with the biogeophysical systems. Faulty institutional arrangements may lead to large-scale environmental problems such as severe depletion of natural resources resulting from unrestricted access to the resource base. Local institutions naturally seem to be potentially powerful, stable, valued and generate recurring patterns of behaviour in regulating forest resource users (Kowero, 2003). Weak institutional arrangements may result into poor incentive packages to the local communities who have been the custodians of natural resources for many years prior to the coming of colonialists.

The sustenance of the natural resource base depends on the appropriateness and effectiveness of the institutions that affect land resource allocation, utilization and management. Whatever policies relating to incentives and are pursued, they will have no effect unless there are effective institutions responsible for relaying information to producers and processing their responses (Barbier et al., 1990; Mbwilo, 2002). Thus it is important to recognize and support existing institutions, promoting their re-emergency in a modified form where they have fallen away and facilitating their development in a new context (Cousins, 1995). Kajembe (2006) argued that strong institutional arrangements may result into sustainable management of natural resources because provisions of incentives to local people establish a situation of ownership in the management of resources. Empowered people based on the benefits they get from natural resource base, they become aware that depletion of resources will affect their livelihood and their economy. The author further argued that perceived rewards can motivate individuals to take actions that are productive for all involved and avoid engaging in actions that are generally harmful to others.

2.2.4.1 Deficiency in local institutions

The formal institutions introduced by state governments have contributed to weakening local institutions for community organization and administration. For example, the Native Authorities Ordinance (Real Act, 1963) abolished African Chief and the Native Authorities. This in effect led into a breakdown of the customary land allocation system and conflict resolution mechanisms. However, the local institutions continue to operate on their weakened state but they lack the legitimacy to adjudicate in resource conflicts. For example in Kilosa, the pastoral communities operating in a more isolated production

system have retained most of the local institutions and have shown effectiveness in conflict resolutions. From this experience, the government leaders in Kilosa district have identified the importance of local institutions, and have been involving the Maasai traditional leaders in conflict resolution. Local communities through their local institutions are best placed in resolving resource use conflicts, which are in most cases isolated and local in nature. However, in their present state, local institutions lack a legal recognition, to provide the legitimacy before the communities (Kisoza *et al.*, 2004).

2.2.4.2 Conflict Management

Mbwilo (2002) argues that conflict management is considered very crucial for ensuring sustainable conservation of natural resources. However, these management approaches vary from place to place and for different types of conflicts due to different driving forces in the conflicts. In many situations, institutional mix is suggested as good approach of resolving and managing conflicts. This means that both customary/informal and formal institutions, which are appropriate, are essential in conflict management and sustainable utilization of natural resources.

Cultural institutions have an advantage over political institutions since they are more realistic in addressing the prevailing factors influencing conflicts (Kihyo *et al.*, 2000). What is needed is to have in place appropriate and adaptive institutional mechanisms to jointly formulate rules or by-laws involving both cultural and political interests. One possible outcome of this can be collaborative resource management and use which involve all stakeholders by representation that is community empowerment. As long-term solution to conflict alleviation and reduction, people living next to forests must be given an alternative means of earning a living. Increasing agricultural productivity and other

income generating activities will deter individuals from expanding their land into forests (Shemwetta *et al.*, 2004). Local institutions have always been a central feature of rural development programmes. The central importance is derived from the conviction that organization activities is vital as mechanism by which rural people can get involved in rural development activities. Institutions have a crucial role in establishing expectation about the rights to use natural resources in economic activities and about the partitioning of the income streams' resulting from economic activities (Mbwilo, 2002).

Institutions are important in resolving the existing resource use conflicts through designing of appropriate rules, regulations and practices for natural resources. These rules are used to govern human activities and shaping peoples' behaviour (Heywood, 1992). For example ,the use of traditional courts or tribunals in Africa have been reported by Rugege (1995) as means of reconciling the disputants and maintaining peace, rather than punishing wrong doers. The Sukuma agro pastoralists in Shinyanga region established *Ngitiri* for grazing and for tree reserves. This practice is known all over the region. Though not practiced in all villages, it is culturally a well-established concept. Every body knows what *Ngitiri* is and what it entails (Johansson and Mlenge, 1993).

Odera (1997) studying on the conservation and utilization of medicinal plants and wild relatives of food crops in Kenya indicated that the use of traditional institutions (taboos, seasonal and social restrictions) on gathering of medicinal plants and the nature of plant gathering equipment used, limited the harvesting of medicinal plants. The author argued further that young people were restricted in cutting *Erythrina abyssinica* tree species in Western Kenya for the same argument of reducing the healing power of the medicine. All

of these have contributed to protection of traditional medicinal plants in the area. *Adonisonia digitata* is another tree that is traditionally protected and worshipped as a fertility tree by communities in Kenya, Sudan and West Africa (Odera, 1997).

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CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Description of the Study Area

3.1.1 Location and climate

Mara river basin (Figure 2) forms a transboundary ecosystem between Kenya and Tanzania. The size of Mara river basin is about 13 750 km² of which about 65% (195 km) is located in Kenya and 35% in Tanzania, which is 105 kilometres (WWF,2003). In Tanzania the river basin is located between 34° E and 35° E and between 1° S and 2° S. The river basin covers part of Tarime, Musoma, and Serengeti districts.

3.1.2 Soils

Soils of Mara river basin have been formed by weathering of granite rocks resulting into a wide range of soil types. Soils found in the basin include light sandy loam, grey clay and black calcareous soils referred as “mbuga” soils. The black calcareous soils are found in lower part of the basin and naturally are very fertile (URT, 2003b).

3.1.3 Vegetation

Mara river basin is composed of diverse vegetations made of wooded lands, wooded grasslands, bush shrubs and grasslands. Climatic zones and soils largely influence the natural vegetation composition in the basin (URT, 2003b).

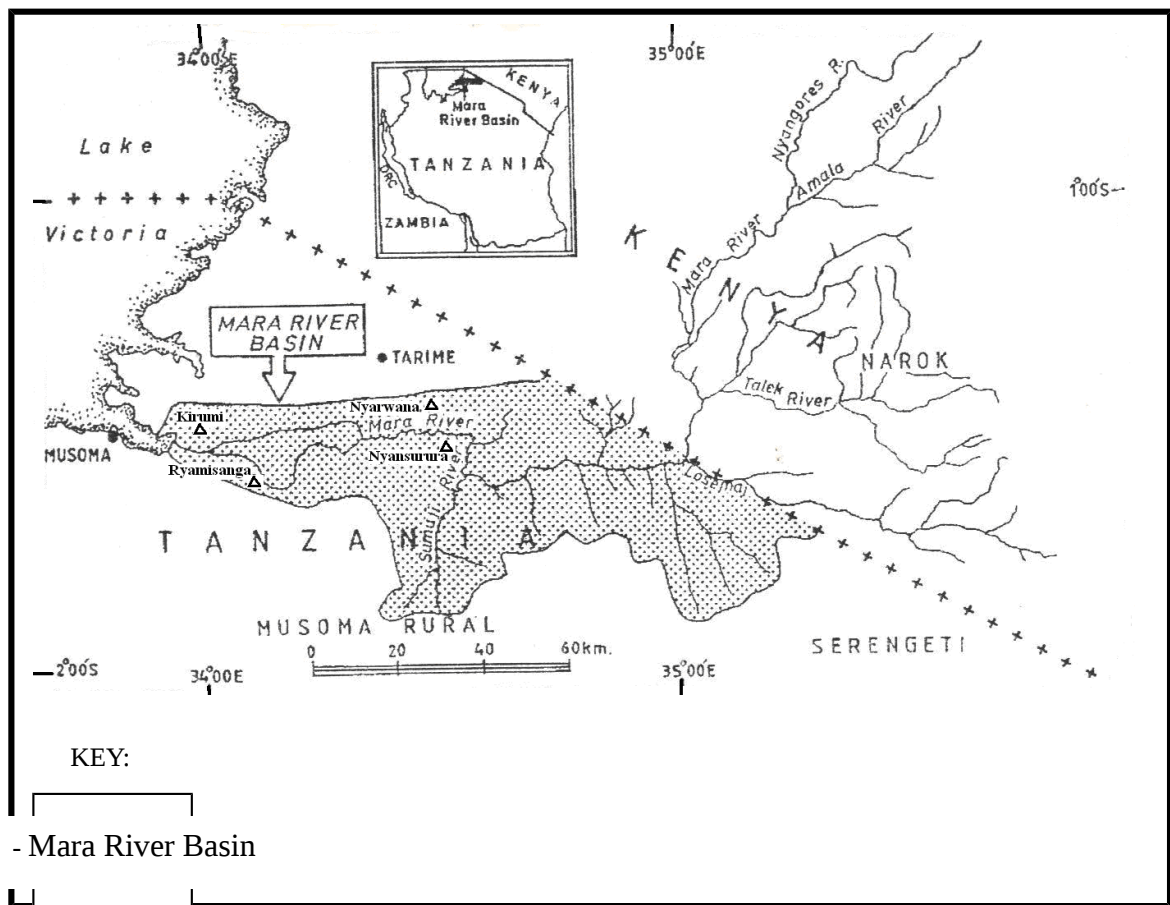


Figure 2: Mara River Basin Map, Tanzania (WWF, 2003).

3.1.3 Climate

The Mara river basin is divided into two major climatic zones. The northern zone which cover parts of Tarime and western parts of Serengeti districts. This zone receives an average rainfall of between 1250 and 2000 mm per annum. However during the past ten years from 1990 to 2000 rainfall patterns have been fluctuating (Figure 3). On the hand the central zone, covering Musoma and western part of Serengeti district, receives rainfall of between 900 and 1300 mm per annum.

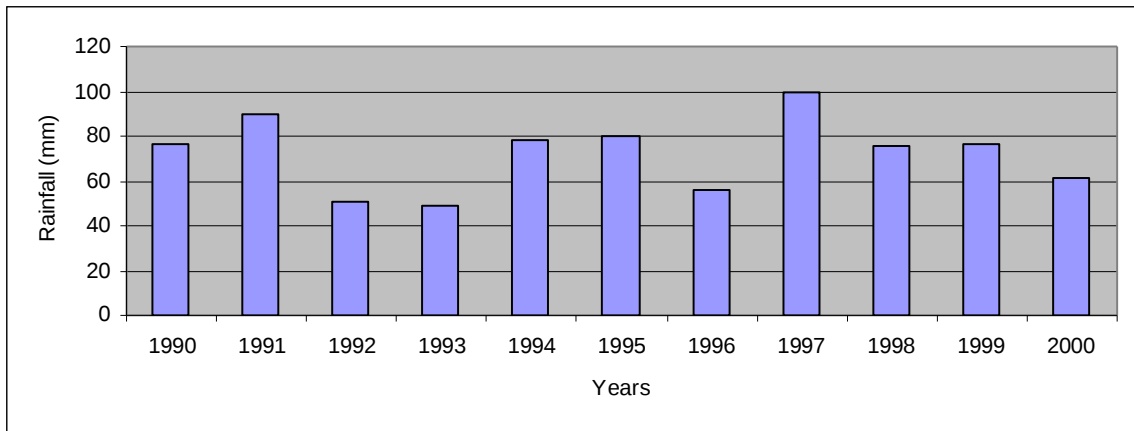


Figure 3: Rainfall distribution in Mara River Basin from 1990 to 2000

Source: Tanzania Meteorological Agency (2005)

3.1.5 Population

According to the 2002 census report, Mara river basin has a total population of 277 016 people of whom 166 804 were females and 653 449 males (URT, 2003b). Average household size was 5.5 members and the annual average population growth between 1988-2002 was 2.5% (URT, 2003b). Mara river basin is occupied by a number of ethnic groups including Kurya, Jalu, Jita, Ikoma, Ngoreme, Kwaya, Hunyaga, Sweta and Luli (URT, 2003). Administratively, the Mara river basin has 16 divisions 97 wards, and 336 villages (Yanda and Majule, 2004).

3.1.6 Wild life

There is a high diversity of mammals in the Mara River Basin as result of being adjacent to Serengeti National Park. Animals found include *Gazella granti*, *Gazella thompsonii*, *Panthera leo*, *Panthera pardus*, *Hippopotamus amphibious*, *Crocuta*, *Equus burchelli*, *Kobus ellipsiprymnus*, *Taurofragus oryx*, *Aepyceros melampus*, *Syncerus caffer*,

Crocodylus niloticus, *Connochaetes taurinus*, *Giraffa camelopardalis*, *Loxidata Africana* (WWF, 2003).

