THE ECONOMIC IMPACTS OF MANGROVE MANAGEMENT PROJECT IN TANGA, TANZANIA

BY

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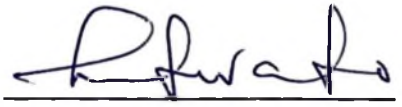
ABSTRACT

This study whose aim was to assess the economic impact of the Mangrove management project in Tanga Tanzania was based on questionnaire survey to households head, informal survey and secondary data. Data were collected from a random sample of 104 household heads. PRA, questionnaire survey and checklist was the main tools used in collection of socio-economic data. Data from household survey were analyzed using Statistical Package for Social Science (SPSS). Cross tabulations were performed to establish significant relationships between villages responses. Content analysis was also used for qualitative data. The result of the study demonstrste the importance of the mangrove ecosystem resources to the livelihood of the local communities. About 40% of people interviewed depend on fisheries as main source of income and fisheries contributes about 48% of the total family income in the study area. Out of 104 respondents about 84% of them indicated that there is a direct relationship between the restoration of the mangrove and increase in fish catch. A total of 1500ha of degraded mangrove area have been restored through replanting while about 80 ha of farmland have been planted with non-mangrove poles and fuelwood trees species. About 68% of the residential houses in the study area were constructed using mangrove poles. Evidence indicates that mangroves poles will continue to be the main construction material due to the prevailing economic hardship in the study area. Majority of the respondents (82%) indicated increased demand in quantity and quality of mangrove poles. Using Net Present Value (NPV) as a criterion the project was found to be economically efficient at a rate of discount of 10% for a 20 years time horizon. The net present value was about TAS 618.7 millions at the discount rate of 10% for a 20 years time horizon but

dropped by 76.5% when the discount rate was increased to 20%. The internal rate of return was about 33%. Sensitivity analysis indicated that the projects NPV would fall to zero if the project benefit were reduced by 54.3%.

DECLARATION

I, ZAWADI DAUDI MBWAMBO, do hereby declare to the SENATE of Sokoine University of Agriculture that this dissertation is my own original work and has never been submitted nor concurrently being submitted for any degree award in any other University.



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Supervisor

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DEDICATION

This thesis is dedicated to my Mother Leah Luita and my brother Elly Mbwambo who devoted much of moral support and financial resources to pay for my basic education.

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LIST OF ABBREVIATIONS AND SYMBOLS

CBFM	Community Based Forest Management
CBNRM	Community Based Natural Resources Managements
CBA	Cost Benefit Analysis
FBD	Forest and Beekeeping Division
JFM	Joint Forest Management
MMP	Mangrove Management Project
MNRT	Ministry of Natural Resources and Tourism
MNRP	Management of Natural Resources Programme
NGOs	Non-Government Organizations
PRA	Participatory Rural Appraisal
SPSS	Statistical Package for Social Science
SUA	Sokoine University of Agriculture
SEEGAAD	Smallholder Empowerment Economic Growth through Agriculture and Association Development
SEMMA	Sustainable Environmental Management through Mariculture Activities
TCMP	Tanzania Coastal Management Partnership
TCZDP	Tanga Coastal Zone Development Programme
TAS	Tanzania Shillings
URT	United Republic of Tanzania
VNRC	Village Natural Resources Committee

CHAPTER ONE

INTRODUCTION

1.1 Background

Tanzania has about 33.5 million hectares of forests and woodlands out of this total area, 13 million hectares are gazetted forest reserves of which 115 000 hectare are in mangrove forest reserve (MNRT, 2002). Millions of people depend on forest resources of which their contribution to their livelihoods can come in different guises (Dubois, 2002). For example, forest support two-third of world's population for wood fuels (CIFOR, 2003). The forest-population relationships have recently been estimated that one-quarter of the worlds poor depend directly or indirectly on forests for their livelihood (CIFOR, 2003).