3.1.7 Socio-economic activities

Socio-economic activities in Mara River Basin include agriculture, livestock keeping, fishing, mining and business and trade (URT, 2003b). Agriculture and livestock keeping are the major socio-economic activities in the Mara River Basin.

3.1.6.1 Agriculture

The Tanzanian agricultural policy aims at promoting crop and livestock growth of 4-5 % per year in order to ensure basic food security, increase output earnings, raise people's nutritional status and increase their standard of living. About 90% of residents of Mara region depend on agriculture as a main source of their livelihood. Agriculture contributes about 60% of the region's GDP. Tarime and Musoma are prone to food deficiencies due to climatic conditions such as rainfall which has been fluctuating for ten past years, poor agricultural methods, decline in soil fertility and big herds of livestock limits area available for crop cultivation (Table 1).

Crops grown in the region include cassava, maize, sorghum, finger millet, paddy, beans and sweet potatoes (Table 2). Cotton is the principal cash crop grown in all districts. in the basin

Table 1: Comparable average crop/livestock yields

Crop	Potential yield under good Management (100kg bags/acre)	Actual yield in Mara River Basin (100kg bags /acre)
Maize	16	5 .0
Sorghum	14	6 .0
Finger millet	12	5.4
Sunflower	8	4 .0
Paddy	16	5 .0
Cow milk*	8	1.5 -2 .0

Source: ACT-Mogabiri, Mara (2005). * = Milk yield in litres per cow/day.

Irrigated farming in Mara region is done on small scale on vegetables. However, its potentiality rests on the existence of Lake Victoria and Mara River (World Bank, 1995).

Table 2: Estimated area (ha) under production of major food crops by district, Mara River Basin, 2001/2002.

Crop	Musoma	Tarime	Serengeti
Cassava	21 910	22 210	31 250
Sorghum	8 130	13 950	19 170
Maize	8 760	20 080	24 160
Sweet potatoes	7 840	7 570	7 110
Finger millet	630	2 070	7 180
Paddy	720	560	3 740
Beans	2 310	1 110	4 620
Total	50 300	68 050	97 230
% of total crop area	19	26	36

Source (URT, 2003b)

3.1.6.2 Livestock keeping

Mara communities rely on livestock production for their livelihoods. The major types of livestock kept are cattle, goats, sheep and donkeys. The livestock sector is the second most important contributor to the region's economy after agriculture. It is estimated that 51% of total agricultural households in Mara region keep cattle and the size of herd per household ranges from 50 to 1 000 cattle. Animals represent a bank stock to be purchased when there is good harvest and sold during distress times in order to buy food. Cattle and donkeys are widely used for transportation of crops and other domestic goods and for ploughing. Most of the livestock kept in the area is grazed in the Mara river basin, particularly in the flood plain of the Mara River during the dry season due to water and pasture availability and grazed in the uplands during the rainy season. Land use for pastures in the basin is limited, thus most of the time livestock is sent in the catchments areas for water and pastures. The key problems to the livestock sector in the basin include lack of reliable water for both wild and domesticated animals during dry season. Tarime has the highest amount of cattle population compared to other two districts of Serengeti and Musoma (Table 3).

Table 3: Estimated livestock population in three districts sharing Mara River Basin, 2002

District	Cattle	Goats	Sheep	Donkeys
Tarime	401 800	133 447	32 468	1 193
Musoma	363 108	143 331	33 119	3 024
Serengeti	273 749	237 762	56 398	769

Source: URT (2003 b)

Both cattle and goats population has been increasing over time thus exerting more pressure on grazing land (Table 4).

Table 4: Livestock population distribution in Mara Region, 1984 and 2002

Year	Cattle	Goats	Sheep
1984 ¹	969 766	394 444	215 558
1998 ²	1 272 537	510 190	194 000
2000 ³	1 291 576	620 748	179 018

Source: URT (2003 b)

1- 1984 Census

2- District Integrated Agricultural Survey 1998/99-National Report.

3- Regional Commissioner's Office, Musoma, 2002.

3.1.6.3 Fishing

Fishing provides employment for people along the lakeshore and rivers there by generating income. However, fishing contributes little to the Mara River Basin's economy compared to crop production and livestock keeping because fish species in the river have declined thus resulting into their scarcity (Madundo, S. pers.comm 2005).

3.1.6.4 Mining activities

Currently, both artisan and large-scale miners are operating in Mara River Basin (Buhemba in Musoma and Nyamongo in Tarime districts). Artisan mining operates in areas around the large scale mining at small scale and is operated illegally and this has always caused conflicts with the licensed big companies. Large-scale mining operations are conducted by Afrika Mashariki Co. Ltd in Nyamongo and Meremeta Co. Ltd in Buhemba (Yanda *et al.*, 2004)



3.1.6.5 Beekeeping

Beekeeping is another income generating activity in the Basin. Beekeeping is practised in traditional way, and it contributes to local communities' income. Beekeeping activities provide an alternative source of income in the basin to some people who are always experiencing an increasing low income resulting from decline in agricultural production, land scarcity and reduction in incomes from fishery activities. Mara River Basin is suitable for beekeeping and nurses about 45000 bee colonies which are capable of producing 450 tons of honey and 30 tons of wax annually (URT, 1998).

3.1.6.6 Non farm income generating activities

Individual villagers and some women groups have developed alternative income generating sources. Main activities observed during the fieldwork were:

- Growing and selling of vegetables,
- Making and selling of mats using reeds from the Mara River Basin,
- Processing, preservation and selling of food crops (mainly cassava flour and tomato jam),
- Manufacturing and sale of improved firewood stoves,
- Carpentry,
- Honey selling.

3.2 Methodology

The study was carried out in two phases. Phase one involved reconnaissance survey while the second phase involved mainly questionnaire surveys. Reconnaissance survey was conducted to get a general picture of the area under study, which involved physical assesmentt of the degraded forests and water resources as well as pre-testing of the

questionnaire. During this phase pre-testing of questionnaires was done to check for clarity, redundancy, meaningfulness and comprehensiveness of the items, to ensure the amount of time required was not excessive and to assess the reaction of respondents. Pre-testing was done up to ten randomly selected households from Kwibuse, Borenga and Nkerege villages which were not involved in the actual survey. Thereafter necessary modifications were made to suit the local conditions.

3.2.1 Data collection

Both socio-economic and ecologic data were collected for this research work. Socio-economic data involved survey in the communities living along Mara river basin. Ecological data were obtained from satellite imagery and Mara hydrological data station.

3.2.1.1 Sampling procedure

A cross-sectional design as suggested by Casley and Kumar (1988) and Kajembe (1994) was employed in this study, whereby data were collected at one point in time from a selected sample of respondents to represent a large population at that time. A sampling unit for this study was a household. According to URT (1993), a household is defined as the number of people who dwell or live under the same roof and share the same bowl. Household samples were picked from the village register books (sampling frames) in which all members of the villages and the households are listed. Selected villages were those within the basin. In this case, 4 villages out of 8 were selected in the basin making 50% (Table 5). Household questionnaire survey was carried out in Ryamisanga, Nyansurura, Nyarwana, and Kirumi. These villages were selected purposively based upon their socio-economic activities that have both impact on forests cover in the basin as well

as on quality and quantity of water necessary for the livelihood of people and domesticated animals in the basin.

Table 5: The number of households sampled and interviewed.

Village	Total No. of households	No. of Sampled Households (12%)
Ryamisanga	400	45
Nyansurura	350	40
Nyarwana	300	30
Kirumi	150	25
Total	1200	140

3.2.1.2 Participatory Rural Appraisal (PRA)

PRA is an approach for sharing knowledge, analysis and for developing practical actions. The methods used were: observing directly, activity profiles and daily routine, historical profiles, participatory resources mapping and modelling, Venn diagrams, direct matrix and pair wise ranking and scoring. The results were given back to villagers for verification and retention.

3.2.1.3 Structured questionnaire

Structured questionnaire was used to obtain information on households. The structured questionnaire (Appendix 3) contained both open and closed ended questions. According to Kajembe & Luoga (1996), significant population representation is attained when a random sample of at least 5% of the total number of households is taken from the population. In this study, the sample size for questionnaire survey was 12% of all the households in each of the four selected–study villages. In each household, the head of the household was interviewed, but other members were encouraged to attend to supplement information. The focus of the survey was to get information on types of natural resources use conflicts in

the study area, to get information on socio-economic and institutional factors underlying natural resources use conflicts, to get information on the impacts of natural resources use conflicts on land cover and land uses. Also the focus of the survey was to get information on the impacts of natural resources use conflicts on livelihoods. A total of 140 out of 1200 households were interviewed as indicated in Table 5.

3.2.1.4 Focus group discussions

A checklist was used to collect information from key informants. A key informant is an individual who is accessible, willing to talk and has great depth of knowledge about issues in question. Key informants are not only members of the clientele, but are most often informed outsiders (Mettrick, 1993). The discussions with key informants focused on types of natural resources use conflicts in the study area, information on socio-economic factors underlying natural resources use conflicts, information on the impacts of natural resources use conflicts on livelihoods, information on the impacts of natural resources use conflicts on land cover and land uses. For this study an open-ended discussion was conducted with the District Agriculture and Livestock Development Officers, District Forest Officers, District Water Engineers, Ward Extension Officers, Village Extension Officers and Village Executive Officers.

3.2.1.5 Participant observation

Participant observation method as the name implies, is distinguished from other methods by the fact that the observer become a part of the situation being studied (Kajembe and Wiersum, 1998). Participant observation facilitated collection of information on local communities' attitudes towards conservation in the study area. In this technique, the

researcher was part of the community being studied. In so doing the researcher gained the confidence of the persons being studied, so that his presence did not interfere with the natural course of events. Much information can be obtained by observing what goes on. What villagers say and what they do may not necessarily coincide. Observing operations in the field gives an opportunity to discuss with the farmer what, why and how things are done. It is always essential to keep ones eye open when visiting the farm and to check what you are told against what you see (Mettrick, 1993). The method of participant observation was primarily used to tie together the more discrete elements of data gathered by other methods. Thus, an iterative process between participant observation and other research methods evolved. The other methods allowed aspects of life in the study area to be isolated and studied out of context of the community life. Participant observation permitted these elements to be examined within the context of the social system. At times, this resulted into a more complete understanding of both the individual elements and the whole. In other situations, more questions about life in the study area emerged.

3.2.1.6 Ecological data collection

Information on land cover and land uses was obtained from the Land sat images (P170 R060) of the year 1990 and subsequent year 2000 covering Mara River Basin. The images were acquired from Institute of Resource Assessment (IRA) University of Dar-es-Salaam. Hydrological information was collected from Mara Mine 5H2 station and from regional water engineer's office-Mara region.

3.2.1.7 Secondary data

Both Socio-economic and Ecological Secondary data were obtained from libraries, documentation centres in various institutions in Dar es Salaam and Mara regions as well as at SUA-Morogoro, and website.

3.2.2 Data analysis

3.2.1 Socio-economic data

Both qualitative and quantitative methods were used to analyse the Socio-economic data.

3.2.1.1 Qualitative data analysis

Participatory Rural Appraisal data were analysed with the help of local communities and the results were communicated back to them for verification and custody. Qualitative data was analysed by using content and structural-functional analyses to get meaningful answers. Content analysis is a set of methods for analysing the symbolic content of any communication. The basic idea is to reduce the total content of communication to some set of categories that represent some characteristics of research interest (Singleton *et al.*, 1993). Through this method, the data collected through verbal discussions with key informants was analysed in details whereby the recorded dialogue was broken down into smallest meaningful units of information or themes and tendencies. According to Kajembe and Luoga (1996), the technique helps the researcher in ascertaining values and attitudes of the respondents thereby generating themes and tendencies. Structural-function analysis helped the researcher to distinguish between visible and hidden functions. Visible functions are those consequences which are “intended and recognized by the actors in the systems” while the hidden functions are those consequences which are neither intended nor recognized by the actors.

3.2.1.2 Quantitative data analysis

Both descriptive and inferential statistical analyses were carried out. All quantitative analyses were performed by using Statistical Package for Social Sciences for Windows (SPSS 11.5). Descriptive statistical analysis involved measures of tendency and dispersion. A Logistic Regression Model was developed to indicate relationship between socio-economic factors as independent variables and natural resource use conflicts as dependent variable. According to Kajembe *et al.* (1994), inferential statistical analysis helps in providing an idea about whether the patterns described in the sample are likely to apply to the population from which the sample was taken.

The Logistic Regression Model was used to estimate the probability of occurrence and non-occurrence of resource use conflicts in the basin. The binary dependent variable used was the existence of resource use conflicts with the value of ONE if the response is YES and ZERO if the response is NO. Using the regression coefficients (β), the prediction models were then developed. In this study, education level, marital status, age, duration of residence, farm size, , distance from home to resource base, household size, and gender were considered as independent variables to influence existence of resource use conflicts in the study area. A linear combination of these independent variables was established for prediction purposes.

The following logistic regression model from Pampel (2000) was used.

$$Y_i = \frac{1}{1 + e^{-z}} \dots\dots\dots (1)$$

Where:

Y_i = the i^{th} observation value (Score) of the dependent variable representing a linear combination of the independent variables underlying resource use conflicts in the study area), which stand for a non- standardized logistic regression equation. This was then used for prediction purposes. Y_i is a binary variable with value of 1 if the respondent reported existence of resource use conflicts in the study area and 0 if otherwise.

e = Natural logarithm equal to 2.718

$$Z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_n X_n + \epsilon_i \quad (2)$$

Z = Summation of independent variables.

X_1 to X_n = Independent variables (education level, marital status, age, duration of residence, farm size, distance from homestead to the resource base and household size),

β_0 = constant term of the model without the independent variables,

$\beta_1 - \beta_n$ = Independent variable coefficients showing the marginal effects (negative or positive) of the unit change in the independent variables on the dependent variable and these were used in developing prediction equations on the resource use conflicts,

ϵ_i random error term,

i 1,2,3,4----- N (Total number of respondents) = Sample size i.e. 140 for the purpose of this study),

n = total number of independent variables ($n = 8$).

From above, the independent variables in the model are elaborated as follows:

X_1 = Level of education of the respondent (including years of schooling). It is assumed

that increase in education level reduces incidences of resource use conflicts due to the fact that educated People have more options to meet their livelihoods and reduce the chance of occurrence of conflicts in the study area.

X_2 = Marital status of respondent. There is a high probability of occurrence of resources use conflicts with increase in number of married heads of households due to increased responsibilities of heads of households to meet household demands from different resources.

X_3 = Age of the respondent in years. It is assumed that increase in age of the respondent reduces the incidences of resource use conflicts because older persons are usually assumed to have accumulated enough resources to meet their livelihoods. Also older people are assumed to have much wisdom related to use resource use and in resolving resources use conflicts through reconciliation committees. On other hand, the increase in number of young members in the community increases the chances of intergenerational conflicts in a given area because they want to accumulate enough resources for their households.

X_4 = Duration of residence (years). It is assumed that the more time a person stays in a particular area, the less the incidences in resources use conflicts. This is due to the fact that an individual who has stayed in a particular place for a long time is assumed to have owned enough land resources to meet his/her livelihoods than an immigrant to the area.

X_5 = Household size. It is assumed that by increasing the number of members in a household, the resources use conflicts also tend to increase due to an increased demand per individual.

X_6 = Farm size (ha). It is assumed to have fewer incidences of resources use conflicts

when individuals acquire enough land because they are capable of allocating it for different uses. Land scarcity is assumed to have higher chances of resources use conflicts.

X_7 = Average distance (km) from homesteads to the resource base and to the market. It is assumed that the closer is the respondent's homestead to the resource base and the market, the more likely occurrence of resource use conflicts due to closeness to the resource base hence more frequent visits to exploit the resources. By increasing the distance from the resource base to homesteads, reduces incidences of resources use conflicts in a given area.

X_8 = Gender of respondents. Gender dimensions reflects clear division of labour at household level as most of african females do most of household chores such as cooking, taking care of children, house keeping while male go out to search for opportunities to improve household welfare. On the other hand gender as social relation has a profound influence in the role of men and women that play in the management and conservation of natural resources. It was hypothesized that men visit forests and water points more frequently than women while searching for opportunities. Thus in so doing men are considered to bring more impact to the forests than what women can do based on the acquired field knowledge.

To test whether the regression coefficients are significantly different from zero, the Wald statistic that asymptotically follows a Chi-square distribution in large samples (Norusis, 1990; Gujarati, 1995) was used. The Wald statistic is distributed as Chi-square with degree of freedom (df) equal to the constrained parameters (r) with single parameter; the Wald statistic is simply the square of the t-ratio. The odds ratios represented by $\text{Exp}(\beta)$ from logistic regression analysis were used in explaining the likely occurrence or non-

occurrence of resource use conflicts in a study area under specified socio-economic factors. Equation 1 above was used to predict the probability of increasing resource use conflicts under given linear combination of independent variables (Y_i).

To assess the goodness of fit the regression model to the data, the model Chi-square as suggested by Pampel (2000) was used. By using the Chi-square test, the significance level of the model was tested at 5% probability level. Both non-standardized equations (Equation 1) and standardized equations (Equation 2 & 3) using logistic regression coefficients (β) and exponential coefficients (Exp (β)) equivalent to beta weights (b^*), respectively, were developed.

Prob (Occurrence of resource use conflicts)

$$= \text{Prob (Event)} = \frac{(e^{z_i})}{(1 + e^{z_i})} \dots\dots\dots(3)$$

The Prob (No occurrence of resource use conflicts) = Prob (No event)

$$= 1 - \text{Prob (Event)}$$

$$= 1 - \frac{(e^{z_i})}{(1 + e^{z_i})} \dots\dots\dots(4)$$

Non-standardized figures (β) are used in predictions of phenomena; whereas standardized figures (Exp (β)) are used to assess the relative impact of each independent variable on the change in odds ratios. Thus standardized figures (Exp (β)) were used to explain the phenomena under the study.

3.3.3 Interpretation of logistic regression results

It should be kept in mind that interpretation of parameters in logistic regression is not as

straightforward and easy as it is the case with Ordinary Least Square (OLS) methods (Pampel, 2000; Powers and Xie, 2000). For proper interpretation of results from a Logistic Regression Model (LRM) the following was done:

- (i) The Wald statistics values were tested to see whether the effect of a particular independent variable was statistically significant,
- (ii) The sign of the effect (β), was tested too to see whether increase in the independent variable increased or decreased the probability of success (in this case occurrence of resource use conflicts in the study area),
- (iii) The relative magnitudes of the similarly measured variables, to determine which of the independent variables were examined to see which of the dependent variables seem to have greater impact on occurrence of resource use conflicts in the study area;
- (iv) Also the value of the exp (β) was tested to see how much a unit increase in X_n changes the odds ratios of success (keeping in mind that the odds of success is not the same as probability of success),
- (v) Different values for independent variables (X) were substituted in the equation to see how changes in the value of a particular independent variable affects the probability of success or failure (Appendix 1)

3.3.2 Ecological data analysis

Land cover and land uses were analysed through visual interpretation of Land Sat T.M. Satellite imagery through a computer Arc View GIS 3.2 Program. The geographic, topographic and Satellite images were georeferenced, classified and interpreted.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

This chapter presents the research findings. It is divided into two sections. The first section presents types of natural resources use conflicts in the study area while the second section discusses contributing factors and their implications on resource base and on livelihoods in the study area.

4.1 Types of Natural Resources Use conflicts in the Study Area

The study revealed existence of natural resources use conflicts in the study area. These conflicts existed mainly over the use of water and forests involving regulators and users, and among users.

4.1.1 Conflicts between regulators and users (forest authorities versus cultivators and livestock keepers)

Figure 4 indicates that 32% of the respondents acknowledged existence of conflicts between users and forest authorities in the basin. It was further discovered that forest reserves in the basin were encroached for settlements by immigrants from other areas. This situation occurred due to limited land availability for different land uses which otherwise implies limited livelihood options for local communities in the area.

The study findings concur with what was reported by Thompson (1997), who argued that absence of alternative livelihood strategies to local communities is one of the driving forces of existence of resources use conflicts among communities in the country. Regulators (forest authorities) emphasised conservation of forested land while the Users

(crop cultivators and livestock keepers) needed the forested land for crop cultivation and pastures.

The findings are also in line with the study conducted by Mayetta (2004) who argued that unless local communities adjacent to protected areas are involved in co-management of natural resources as of the practical livelihood strategies, resources uses conflicts will remain inevitable in Tanzania.

It is therefore, appropriate to enhance local institutional arrangements that may help to reverse the existing situation through land use management plans. Also scarcity of land in the study area could be mitigated through adoption of agro-forestry practices whereby trees for different uses and crops could be planted as well as rearing of domesticated animals in one spatial area. Agro-Forestry practices could create income-generating opportunities such as planting of trees for building materials, fruits and for fuel wood (fire wood and charcoal production) for commercial purposes from which they could get income to improve livelihoods and reduce competition from the forest resource base.

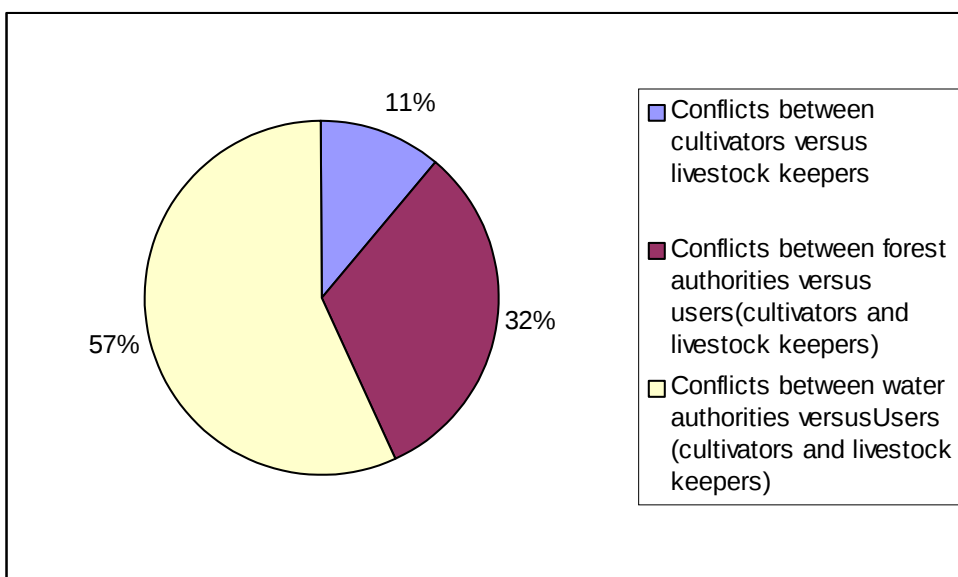


Figure 4: Types of natural resources use conflicts in the study area.

4.1.2 Conflicts between regulators and users (water authorities versus cultivators and livestock keepers)

The study revealed that 57% of all respondents acknowledged the existence of resources use conflicts between water authorities and users (Figure 4). This could be attributed to lack of land-use plans and limited supply of water in the study area for both human and domesticated animals' populations.

4.1.3 Conflicts between users (cultivators versus livestock keepers)

The study revealed conflicts between cultivators and livestock keepers in the study area. Figure 4 indicates that 11 % of all respondents acknowledged on the existence of resources use conflicts. This conflict has been found to occur due to limited land availability which cannot accommodate the rapid growing human population in the study area. This conflict has been reported by Mkeya (1994) and Makangale (2006), who argued that land shortage both for crop cultivation and livestock production is the driving force underlying these conflicts. These conflicts have forced users to encroach forest areas to fulfill individuals' interests. These conflicts are probably also occurring due to inadequate pastures to accommodate large populations of domesticated animals (URT, 2003a).

This conflict among the users has been reported else somewhere in the country (Kisoza, *et al.*, 2004). Therefore proper land-use planning is important in avoiding such conflicts.

4.1.4 Conflicts between crop cultivators and game reserve authorities

Wildlife has been reported as another competitor for water resources (Figure.5). The conflicts are those between cultivators and game reserve authorities. Figure 5 shows that 79% of the respondents acknowledged the destruction of water points by wild animals. These conflicts occur because during the long dry season (June-September) in the study area, there is scarcity of water in the National Parks for wild animals. Due to this situation, wild animals regularly leave protected areas in search of water and food and in the process they bring damage to water sources, crops, livestock predation and occasionally causing human injury and loss of life to villagers (Mamuya.pers.commun, 2005). Bayona (2003) reported that crop damage by wildlife brings enmity between wildlife authorities and crop cultivators because there is no compensation to the damage of crops caused by wild animals. Mayetta (2004) argued that conflicts between crop cultivators and wildlife are due to competition for water, which is limited in supply. This problem could probably be solved by construction of artificial dams in the National Parks as well as involving local communities in the management of wildlife. The approach of local communities participation could make the local communities feel a sense of ownership of the wildlife, hence conflict resolution in the study area.