Mangroves are well known for their high biological productivity and their consequent importance to the nutrient budget of adjacent coastal waters. Thus, they support local and commercial fisheries (Bann, 2003; FAO, 1994; Christensen, 1983). Apart from nutrient export, mangroves also contribute to offshore fisheries by acting as nurseries and shelters for many species of commercially important finfish and crustaceans. Furthermore, mangroves act as a natural barrier to shoreline erosion, and in fact stabilize fine sediments and provide protection against destructive forces such as strong waves, typhoon, and cyclones (Bann, 2003; FAO, 1994; Christensen, 1983).

Despite the many benefits provided by mangroves, they are under intense pressure from competing resource uses, in particular, the cutting of mangroves for

establishment of salty solar evaporation ponds, agriculture, aquaculture and urban development. Sixty percent of the world populations reside along the coastal habitat; consequently alteration of such habitat can have devastating environmental and social effects (Holman, 2002). Recently however, society has begun to appreciate the benefits of mangroves and there is a growing awareness of their values.

On an international level, convention to protect Wetlands of International Importance was developed in Ramsar, Iran in 1971. Since this convention, 100 countries have signed on to protecting certain mangrove and wetland areas, resulting in approximately 830 Ramsar sites (53 million hectares). One third of these wetland areas contain mangroves Ramsar site (Holman, 2002). Rufiji and Kilwa mangrove in Tanzania is among Ramsar site. There are also increasing efforts by governments, NGOs and local communities around the world to conserve, rehabilitate and manage mangrove sustainably (World Bank, 2005a).

According to URT, (2002) the population growth in Tanzania is around 2.9 percent per year and the population size is now 34.6 million. Present trends in population growth and unplanned activities have lead to deterioration and degradation of many forested areas including the mangrove forest reserves. The current rate of deforestation in Tanzania is said to be 91, 200 ha per annum (URT, 2001. For many decades, Tanzania's forest resources had been controlled by the state with management policies being characterized by centralized decision-making process. This classical management system did not lead to proper protection as illegal harvesting continued in the forest reserve and in general lands (Luoga *et al.*, 2005).

1.2 Problem statement and justification for study

Mangroves ecosystem form a rich and diversified ecosystem on which coastal dwellers have depended for decades (Kumar, 2000). It is estimated that approximately eight million Tanzanian live in the coastal areas where livelihood of the majority are closely tied to marine and marine related resources (TCMP, 2001). However throughout the world, livelihood opportunities for people living along the coastline are changing; coastal areas are experiencing rapid expanding population putting ever increasing pressure on limited resources which in some area have led to very serious resource degradation. To attain sustainability there must be a balance between existing resources and the surrounding communities needs, which is only possible when the resources meet the needs of the people without it being degraded. Therefore there is a need to balance between conservation, livelihood needs and development (Havnevik, 2001).

Lipper (2000) and Bryceson *et al.* (2004) found that there is a clear relationship between rural poverty and loss of forest cover and biodiversity in developing countries. Strategies and methods for environment conservation must therefore promote programme that combine environmental improvement with alleviation of poverty through income and job creation (FAO, 2002).

Reduction in government spending has decreased agriculture support in terms of extension services and subsides on farm inputs. The increase in prices of input factors relative to output has raised cost of farm inputs, cost of living in general and decreased disposable income for most rural dwellers, forcing some of them into extensive forest products exploitation and trade for cash income (Monela *et al.*,

2000). Luoga *et al.* (2000) reported that one way to build capacity for managing natural resource is to improve farm productivity and help people to engage in alternative income generating activities. Household budget survey of 1991/92 and 2001/01 showed that the number of Tanzanian who cannot meet basic needs decreased from 38.9 percent in 1991/92 to 35.4 percent in 2000/01(URT, 2006). Despite the slight decline in poverty in rural household its impact on reducing national poverty rates was significant. This implies that acceleration in national poverty reduction could quickly be achieved if more effort will be directed to rural areas (URT, 2006).