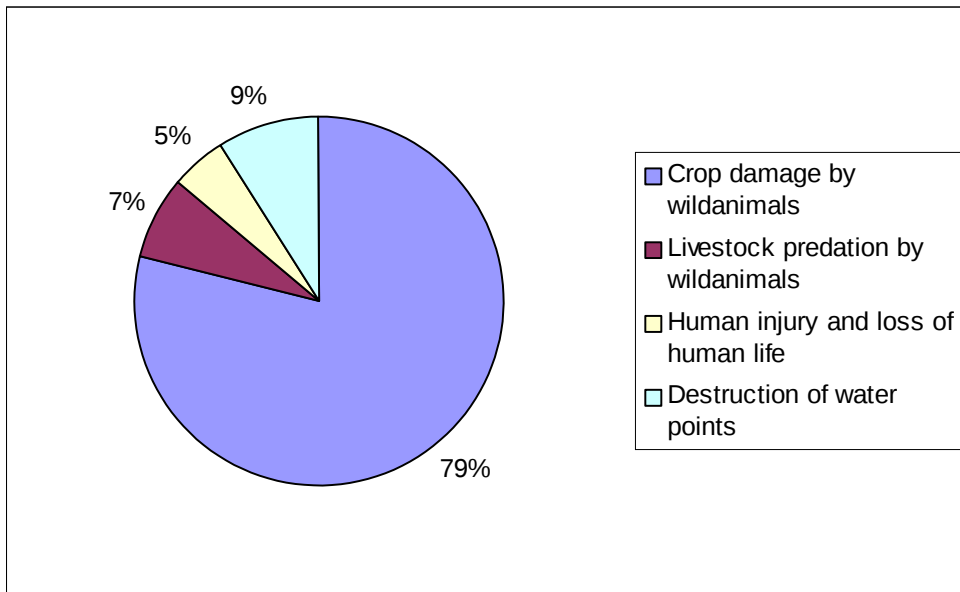


Figure 5: Wildlife based resources use conflicts in Mara River Basin, Tanzania.

4.2 Socio-Economic and Institutional factors Underlying Natural Resource Use Conflicts in the study area

4.2.1 Socio-Economic Factors

Many of the resources use conflicts that are witnessed today are to a large extent a result of man's own creation to satisfy his/her basic needs for livelihood and economic growth (FAO, 2000b). Massive deforestation and drying of water resources are manifestation of increased environmental stress through resources use competition that impact negatively on local communities livelihoods (FAO, 2000b) The socio-economic factors considered in this study include sex, education level, marital status, age, land size allocated for crop production, average distance from homesteads to the resource base duration of residence and household size.

4.2.1.1 Sex

Sex of respondents has a positive logistic coefficient of 0.767 and odds ratios of 2.153 (Table 6). This implies that for every increase in one person the perception on odds of an event to occur is not statistically significant ($P = 0.121$), increasing by a factor 2.153. Men visit forests and water resources more frequently than women while searching for income generating activities such as harvesting forest products and fishing. In the process they gain more knowledge on the natural resources status as whether they are well or poor managed.

These findings concur with studies conducted by MNRT (2006) on assessing knowledge of stakeholders in regard to the concession process in the forest management. The study revealed that men are more knowledgeable on forestry sector than women. These differences in perceptions regarding natural resources reflect the differences and responsibilities undertaken by men and women and their impacts on natural resources adjacent to them. Sex impact to the natural resources use conflicts was not statistically significant ($P = 0.121$), which means that resource use conflicts would occur irrespective of the sex of the resource user.

Table 6: Socio-economic factors of natural resources use conflicts results from logistic regression

Variable	B	SE	Wald	t-ratio	df	Sig.	Exp (β)
Sex.	.767	0.495	2.402	1.549	1	0.121	2.153
Education	-.162	0.088	3.394	1.840	1	0.065	.851
Marital status	0.159	0.633	0.063	0.251	1	0.802	1.172
Age of respondents	0.037	0.034	1.206	1.088	1	0.272	1.038
Land allocated for crop production	-.385	0.216	3.172	1.782	1	0.075	.681
Average distance from home to the resource base	-0.043	0.215	0.040	0.2	1	0.841	0.958
Duration of residence	-0.052	0.021	5.896	2.476	1	0.015*	0.949
Household size	0.146	0.059	6.244	2.475	1	0.012*	1.157
Constant	0.302	1.526	0.039	0.198	1	0.843	1.352

-2LL = 147.344

- 2LL (Log Likelihood) is a probability that the observed values of the dependent may be predicted from the observed values of the independents and it varies from 0 to 1. The statistic – 2 Log L (minus 2 times the log of likelihood) gives significance of logistic regression model when its value is less than 1. In this study the model was found statistically significant at 0.05 because the – 2 LL value was found to be – 147.344 which is less than 1 (Powers and Xie, 2000).

Model Chi-square = 22.698 (df =9)**

Overall percentage of classification = 75.7%

Number of cases = 140

Exp (β) = Odds ratios (probability of success/probability of failure)

SE = Standard error of the estimate. *Statistically significant at 0.05 level of significance, Exp (β) = e^β where $e = 2.718$ and β = Regression coefficients in Table 6 above which stand for the odds ratio which is the ratio of probability of success to the probability of failure. According to Pampel (2000) and Powers and Xie (2000) Wald statistics (W) = $\beta / (SE)^2$ and t-ratio = $\beta / (SE)$.

4.2.1.2 Education

The negative coefficient (-0.162) in education level implies that a decrease in education level of respondents increases the odds ratios of resources use conflicts by a factor of 0.851 (Table 6). This is due to the fact that a decrease in education level is normally associated with a decrease in understanding of the broad benefits accrued from the conservation of natural resources. Decreased level of education also decreases the willingness of local communities to accept the idea of co-management of natural resources thereby increasing the tension between local communities and natural resources management authorities (regulators). Decreased level of education also decreases options of respondents to meet their livelihoods. Limited post-formal education among rural population causes “inadequate” awareness of environmental issues. The study revealed a low number of respondents with post primary education (Table 7). However, the majority of respondents with post primary education were reported that they do not to live in villages but migrate to towns for “white collar” jobs or get involved in trading activities mainly across Tanzania – Kenya border.

The findings concur with that of Kajembe *et al.* (1996) who argued that there is no development without education. Katani (1999) argued further that an increase in education level increases the level of awareness and thereby creating positive attitudes, values and thereby motivating people to manage natural resources sustainably since increasing education levels usually increases people’s awareness of the value of the resource hence imparting a positive perception of conservation initiatives.

Mbwambo (2000) argued that people who are better educated tend to plant more trees for different uses at their homesteads as opposed to less educated ones. Planting of trees around homesteads normally reduces pressure on common pool resources thereby reducing chances of conflicts. The impacts of education level on natural resources use conflicts was not statistically significant ($P = 0.065$). However non-zero of Wald values indicate that there are some interactions with other independent variables to cause conflicts.

Table 7: Education status in Mara River Basin, Tanzania

Education level	Frequency	Percentage (%)
No formal education	10	7.14
Primary school education	111	79.29
Secondary school education	19	13.57
Total	140	100

4.2.1.3 Marital status

Marital status of respondents has a positive regression coefficient of 0.159. This implies that marital status causes heads of most households to look for more household basic needs. Most households in the basin are married and in most of the Kurya and Jaluo communities, polygamy is a common feature. To them being married to many wives signifies wealth and status symbol. Traditionally communities in the study area, consider wives and children as sources of household labour in farms and livestock rearing. Polygamy in the study area was observed to increase demand for different products, increases pressure on the available resources and thereby increasing the likelihood of resource use conflicts in the study area by factor of 1.172. This is due to the fact that more

wives mean more children and hence more demand for the resources. However marital status was not statistically significant ($P = 0.802$), indicating that the sampled households had enough land thereby not warranting conflicts with others.

4.2.1.4 Age structure and resources use conflicts

Age of a respondent has a positive regression coefficient of 0.037 and odds ratio of 1.038. This implies that increase in age increases the odds ratio of perceptions on the conservation of natural resources in Mara River Basin by factor of 1.038. A plausible explanation is that the older the respondent the more chances one had experience to see management of natural resources practices and as such able to compare and judge when natural resources are well or poor managed.

It was also observed that most of the households (82%) were headed by people in the age class of 20 – 40 and relatively few households (18%) were headed by people in the age class of 60 – 71. In many cases the 20 – 40 years age class constitute the productive group of a population and usually are the ones who are more involved in the exploitation of natural resources. It is therefore the age group which has the greatest influence on resources use conflicts.

Kajembe and Mwihomeke (2001) in the study carried out in Handeni district, argued that young people always argued that it was unfair for anyone to prohibit them from obtaining poles for building their houses since most of the elders in the villages started building their houses with poles and not bricks as recommended by elders. These conflicts were caused by elders imposing what was perceived to be an “invented tradition” of compelling the

young generation to start from brick houses while most of them (that is the elders) started off with poles and mud structures. The authors further argued that elders were able to judge appropriately the need to conserve natural resources unlike the youth whose major interest was to create economic benefits out of forest at the expense of over-exploitation of natural resources. Mayetta (2004) reported that older people have indigenous knowledge of forest management and values after using them for decades. Thus they can be resourceful in guiding the young generations on the cultural practices to protect and manage the natural resources. This factor was found not statistically significant ($P = 0.272$) on the natural resources use conflicts in the study area. This could be that young generations from the sampled households had acquired enough knowledge from their elders on how to protect and manage natural resources thereby avoiding over-exploitation of natural resources.

4.2.1.5 Land allocated for crop production

The land allocated for crop production had a negative regression coefficient of -0.38 implying that a decrease in farm size increases the chances of resource use conflicts. Crop production in the basin has received a high priority followed by livestock keeping. The study showed that Land allocated for crop production vary from one household to another and has a high influence on occurrence of resource use conflicts in the Mara River Basin. It was observed that a unit increase in farm size reduces the odds of resource use conflicts by a factor of 0.681 (Table 6). Land allocated for crop production was not statistically significant ($P=0.075$). However, results in Table 6 has indicated Wald statistics non-zero value implying that there are interaction between the independent and dependent variables. According to Pampel (2000) and Power and Xie (2000) non-zero values for the

Wald statistics indicate presence of relationships between the explanatory variables.

4.2.1.6 Average distance from resource base to homesteads

The distance from the resource bases to the homesteads has a negative regression coefficient of -0.043 (Table 6). This implies that reduction of distance from the resource base increases the odds of resource use conflict by a factor 0.958. This is because there is an increase in the pressure demand for the natural resources due to short distances from homesteads to the resource base as compared to those who are far away from the resource base. Those who are far away from the resource base tend to look for alternative livelihood strategies like harvesting rainwater and planting of fast growing trees species. The change in distance had no significant effects ($P=0.841$) on resource use conflicts (Table 6).

4.2.1.7 Duration of residence in the Village

It was assumed that the more time a person stays in a particular area the more he/she becomes knowledgeable on the surrounding environment. Similarly the more time a person stays in a particular area, the less the incidences in resources use conflicts. This is due to the fact that an individual who has stayed in a particular place for long time is assumed to have owned enough natural resources to meet his/her livelihoods needs than an immigrant to the area. The results in the logistic regression (Table 6) indicated that duration of residence of respondents has a negative regression coefficient of -0.052 . This implies that an increase in years of duration of residence of respondent reduces the odds ratios of natural resources use conflicts by a factor of 0.949.

These findings concur with those of Mayetta (2004) who reported that the longer a person stays in a particular place the more he/she becomes involved in natural resources conservation and conflicts resolution and hence the more such a person becomes aware of the broader role of natural resources conservation to an individual, national and international economy. The logistic regression results indicated that the impact of duration of residence on natural resources use conflicts was statistically significant ($P=0.015$).

4.2.1.8 Household size and its implications in natural resources use conflicts

Household size had a positive coefficient of 0.146, implies that by increasing the household size the odds of resource use conflicts are increased significantly ($P < 0.012$). This is because, as the size of household increases, the household demand for different products from the natural resource base also increases. The household size in the study area is 11 persons (Table 8), which is far above the Mara region household size of 6.7 persons (URT, 2003b). This has an implication of increased demand for different products, thus creating more conflicts over the use of natural resources in the Mara River Basin.

Increased household size increases the demand of various products which also increases the chances for people's to diversify economic production due to available labour supply. This in turn may result into increased forests clearing for agriculture and pastures in order to meet the increased food demand at the household level. This also means an increase in felling of trees for building poles to meet housing requirements. Felling of trees for charcoal production also increases in order to meet increased demand for domestic energy. When all these activities are increased, then there are higher chances of increased resource use conflicts in the study area. The findings concur with the studies by Mayetta (2004) and

Shrestha (1996), who documented on the effects of increased household size on resource use conflicts, thus making the use of the available resources unsustainable (WRI *et al.*, 1992).

Similarly, Desloges and Gauthier (1996) and Borrini-Feyerabend (1997) reported similar results under a situation of increased household size. The direct effects of increased household size are well documented (Bilsborrow *et al.*, 1992; McNeely *et al.*, 1995), including increased consumption of the available resources, while the indirect effects are through increased poverty and migrations with subsequent breakdown of local institutions (McNeely *et al.*, 1995). The authors argued further that increased population growth strongly contributes a high demand on forests resources in the tropics thus leading to their depletion.

Table 8: Household status in the study area

Description	Minimum	Maximum	Mean	Standard deviation
Household size	2.0	31.0	11.0	5.475
Land for crop (hectare)	1.0	2.0	1.5	0.501
Age of head of HH	21.0	71.0	38.0	9.115

4.2.2 Institutional factors underlying natural resources use conflicts in the study area

Institutions are regulatory systems of formal laws, informal conventions and norms of behaviour, mainly designed to coordinate individual and collective actions for controlling, structuring incentives in human exchange and provide local regulations in the management of natural resources (Mayetta, 2004). The prevailing conflicts in the study area indicate

existence of weak institutional arrangements. Also the study area falls under three districts (Tarime, Musoma and Serengeti) in which each district is full mandated in planning and management of various natural resources thus bringing conflicting management strategies (Yanda and Majule, 2004). Institutional factors considered underlying resources use conflicts among others include land tenure, incentives, participation and informal laws.

4.2.2.1 Land tenure and resources use conflicts

The study revealed that 72% of the respondents acknowledged about weak existence of secure land tenure arrangements in the study area. This situation has resulted into over-exploitation of resources in the basin which in turn has led to scarcity of resources. The study shows that weakness in the local institutions to check over-use of resources is one of the underlying causes of competition for the available resources in the basin. These findings concur with a study conducted by Mkeya (1994), who argued that lack of land tenure to provide land security has been the source of conflicts among local communities due to lack of ownership and control mechanisms. It is believed that natural resources use conflicts can be reduced if land security mechanisms are put in place as control measure.

4.2.2.2 Incentives and resources use conflicts

The study indicated that 66% of the respondents acknowledged about poor incentive packages from the Government to be the source of the prevailing conflicts and unsustainable utilisation of resources in the basin. The study further revealed that local communities were not motivated in the conservation activities and no efforts were made by the government institutions to train local communities on the conservation programmes. Local communities lacked a sense of ownership of the resources and started

to exploit the resources as “no mans land”. Kajembe *et al.* (2004) argued that user rights and security of tenure to village government are among the incentives for sustainable development management of natural resources. Natural resources use conflicts in the study area existed because individuals were struggling to get “lions share” for their household needs.

4.2.2.3 Participation

The study indicated that 78% of all respondents acknowledged the existence of resource use conflicts as result of the government not involving local communities in the management of natural resources. Involving people in resource management is necessary to the conservation of natural resources and is geared towards solving the problems such as over-exploitation which is driven by poor governance and socio- economic activities of local communities. The importance of local communities’ participation in the conservation of natural resources reduces conflicts because ownership of resources becomes recognized and this avoids conflicts with the regulators. These findings concur with a study conducted by Kajembe and Mgoo (1999), who reported from Duru-Haitemba in Babati district that it was devolution, democratization, empowerment and sense of ownership that induced local communities surrounding the Duru-Haitemba forest reserve to invest their labour and time for sustainable conservation and management activities. This has resulted into a recovery of the degraded forest, which is now intact and rich in flora and fauna. Community involvement in conservation of forest resources in Duru-Haitemba has reduced costs of conservation. The observed success has been due to awareness, community participation, power and responsibility sharing and control of the resource.

4.3 Implications of Natural Resources Use Conflicts on Land cover, Land use

Results from T.M.Satellite images indicated existence of Land cover and Land uses changes in Mara River Basin between 1990 and 2000.

4.3.1 Implications of Natural resource use conflicts on Land cover

Table 9 shows that there was a decrease in inland water cover by – 7.6% from 1990 to 2000. This probably could be due to conflicts between livestock keepers and crop.

Table 9: Land use and cover changes by area in Mara River Basin between 1990 and 2000.

Land use/ cover	Years		Changes. Area (ha)	Land use/cover change in percentage (%)
	1990 Area (ha)	2000 Area (ha)		
GL	43013.66	34661.66	-8352	-19.42
WL	2021.13	4516.52	2495.39	123.47
CL	151418.88	77926.54	-73492.34	-48.54
InWN	7314.46	6759.86	-554.60	-7.58
OWL	11339.08	38433.81	27094.73	238.95
CF	30174.09	26315.09	-3859.00	-12.79
OF	137540.44	73867.16	65673.28	47.75

Source: Classification of Land Sat TM images of the year 1990 and 2000.

Note: GL = Grass lands; WL = Woodlands; CL = Cultivated land;

InWN = Inland water (natural); OG = Open Grasslands;

CF = Closed Forests; OF = Open Forests.

Cultivators competing for water and pastures from which crop cultivators were pushed away from their farms and moved to inland water (wetlands) for crop production through small scale irrigation. Conflicts between cultivators and Livestock keepers resulted into clearance of more forests for crop cultivation. Area for forests decreased from 139540 hectares in the year 1990 to 73867 hectares in the year 2000 (Figures 6 and 7). This is

equivalent to 47.8% decrease. Also open grass cover increased from 11339 hectares in the year 1990 to 38434 hectares in the year 2000 (239%). This was probably caused by conflicts between cultivators and Livestock keepers from which cultivators were pushed further into the forests where they cleared and caused closed forests to decline by -13% (Table 9).

The study showed that the rapid growing populations of both human and livestock increases the intensity of resources use conflicts in the basin. These findings concur with those of Scholes *et al* (1996) who reported that the growing populations are fed by expansion of land at expense of forests, woodlands and other ecosystems. This scenario signifies existence of increased human needs through pastures and crop production which consequently has been a source of conflicts between cultivators and livestock keepers leading to land cover degradation (Appendix 4).

4.3.2 Implication on Land use

The changes in the land uses in Mara River Basin are presented in Table 10 which indicates that areas for settlements in rural areas increased from 71 hectares in 1990 to 669.01 hectares in 2000 (Figures 6 and 7). The increase in settlement areas was due to increased populations of both human and livestock, consequently increased demand of water and land for crop production and livestock keeping. General land use increase by 845.20% from the year 1990 to 2000 for settlement also created a high demand of water needed for domestic use and for small scale irrigation. These forced local communities to look for more water and land elsewhere at the expense of forests which resulted into natural resources use conflicts among users as well as between regulators and users (Appendix 4). The study revealed that land under cultivation has decreased by 48.5% in the year 2000. This is due to two reasons; one, conflicts between livestock keepers and

cultivators forced the cultivators to move into degraded areas and opted for small farming and other businesses across the border of Tanzania and Kenya. Reduced land and poor soil fertility for crop cultivation has resulted into food insecurity in the basin. Second, crop damage caused by wildlife forced local communities to look for other options such as increase livestock per household as an alternative to get livelihood basic needs. These conflicts on land use have resulted into increased pastureland from the abandoned crop fields. This observation supports the argument by Frost and Desanker (1998) argued that where livestock is mostly valued local communities clear forests to favour to increase grass cover for pastures.

Table 10: General Land use changes by area in Mara River Basin between 1990 and 2000.

Land use	Years		Vegetation changes. Area (ha)	General Land use change in percentage (%)
	1990 Area (ha)	2000 Area (ha)		
RS	70.78	669.01	598.23	845.20
UA	141.94	493.62	351.68	247.77
InWA	53.56	43.81	-9.75	-18.20

Source: Classification of Land Sat TM images of the year 1990 and 2000.

Note: RS = Rural settlement; UA = Urban areas; InWA = Inland water (artificial);

CL = Cultivated land.

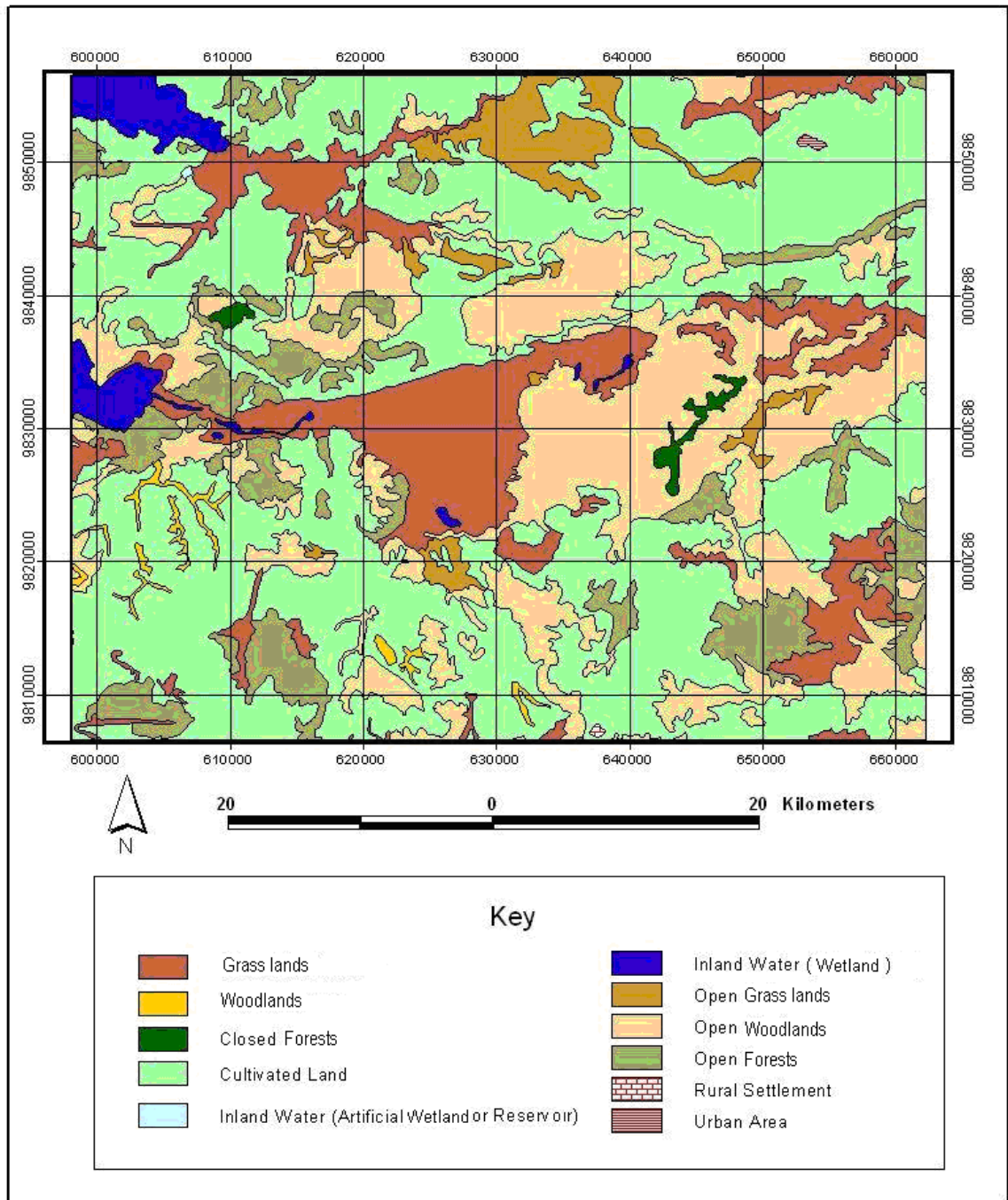


Figure 6: Land cover/Land use in Mara River Basin in 1990.