Projects are principal means governmental and non-governmental organizations use to encourage and shape development (Gregersen & Contreras, 1992). Grundy (1985) define a development project as "any Scheme for investing resources which can be evaluated as an independent unit". In forestry, a project can be framed to bring in all aspect of forestry development including programs, which produce goods, and service, which are not sold. From this definition, a range of project may be undertaken in forest and those vary widely in nature, scope and size, from small plantation to large integrated forestry and forestry industry complexes (Watt, 1973).

With deepening of poverty particularly in the rural areas and the lack of productivity enhancement in agriculture many donors including Norwegian Government decided to widen their engagement in the rural areas to include programme and projects related to environmental protection, sustainable management of natural resources and rural developments for the past three decades. This response by donors was based on

the acknowledgement that rural productions were increasingly becoming dependent upon non farm income especially the use of natural resources (Bryceson *et al.*, 2004).

Mangrove management project is an example of such projects and was initiated to ensure that mangrove forest is appropriately managed and the resources sustainably contribute to the livelihood of the surrounding communities. The project was funded by Norwegian government under the Tanzania and Norway Sector Agreement designated as TAN-092 with the NORAD system under the programme known as the Management of Natural Resources Programme (MNRP). The Government of Tanzania and the Government of the Kingdom of Norway through its International development agency NORAD have spent millions of money in funding mangrove conservation activities in the period of eleven years (1994/05 to 2005/06). Ecological studies have shown that the forest formally degraded due to human disturbance have actively regenerated due to effective protection and rehabilitation effort of the mangrove management project (Luoga *et al.*, 2004; TCMP, 2001). However, very little is known on the economic impacts of these financial supports. Against this background it was therefore necessary to conduct economic impact analysis in order to quantify costs and benefits associated with various conservation activities and recommend how the existing livelihood options can be utilized to reduce income poverty of the surrounding community.

1.3 Objectives

1.3.1 Overall Objective

To assess the economic impact of the mangrove management projects in the three coastal districts of Tanga, Mheza and Pangani.

a) To examine projects activities and assess how they have contributed to improvement in natural resources and community's livelihood,

b) To examine the impacts of the project on the role of the local community in mangrove ecosystem management,

c) To carry out project cost –benefit analysis to determining whether project benefits justify the use funds which are scarce resources.

1.3.2 Research questions

a) What were the main objectives of the project and what activities were conducted to address the main objectives?

b) What was the role of the communities in mangrove ecosystem management before, during and after the project and what are their benefits?

c) To what extent mangrove ecosystem contributes to community's livelihood and how was it influenced by the project?

d) Which community's livelihood alternatives activities are directly results of the project activities and how much are they contributing?

Hypothesis:

H_0 = The Mangrove management project activities have no significant economic impact on coastal community's livelihood.

1.3.3 Conceptual Framework

Conceptual framework provides guideline towards realistic collection of data and information. Fig.1: presents the conceptual framework underlying this study. It provides the general picture of the linkages between the conservation of the mangrove and improvement in life support function of the mangrove ecosystem. The framework further hypotheses that the increase in household income will be a motivation for local communities to further participate in environmental protection. The figure demonstrates that improvements in the mangrove resource increase the capacity of the ecosystem to produce direct and indirect benefits which when well shared with communities they will they will improve rural livelihoods and contribute to sustainable management through local participation.

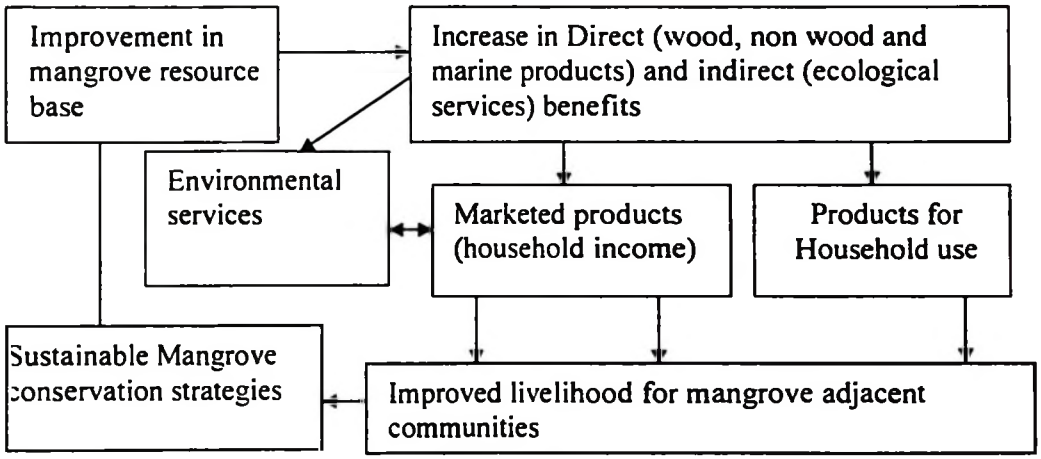


Fig 1: Conceptual Framework correlating Conservation and Livelihoods.

Sources: Adopted from mangrove management project proposal

CHAPTER TWO

LITERATURE REVIEW

2.1 Values of the Mangrove ecosystem

To the economist, *scarcity* is what imparts value to a good or service. Where a market for the good or service exists, its scarcity is measured by its price (Bann, 1998). Therefore the simplest ways of assessing the value of a product is to look at how much people pay to buy or sale it –its market price. However for the case of most environmental goods and services, including those from forests, there are no direct market prices to act as the basis for valuation (Emerton, 1996), although it is appreciated that economics is an important tools for environmental management and conservation and valuation forms a key part of environment economics.

Valuing mangrove resources essentially means valuing the characteristics of a system. The direct use value of mangrove resources and services are relatively straight forward to measure, usually involving the market value of production gains. The direct use value of environmental function is related to the change in the value of production or consumption of the activity or property that is protecting or supporting (Bann, 2003). However as this contribution is typically not marketed and is only indirectly related to economic activities, the first steps is to decide whether the service support economic productivity or is protecting economic activities and property. Where economic productivity is being supported , the value of this function can be measured through change in productivity in other words the value of productivity gained (or lost) of the marketed goods and services as a result of environmental improvement (degradation) (Bann, 2003). Where economic activities

are being protected, the value can be expressed in terms of preventive expenditure that would be required if the function were degraded or irrevocably disrupted (Campbell and Luckert, 2002).

Mangroves provide nursery and shelter for important marine stocks while decomposed litter fall supply a considerable amount of nutrients that can be used directly by fish and other aquatic species (Castro and Huber, 2005). Over 60% of commercially important marine species are known to live in mangroves or depend on mangroves foods webs at some stages in their life (Shumway, 1999). Hogarth(1999) report that there is a statistically significant linear relationships between mangrove and fish. In Malaysia, for instance, the annual shrimps catch(C) in thousands of tones, was related to mangrove areas (A) in thousand of hectares, by the regression formula $C= 0.6368 + 0.5682A$.

Much of what has been said about the relationship between shrimps and mangroves applies equally to that between fish and mangroves (Hogarth, 1999). In Sumatra, the linkage between fisheries productivity and the size of mangrove area is so strong and obvious that local fishermen have voluntarily replanted mangroves in places where they have been depleted, in an attempt to re-establish fishery productivity which has been lost (Bann, 1998). Different estimates of the value of fish productivity supported by the mangroves are available in the literature. Rönnbäck *et al.* (2002) reported that in developing country annual market value of fisheries supported by mangrove range from USD 90- USD1240 ha^{-1}mangrove per year with USD 340ha^{-1} as a mean. Other researchers have reported different values of fisheries supported by

the mangroves. For example Costanza *et al* (1997) In Horgath (1999) and FAO, (1979) In Christensen (1983) have reported the value to be USD 466ha^{-1} and USD 130 ha^{-1} respectively. Giesen *et al.* (1991) calculated a net value of USD 600 per hectare per year. A study conducted in the United States by Costanza *et al.* (1989) established an estimated annual economic value of coastal mangrove productivity for commercial fish harvests at USD 62.66 per hectare. The above facts illustrate the potential life support value of the mangroves. Table 1 shows some of the estimated values of the mangrove ecosystem.