Source: Land Satellite imagery (T.M), 1990.

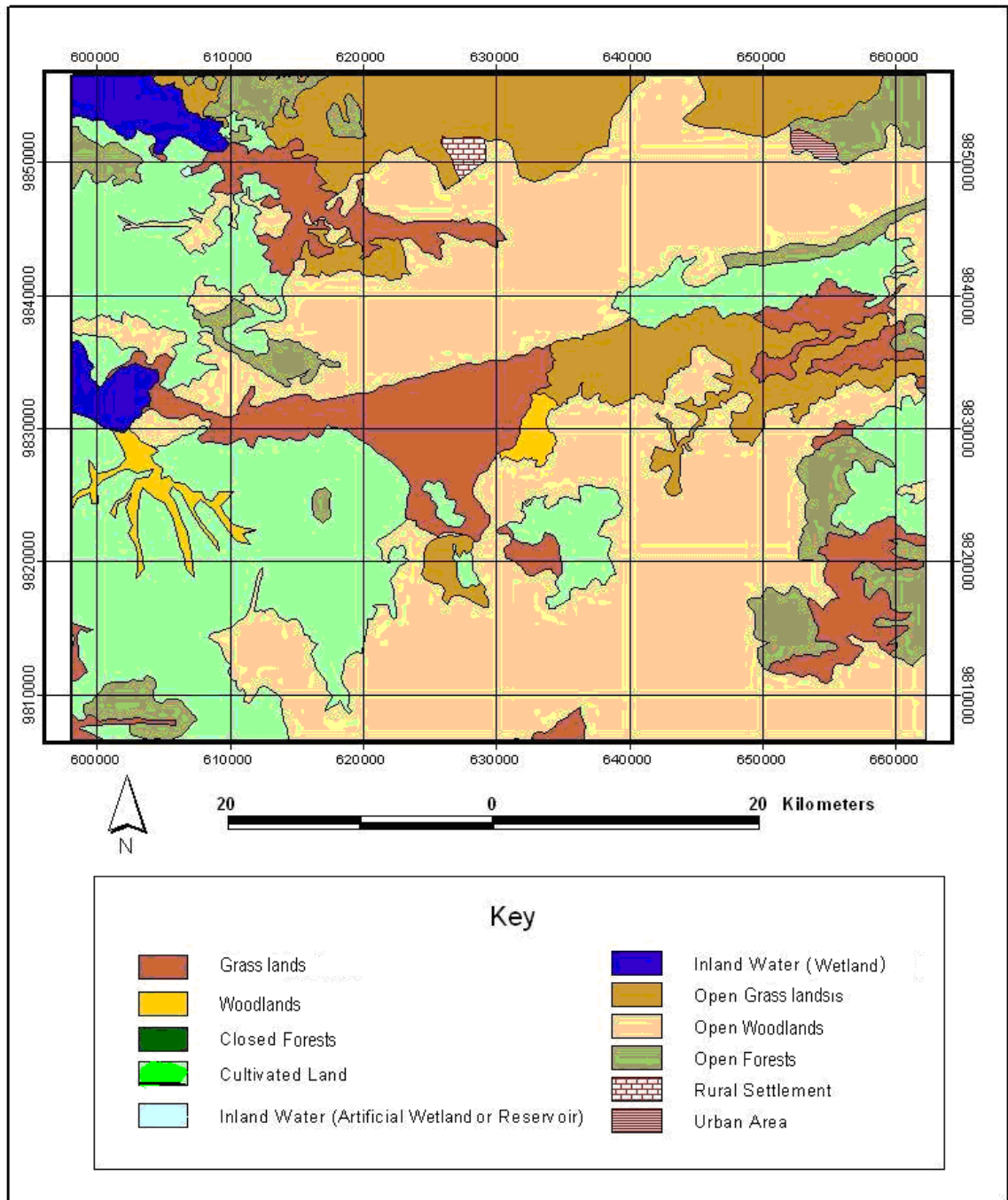


Figure 7: Land cover/ Land use in Mara River Basin in 2000.

Source: Land Satellite imagery (T.M), 2000.

4.3.3 Implications of natural resource use conflicts on water resources

Results in Table 11 indicate that 90% of the respondents acknowledged about a decrease in water availability in the basin since 1990. This is probably due to competition for natural resources among the users that has resulted into clearing of forests for pastures and agriculture practices from which water sources have been damaged and consequently a decline in water volume down streams.

Table 11: Water supply status in Mara River Basin

Water status	Frequency	Percentage (%)
Decrease	126	90
Constant	10	7
Increase	4	3
Total	140	100

Table 12: Annual Mean Discharge of Mara River at Mara Mine 5H2 Station.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Water discharge	42.76	37.82	13.89	9.31	11.80	10.43	8.22	9.67	7.34	5.01	2.03

(m³sec⁻¹)

Source: Mara Mine 5H2 Hydrological station (2004).

Mbuya (2004) reported that river flows in Mara River Basin has been observed to decrease year after year as a result of destruction of watershed catchment areas due to conflicts between cultivators and livestock keepers who compete to get more land by clearing catchment forests. The author further noted that there is a general decline in the amount of river flows (Table 12) which goes up to 0.10m³/s during dry season. These two photographs (Plates 1 and 2) were taken from two different points in December, 2005

indicating a decline in water quantity. This situation has resulted into water scarcity, food insecurity poor sanitation and break up water borne of diseases (WWF, 2004).

This concurs with Kilahama (2003) who reported that usefulness of natural forests could be judged from their beneficial effects on water catchment areas where they have a regulatory effect on stream flow. Therefore clearing of forests and woodlands for other land uses results into environmental problems such as decline in the flow of water in streams and rivers due to destruction of ecological values in the forests. The author further noted that amount of water down stream significantly decline causing serious shortage of water which is needed by flora and fauna as well as for other development activities. Yanda *et al.* (2004) reported that over-exploitation of resource base in Mara River Basin has caused water resource in the river to decline due to destruction of catchment forests, thus affecting the life of urban and rural local communities.

Declining of water supply due to other factors such as reduced amount of rainfall and increased evaporation due to increased temperatures in the study area has negative social impact which may include travelling greater distances which will involve more time consumption for water collection, lack of enough water for livestock, wildlife and small-scale irrigation. Therefore further degradation of water sources in the basin will most likely result into more conflicts for water due to its high demand among the local communities as well as wildlife from Serengeti National Park.

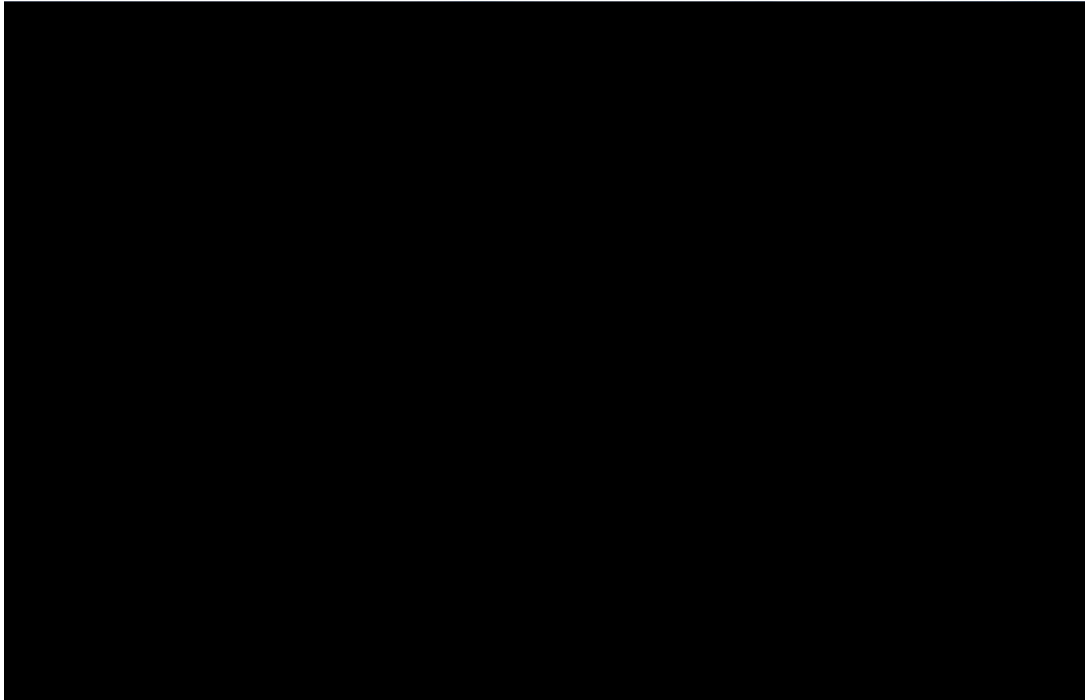


Plate 1: River flow of Mara River, Tanzania December 2005.

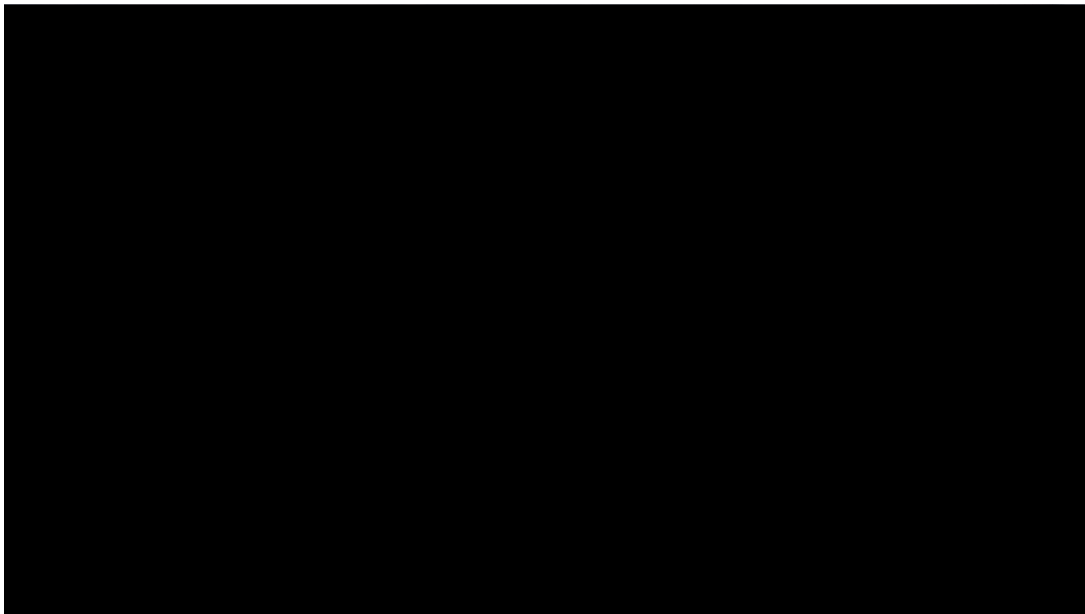


Plate 2: Fluctuations in water flow in Mara River, Tanzania December 2005.

4.4 Implications of resource use conflicts on livelihoods

Natural resources use conflicts in the study area have resulted into negative impacts to

livelihoods of local communities. These negative impacts among others include food insecurity, low-income, depletion of medicinal plants and valuable trees for ritual ceremonies.

4.4.1 Implications of resource use conflicts on food security

It was revealed in that food production has dropped down per household due to competition of resources between cultivators and livestock keepers from which cultivators were pushed into degraded land where crop production became poor. The study revealed that 63% of respondents acknowledged experiencing food shortage in the basin. Food shortage observed in the basin was due to small-farms per household as well as poor soils as results of degraded resource base (Table 3). The poor food production in the study area could also be attributed to limited availability of water required for small irrigation. The decline of water has reduced the amount of fish and food crops required by local communities in the basin.

These findings concur with HIFI (1991), which reported that more than 3 000 people depend on fish supplied from Masurura swamp located in Mara River Basin and that the decline of water has reduced the amount of fish required by local communities in the Basin.

Adoption of Agro forestry practices in the area can improve soil fertility hence productivity per unity area.

4.4.2 Implications of resource use conflicts on income

The study revealed that about 46% of respondents are using forest for charcoal production as source of income Table 13 and the preferred tree species include *Brachystegia boehmii*,

Brachystegia spiciformis, Combretum schumannii, Terminalia sericea, Pterocarpus angolensis and Afzelia quanzensis.