Table1: Estimated average value of ecosystem services for mangrove and salt marsh combined.

Goods/Services	Examples	Value US$ ha^{-1}year^{-1}
Disturbance Regulation	Protection against coastal erosion, typhoons	1839
Water treatment	Assimilation of effluent from ponds and sewage	6696
Habitat/ refuge	Nursery for shrimps and habitat for Birds	169
Food production	Energy sources for local fisheries	466
Raw materials	Timber, charcoal	162
Recreation	Ecotourism	658
Total		9990

Source: Costanza *et al.* (1997)

A fundamental function of all forests has been to supply timber for various uses and mangrove forests are no exception (FAO, 1982). Traditionally, people have used mangroves for the benefit of the local community, but increasing populations have led to an increasing non-sustainable abuse of the resources. Many of the coastal people depend to a great extent on mangrove forest to meet their needs for timber and non timber forest products (Kajembe *et al.*, 2000). According to Semesi (1991) it

is possible to sustainably remove 300 poles/ha of class I-II; 400 poles /ha of III- IV and $10m^3$ of firewood per hectare through selective harvested from the designated mangrove productive zone annually. Over harvesting for construction poles and conversion of mangrove forest to other land use affect the ecological function of the mangrove ecosystem. When an important habitat for plants and animals is lost many species may disappeared from an area, either through extinction or out migration (Govindasamy *et al.*, 1997). This may lead to a reduction in the number of species or number of individuals. Inevitably most people living in or associated with mangroves suffer economic losses once this ecosystem is disturbed or eliminated.

The current Mangrove management plan recognizes the importance of the mangrove forest as both productive and protective forest by categorizing the forest into four utilization zones. The four zones include protection zone, productive zone, restoration zone and development zones (Semesi, 1991). Development zone permit conversion of mangrove forest into other uses of land such as solar evaporation ponds and aquaculture ponds. According to (Sjaastad *et al.*, 2003) conversion of the forest to other land uses which is permitted in zone four is efficient only when the discounted net gain from such conversion and alternative use exceed aggregate net benefits from sustainable extraction and environmental services. Generally one can assume that an increase in the level of extraction will come at the expenses of the environmental services and vice versa. The marginal cost of increased extraction will therefore appear as loss of environmental services. At some stage one therefore reaches a level of socially optimal extraction where marginal cost and benefit are

equal. Increasing extraction beyond this point will entail greater cost (Sjaastad *at al.*, 2003).

According to FAO, (1994) about 25% of the annual total honey production in Cuba (Some 8000-10000t) is derived from the mangroves. Hernández *et al.* (2001) report that in Cuba every year between May and July up to 45 000 beehives are placed under mangrove trees. The current honey and beeswax production in Tanzania are estimated to be 4,860 tones and 324 tones per year, respectively, which is about 3.5% only of the production potential(URT, 1998b). Beekeeping offer great potential for development and is comparatively less demanding in terms of investments, labour and time (Apiconsult, 2003). Beekeeping in the mangroves has greater potential to improve livelihood of local communities living adjacent to mangroves.

Mangrove forest provides protection against weather damage to productive activities located in or just behind mangrove ecosystems and to assets such as housing and infrastructure located inland (Spaninks and van Beukering, 1997). Ecologically mangroves play a significant role in coastal stabilization and promoting land accretion, fixation of mud banks, dissipation of winds, tidal and wave energy. Fringe mangrove may contribute little productivity hence may not be of much significance as a source of wood or in contribution to fisheries, but they are often of great importance in coastal protection (Hogarth, 1999).