These tree species have also been cleared for other land uses such as creation of pastures and agricultural development. Disappearance of some tree species was due to conflicts among the users in Mara River Basin who forced their rivals to clear more forests to get land for pastures and agricultural activities which in resulted into economic loss for local communities.

These findings concur with those of Butler (1992), who reported that resource base degradation and land use conflicts in the Amazon basin created rural violence, increased urban migration and life hardships in urban areas and ultimately extreme poverty.

4.4.3 Implications of resource use conflicts on health care and cultural practices

Table 13 shows various uses of forest resources in the study area namely provision of fuel wood for domestic energy supply (both domestic and commercial purposes), building poles and logging for timber, traditional medicines and ritual performance in scared forests.

Table 13: Uses of forest resources in Mara River Basin

Type of resource	Frequency (n= 140)	%
Fuel wood	138	98.57
Traditional medicine and ritual performances	60	42.86
Charcoal production	65	46.43
Building poles and logging for timber	61	43.57

Medicinal plants were found important to the social life of the people along Mara River basin both for traditional healing, ritual performances and as an off-farm income generating activity.

The data in Table 13 shows that about 43% of the respondents acknowledged the use of forest resources as the main source of traditional medicine in curing various diseases as indicated in Appendix 2. This is because in rural areas the majority of poor people cannot afford prices of conventional medicines. Also field visit revealed that some of the valuable sacred forests used for ritual ceremonies have been cleared due to competition among local communities to create pastures or for agricultural purposes. Over-exploitation of forests has further resulted into extinction of some of the medicinal plants and valuable tree species such as *Kigelia africana* and *Ficus sycomorus* usually used for ritual ceremonies.

Farnsworth (1985) reported that more than 75% of world population rely on traditional medicines for their primary health care. This is done due to their low prices compared to conventional medicines. Over exploitation of natural forests reduces the number of species classified as ethno medicinal plants. The author further cautioned that habitat destruction

through deforestation jeopardizes the existence of tropic species, which are sources of the current medicine.

Health is an economic resource thus having time off for sickness is major cost in production and development. Depletion of forests in the study area seemed to threaten socio-economic and cultural patterns of local communities. The overall impact tends to raise living costs for conventional medicine and productive efforts for rural development in rural areas get reduced.

4.5 Conflict Management

The study revealed that the emerging conflicts in the basin are usually resolved using traditional councils called “RITONGA” comprised of elders. About 82 % of all respondents acknowledged the existence of these traditional councils which are used to resolve the conflicts. The study results showed that the strategies in response to the emerging conflicts include among other:

Uses of elders’ councils (Ritonga) are used to resolve conflicts on farm boundaries through dialogue and mediations. Most of the conflicts emerging from natural resource use are discussed in the elders meeting and if need arises the deliberations are taken to the village government.

4.5.1 Conflicts resolution with informal institution

The study revealed that 53% of respondents acknowledged about the need to enhance informal rules in the village for enforcing control mechanisms on the use of resources and natural resources use conflicts in the study area. Conflicts on the use of natural resources in the basin existed because the informal rules were weak to protect the utilization of

resources. Effective informal rules can play a great role in the management of natural resources and resolution of natural resources use conflicts. A study conducted by Kisoza *et al.*, (2004), in Kilosa district, Tanzania reported that the use of local institutions on regulating land resource utilization and conflict management between pastoralists and cultivators. Also another study carried out in Usangu in Mbalali district by Mbwilo (2002), reported the use of local institutions in regulating water and grazing land resource and conflict management has proved to be effective because they are based on the values, knowledge and practices of the local communities.

4.5.2 Conflict resolution with formal institution among users

Using established by laws through Village Environmental Committee (V E C) the village governments have been able to impose fines to the offenders. About 52 % of respondents interviewed indicated that creation of Village Environmental Committee has enabled the villages to have forum where natural resources matters are handled. This has been a bridge between natural resource regulators and the neighbouring communities E C works hand in hand with forest and park authorities to organize patrols and tree planting activities.

These approaches concur with a study conducted by Ssembajjwe (1999) who reported that cultural institutions are very effective and that local communities should be involved in the co-management of natural resources as long term solution to conflicts alleviation and reduction

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The study has shown that Mara River Basin is an important ecosystem for many goods and services from which local communities are highly dependent for their socio-economic basic needs. It has been revealed that natural resources are limited to accommodate all needs of the rapid growing population in the basin. Scarcity of resources forces local communities to compete for resources uses resulting into conflicts. The underlying causes of such conflicts were found to be basically due to socio-economic factors such as sex, education level, duration of residence, land allocated for crop, average distance from resource base to homesteads, and household size which all showed interactions but only household size and duration of residence were the only factors statistically significant to bring the impact on resources use conflicts. Institutional factors caused conflicts included disincentives, existence of weak by-laws, inadequate in land tenure arrangements and poor participation of local communities in the management of natural resources programmes. The study found out that implications brought out by natural resources use conflicts have led to loss of livelihoods of local communities which resulted into low income, food insecurity, loss of human life and poor health services. Ecologically, resources use conflicts resulted into land cover degradation and increased land uses especially for pastures and settlements between the year 1990 and 2000. The study concluded that the existing natural resource conflicts in the study area were basically due to socio-economic factors where the weak institutions made local communities compete for water and forests resources in the area without being regulated.

5.2 Recommendations

Some of the pertinent recommendations for the study include:

5.2.1 Building up new institutions and strengthening the weak ones

Strengthening of the existing institutions has been identified as means to reduce resources use conflicts and bring about sustainable management of natural resources in the basin. Local institutions should be nested to various levels of governance such as ward level, division, and local government, regional and national levels. This process will enhance legitimacy of the local institutions. It has been found out that in a situation like the one observed in the study area, it is unlikely that one local level natural resource management body can handle all local matters of the natural resource management. It is therefore recommended that various types of institutions be initiated or strengthened to manage different natural resources at different levels with various means of interactions. For example, Water users' group associations could be formed to manage water for different uses; similarly forested areas could be subjected for zonation for different uses whether direct or indirect. This approach could reduce natural resources use conflicts in the area of study.

5.2.2 Carrying out a stakeholder's analysis

Stakeholder analysis (inter and intra) should be carried out before any natural resource management initiative is started so as to identify all-important stakeholders in the use of local resources, their interests and their potential impact on the natural resource base. The analysis can be used to resolve conflicting interests of stakeholders, thereby avoiding potential conflicts that can be detrimental to local natural resources and the community at large.

5.2.3 Enhancement of crop-livestock linkage

Crop-livestock linkage has been one of the key sources of natural resources use conflicts in the study area. This calls for concerted efforts to educate farmers and livestock keepers on crop-livestock linkages so that they may improve their levels of productivity and get away with agricultural extensification into forests thereby resulting into conflicts.

5.2.4 More research work

The results of this study should be used as guide in developing plans for more research work necessary to get findings required for the implications of natural resource use conflicts on the resource base and on livelihoods of the local people in the Mara River Basin.

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APPENDICES

Appendix 1: Logistic regression results

It can be clearly observed from the results in Table 6 that all the independent variables included in the prediction model have non-zero regression coefficients implying existence of relationship between the independent (socio-economic) and the dependent variables (sources of conflicts). Based on these observations (Table 6), the null hypothesis was rejected in favour of the alternative hypothesis at 5% level of significance. Furthermore the general functional form of prediction model can be used to confirm the existence of resource use conflicts as shown below.

$$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 \dots\dots\dots (5)$$

Where: β_0 = Constant = .302, X_1 = Education level, X_2 = Marital status, X_3 = age, X_4 = land size (ha), X_5 = distance from home to the resource base, X_6 = household size, X_7 = duration of residence and X_8 = gender. While $\beta_1 - \beta_8$ are the coefficients of education, marital status, age, land size, distance from home to the resource base, household size, duration of residence, and gender respectively. By substitution method using table 6 values, we have the equation below:

$$Z_i = 0.302 - 0.162 (\text{Education level}) + 0.159 (\text{Marital status}) + 0.037 (\text{Age}) - 0.385 (\text{Land size}) - 0.043 (\text{Distance from home to resource base}) + 0.146 (\text{Household size}) - 0.052 (\text{Duration}) + 0.767 (\text{Gender}) \dots\dots\dots (6)$$

For instance when the above equation 6 is applied to a person who has no formal education (1) and married (1) while age, land size, distance from the home to the resource

base, gender, duration of residence and household size are held constant then the model is presented as:

$$Z_i = 0.302 - 0.162 + 0.159 = 0.299$$

Substituting $Z_i = 0.299$ in equation (7) below, the probability of resource use conflicts can be obtained as follows:

$$\text{Prob (Occurrence of resource use conflicts)} = \text{Prob (Event)} = \frac{(e^{z_i})}{(1 + e^{z_i})} \dots (7)$$

Where:

$$Z_i = 0.299$$

e = natural logarithm equal to 2.718.

$$\begin{aligned} \text{Prob (Occurrence of resource use conflicts)} &= \frac{(2.718^{0.299})}{(1 + 2.718^{0.299})} \\ &= \frac{1.348}{1.481} \\ &= 0.910 \text{ (or 91\%)} \end{aligned}$$

Therefore, the probability of occurrence resource use conflicts due to difference in education and marital status is 91%. This implies that resource use conflicts are likely to occur due to differences in education level and marital status of respondents. According to Pampel (2000) and Pampel (2000) the probability of success or failure of any event to be 0.5 (i.e. 50%) and that event is likely to occur if its probability is greater than 50% and vice versa. In this case, resource use conflicts are likely to occur (91% > 50%) as the number of illiterates and married couples increases in a given community of the study area.

On the other hand, the probability that resource use conflicts are not likely to occur based

on differences in education level and marital status of respondents can be computed using equation 8 below:

$$\begin{aligned}
 \text{The Prob (No occurrence of resource use conflicts)} &= \text{Prob (No event)} \\
 &= 1 - \text{Prob (Event)} \\
 &= 1 - \frac{e^{z_i}}{1 + e^{z_i}} \dots\dots\dots \quad \mathbf{(8)}
 \end{aligned}$$

Through substitution, the probability of no conflicts is (1-Prob (Success)). This gives $1 - 0.910 = 0.09$ or 9%, which implies that occurrence of resource use conflicts can be predicted provided that the education level and marital status of respondents are well understood. The same prediction can be applied to other socio-economic factors on resource use conflicts by using Logistic Regression Model (LRM) as opposed to Ordinary Least Square (OLS) approach.

Appendix 2: List of Medicinal tree species found in Mara River Basin.

S/n	Vernacular Name (L=Luo and K=Kurya)	Common Names	Botanical Name	Disease s Treated
1	Okilo(L) Kihor(K)	Mgunga	<i>Acasis nilotica</i>	Leaves and tender bark chewed to treat sore throat
2	Useembe(L), Omogo(K)	Mgunga	<i>Acacia Senegal</i>	Root is boiled and drunk to treat Amoebic dysentery diarrhoea
3	Ongalwanda(L), Mkilwakilwa(K)	Mturituri	<i>Commiphora mollis</i>	Leaves are boiled and used as steam-bath for fever and colds
4	Oseno(L), Omutununu(K)	Mringaringa	<i>Cordia ovalis</i>	Leaves are boiled and used as steam-bath for treatment of leprosy
5	Odenga(L), Ekekarya(K)	Mpekechu	<i>Garcinia buchananii</i>	Crushed leaves are applied to sores
6	Powo(L), Mkoma(K)	Mkole	<i>Grewia micrantha</i>	Roots are pound soaked in water and drunk to treat Yellow fever
7	Yogo/Yago(L), Umuriba(K)	Mwegea	<i>Kigelia africana</i>	Treat Yellow fever and Increase RBC
8	Obolo(L), Umusarwa(K)	Mtundu	<i>Lannea schweinfurthii</i>	Bark is boiled and used for treating anaemia
9	Obondlochaka(L), Mugutugutu	Mvale	<i>Lonchocarpus eriocalyx</i>	Bark is boiled and used for treating asthma
10	Orange(L), Omumange(K)	Mubambangoma	<i>Pappea capensis</i>	Bark is boiled and drunk to treat stomach-ache and diarrhoea
11	Sangla(L), Omusangura(K)	Mkumba	<i>Rhus natalensis</i>	Fruit is pound, soaked in water and used to treat cough
12	Olemba(L), Urembi(K)	Mtonga	<i>Strychnos innocua</i>	Bark is boiled and drunk by pregnant women to ease childbirth
13	Olemo(L), Omuseka(K)	Mpingi	<i>Ximenia caffra</i>	Roots are boiled and used for treating malaria, STDs, Coughs and worms
14	Chwa(K),	Mkwaju	<i>Tamarindus indica</i>	Bark and leaves are boiled to cure diabetes
15	Oturuban (L)	Mkingu	<i>Albizia lebeck</i>	Leaves are boiled and drunk to treat diabetes
16	Omoku(L), Ngovu(K)	Mkuyu	<i>Ficus sycomorus</i>	Leaves and bark are used to treat snake bites
17	Amoki(L)	Mgunga	<i>Acacia polyacantha</i>	The bark and leaves are boiled to treat heart attach and stomach-ache
18	Munyingamaji (K)	Mpera	<i>Psidium guajava</i>	Leaves are crushed boiled and used for treating yellow fever and improvement of RBC

Appendix 3: Checklist and Questionnaires for Socio-Economic Data Collection.

1.0 A checklist of questions for focused group discussion.

1.1 For District Natural Resources Officials

- Type of natural resource use conflicts.
- The underlying causes of natural resource use conflicts.
- Implications brought in by natural resource use conflicts.
- Incentives and disincentives for people's participation in the natural resource management
- Existing institutions that regulate resource use conflicts management in the study area.
- Views or opinions to resolve the existing natural resource use conflicts and their management.
- Implications brought in by natural resource use conflicts on livelihoods.
- Implications of natural resource use conflicts on Socio-economic activities in the study area.
- Implications of natural resource use conflicts on the resource base (forests and water)

1.2 For Village leaders

- Type of natural resource use conflicts.
- The underlying causes of natural resource use conflicts.
- Implications brought in by natural resource use conflicts.
- Incentives and disincentives for people's participation in the natural resource management
- Existing institutions that regulate resource use conflicts management in the study area.
- Views or opinions to resolve the existing natural resource use conflicts and their management.
- Implications brought in by natural resource use conflicts on livelihoods
- Implications of natural resource use conflicts on Socio-economic activities in the study area.
- Implications of natural resource use conflicts on the resource base (forests and water)

2.0 QUESTIONNAIRE FOR RESPONDENTS FOR NATURAL RESOURCE USE CONFLICTS AND THEIR SOCIO-ECONOMIC AND ECOLOGICAL IMPLICATIONS

Division.....
 Ward.....
 Village.....
 Village registration number.....
 Date of interview.....
 Name of enumerator.....

A. General Information Questions

House hold characteristics:

1. Name of respondent
2. Tribe.....
3. Age.....
4. Sex.....Male 1 Female 2
5. Marital status (circle the appropriate answer)

S/n	Marital status	Code
i	Single	1
ii	Married	2
iii	Divorced	3
iv	Widowed	4

6. Education level (circle the appropriate answer).

S/n	S/n	Education level	Years of schooling	Code
i		No formal education		1
ii		Primary education		2
iii		Secondary education		3
iv		Others (specify)		4

7. Household composition (circle the appropriate answer).

Age(years)	Female	Male	Total	Code
<15				
16-35				
36-45				
46-55				
56-65				
>66				

8. What are the benefits do local communities get from Mara River Basin? (circle the appropriate answer).

S/n	Benefits (Uses)	Code
i	Fishing	1
ii	Cultivation	2
iii	Water for domestic use	3
iv	Livestock feeding	4
v	Lumbering	5
vi	Charcoal making	6
vii	Others (specify)	7

9. What are the major sources of household income? (circle the appropriate answer).

S/n	Sources 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	All of the above	6
vii	Others (specify)	7

B. Natural resource use conflicts.

1.0 Do you experience any resource use conflicts in this area?

1.1 What are the types of natural resource use conflicts in the study area?

.....

2.0 What are the causes of the existing natural resource use conflicts in the area?

.....

3.0 Who make decisions on the use of the available natural resources like water, grazing land, farming land and forests?

S/n	Decision on the use of Natural Resources	Code
i	Individuals	1
ii	Village council	2
iii	District council	3
iv	Others (specify)	4

Forests Resource Use.

4.0 Which benefits do members of your household get from the forest resources?

.....

5.0 Which forest resources do you collect?

Resource	Distance (km) from the resource base							Purpose	Code
	<1	2-3	3-4	4-5	5-6	9-10	>10		
Firewood									1
Building poles									2
Medicinal plants									3
Charcoal making									4
Lumbering									5
Others (specify)									6

6.0 What is the main source of energy do you use in cooking at your house hold?(Circle the appropriate answer and you may circle more than one answers).

Source of energy	Code	Remarks
Fuel wood	1	
Kerosene	2	
Charcoal	3	
Cow dung	4	
Crop residue	5	
Others (specify)	6	

7.0 How long does it take to collect firewood from the nearest forests ((Circle the appropriate answer)

Hours spent on fuelwood collection	Code
0-3	1
3-6	2
6-9	3
9-12	4

8.0 Does the walking distance to collect firewood from the source affect your household meals ?.....Yes

1 No 2

10. Do you think the supply of forest resources in your area is a problem? (Circle the appropriate answer).

Yes 1 No 2

If yes how do you overcome the problem ?.....

Medicinal plants

11.What medicinal tree plants are available in Mara river basin ?.....

.....

12 What diseases are cured?.....

13.What is the production trends of medicinal plants if you compare with 5 years ago?(Tick the appropriate answer)

(i)Constant... ..

(ii)Increasing...

(iii)Decreasing

(iv) I don't know.....

Why are decreasing?

14.If forests get depleted do you think is a problem ? Yes 1 No 2

If it is Yes Why.....

Cultural functions

15. Do you use the available forests for cultural activities? Yes 1 No 2

What cultural functions are performed in these forests?

16. Are you allowed entering into the forests without restriction? Yes 1 No 2

17.Does depletion of forests have affected your cultural functions ? Yes 1 No 2

If yes how ?.....

Rainfall

18 What do you think is the rainfall trends now if compared to the past ten years ?

(i)Constant.....

(ii)Increased.....

(iii)Decreased.....

Is it reliable ? Yes 1 No 2.....

If not how

(a)Are there any other changes in climatic condition noticed? Yes 1 No 2

(b) If it is yes what are they ?.....

Do the changes in rainfall have affected your livelihood ? Yes 1 No 2

If it is yes how it has affected your life ?.....

Water resources

19.What is nature of water do you use?(Tick the appropriate answer)

(i)Stream

(ii)River .

(iii)Spring

(iv).Piped

.....

(v)Others specify

20.Where is the major source of this water?

In the village...

in the forests

Other places

I don't know

21.What is the trend of water supply at present compared to the past?(Tick the appropriate answer)

(i)Constant

(ii)Increased

(iii)Decreased

22. If decreased, what do you think is a problem?

(I)Water source in the forest destroyed

(ii)Siltation from poor farming

(iii)Drought

(iv)Increased diversion

(v)Illegal

taping

(vi)others

(specify)

23. Does water availability reliable year round? Yes 1 No 2

If not why?.....

Does it affect your life ? Yes 1 No 2

What are the problems associated with water inavailability?.....

B. Land use pattern.

Agriculture

1.What is the type of land ownership?

(i) Communal (ii) State (iii) Private (iv) Open access

2. Total land owned by household –acre(s)

Type of crop grown	Hecterage cultivated									
	< 1	1-2	3-4	5-6	7-8	8-9	9-10	10-11	11-12	

3.What is type of land acquisition?

(i) inherited Bought (ii) rented .(iii)

(iv) Village allocation

4.How long have you been in this area ?.....

Do you own enough land for your household needs ? Yes 1 No 2

5 If land is bought, how much do you pay per acre (Tshs).....

6 If land is rented, how much do you pay per acre (Tshs).....

7 How much land do you own for crop production (acre).....

Is the land owned enough for crop production? Yes 1 No 2

If not, why?.....

8.What cropping systems do you use for crop production?

(i) Mixed cropping

(ii)Agro forestry.

(iii)Monoculture

9 What are the main crops grown in your farms

(i) Maize (ii) Cassava (iii) Sorghum

(iv) Millet

(v) Others

10. How was the productivity trends in your farms during the past 5 years?

(i) Constant (ii) Increasing (iii) Decreasing

11. If constant, do you produce enough for home use? Yes 1 No 2

12. Has the productivity decreased? Yes 1 No 2

13. If the productivity has decreased, what do you think is the reason for the decrease?

(i) Soil erosion (ii) Change of weather (iii) Farm size declining

(iv) Other reasons

14. What do you think the cause of poor soils

(i) Continuous cropping (ii) Degradation of soil

(iii) Weathering (iv) Others specify

15. Do you practice shifting cultivation? Yes 1 No 2

16. Do you undertake other economic activities apart from agriculture and livestock production?

Yes 1 No 2

Code	Activity	Priority		
		High	Medium	Low
1	Carpentry			
2	Brick making			
3	Handicraft			
4	Charcoal burning			
5	Lumbering			

17. Do natural resource use conflicts influence decisions with regards to the followings? .

Resource use decisions	Code
(i)Expansion of farm holding	1
(ii)Improving of farming systems	2
(iii)Limit diversification of enterprises	3
(iv)Favour improvement, diversification and expansion of enterprises	4

18 Does the in-migration of other ethnic groups affects the farm/land holdings you previously had traditionally owned.? Yes 1 No 2

If yes in no.18 above, how do you handle the situation?.....

19. What are the reasons for the existing land scarcity?.....

20. What do you do to solve problems of land scarcity if migrated from other areas?

.....

Livestock

21. Do you keep livestock? Yes 1 No 2

22. What type and number of livestock do you herd?

Cattle	Goats	Sheep	Donkeys
1	2	3	4

For what purpose do you keep them?

S/N	Purpose of livestock	code
1	Source of income	1
2	Source of food	2
3	Dowry	3
4	Prestige	4
5	All above	5

23. How do you use pasture/grazing land?

Type of ownership	Code
Common	1
Private	2
Both	3

If commonly used is it enough for the size of livestock you have currently? Yes 1 No 2

24. Where there any trees in the grazing land in the past years? Yes 1 No 2

25 Currently, are there any trees in the grazing land compared to the past period? Yes 1 No 2

26 Do you face any problems in livestock production? Yes 1 No 2

If it is yes what are the problems ?.....

How do you solve the problems mentioned above ?.....

Local people's views to resolve natural resource use conflicts.

1.0 What is the present state of forests and water in the basin ?

Natural resources	Status	Code
Forests	Good	1
	Bad	2
	Same	3
	Don't know	4
Water	Good	1
	Bad	2
	Same	3
	Don't know	4

If it is bad , what are the destructive agents ?.....

3.0 What is your opinion about the present management system of the natural resource base in Mara river basin?

Opinion on management system	Code
Good	
Bad	
Same	
Don't know	

Why do you think so?.....

4.0 Do you have an access to incentives (Support from any institutions) required for the sustainable management of natural resources use in the Mara river basin? Yes 1 No 2

If yes what are the incentives (support given) ?.....

I

5.0. What are your views on the conservation programmes (both local and International ones) to work in your village is it good? Yes 1 No 2

If no why?

D. Information on local Institutions for Regulation of Resource use and Conflicts

Management

1.0 Are there any local Institutions (committees) for regulating resource use in the village?

Yes 1 No 2

2.0 If yes, how do these Institutions regulate the natural resource uses in the area?

.....

3.0 Do the new policies (Land, Forests and Water) with regard to sustainable management of natural resources have they been circulated to your institutions? Yes 1 No 2

If not why?.....

4.0 What do you think should be done in order that the conservation of natural resources in the Mara River Basin become successful?.....

Appendix 4: Implications of natural resources use conflicts on Land cover/Land use and on livelihoods in Mara River Basin.

Types of Conflicts.	Implications on livelihoods	Implication on Land Cover	Implication on Land use
Livestock keepers versus Cultivators	. Food insecurity . Low income and Human loss	Degraded land cover	. Increased areas for pastures and settlements . Reduced land for crop production
Users (livestock keepers and cultivators) versus Water authorities	. Scarcity of water . Food insecurity . Increased siltation . Break up of diseases.	Degraded water catchments.	Inland water areas reduced.
Users (livestock keepers and cultivators) versus Forest authorities	. Food insecurity . Destroyed water catchments. . Depleted medicinal and cultural plants	Degraded forests.	. Increased areas for pastures and settlements . Reduced water sources . Reduced cultivated land.
Wildlife versus Local communities	. Low income . Low income . Food insecurity . Loss of human life . Water scarcity	Destruction of catchment forests.	Reduced in land water sources.