The Indian Ocean tsunami disaster of December 2004 highlighted the folly of destroying coastal habitats, whether they are coral reefs and or mangroves (Tundi,

2006). When the tsunami struck India's southern states, areas with dense mangroves suffered fewer human casualties and less damage to property compared to areas without mangroves (Barbier, 2006; Padma, 2004). Devinder (2005) report that while shrimp farming, which is the main cause of mangrove destruction, is now a $9 billion industry in Asia, one massive wave of destruction caused by tsunami in 11 Asian countries has exacted a cost immeasurably greater than the economic gain that the shrimp industry claims to have created. Beach erosion has also affected several areas along the Tanzania coast causing significant social economic and ecological impacts (Mhando *et al.*, 2001). Plate 1 shows different scenario of a riverbank demonstrating effects of human activities (b) showing the condition when mangrove were cut.

(a) **(b)**

Plate 1 Role of mangroves in Riverbank (Photo by Z. Mbwambo 2005).

Peri-urban coastal areas of many developing world receive extensive amounts of untreated sewage, which is typically discharged into creeks lined by mangrove forests. Mangroves in all probability filter this discharged wastewater, thereby limiting coastal sewage pollution. Although no monetary data is currently available

in the country on the value of the mangrove as wastewater purifier data from Fiji show that this value can be as high as USD5820 ha^{-1} (Hogarth, 1999).

Mangroves ecosystem can provide ecotourist with unique habitat and biodiversity opportunity with many potential activities, including recreational fishing, bird watching, viewing wildlife and scenic boat trips (World Bank, 2005a). Browsing the Internet, one is overwhelmed by websites that mention mangroves as potentially viable as ecotourism destinations. As pointed out by Ayoub, (2006) one just need to type "mangrove ecotourism" in any Internet search engines and the information displayed is enormous. In Tanzania mangrove ecotourism is not well developed but where efforts have been made to develop, it has attracted many tourists like the one in Jozan in Zanzibar.

2.2 Socio-economic parameters likely to affect forest resource management

Education

Education is an important ingredient for sustainable natural resources management. One of the most important approaches in improving involvement of local communities in conservation is capacity building, which is achieved through formal and informal training (Mallik, 2000; Hogarth, 1999). Education tends to stimulate self- confidence and self-reliance and therefore there may not be development without education (Mahinya, 2005). For example Hogarth (1999) argued that future of the mangroves must not depend only on isolating the remaining forest from human influences but on properly regulated interaction with human demands and effective management which is only possible if stake holders are properly educated.

Household economy

Over-exploitation of mangrove by traditional users is closely linked to the general problem of rapidly expanding population and decrease in economic standard (Mainoya, 1986). According to Amalu, (2005) in 1993 Word Bank estimated that 40% of the people live on less than one USD per day and that at least 59% of the poor live in five East African countries and Nigeria. Tanzania is among the poorest countries in the world (UNEP, 2001). The per capita income of a Tanzanian was estimated to be at about USD 282, which was about TAS 26000 per month (World Bank, 2004). This was an estimate of TAS 867 per person per day, which was also less than one US dollar per day. These poor economic situations are likely to increase hardship in the livelihood systems of the people and bound to pose more pressure on natural resources and ultimate loss of ecosystem integrity. Evidence from Africa has shown that rural poverty contexts imply a strong pressure on natural resources in the sense that rural people increasingly rely on "environmental products" i.e. products and commodities that in essence are based on production by nature itself (Bryceson, 2004).

Family size

Family size is an important variable in determining sustainability of the natural resources in an ecosystem. The baseline survey conducted in Malagarasi-Moyowosi Ramsar site by IRA, (2002) pointed out that there is a strong relationship between household size and environmental degradation. Large household tend to over-exploit their resource in order to meet their need while also undermining their very resource of livelihood (Mahinya, 2005).

Land use/tenure

Land use and related rights play a crucial role in determining the use and sustainable management of land resources, since they specify access to the land , resources on it and the rights of using them (Eboh, 2000). Proper land use has a significant bearing on use and management of natural resources as it may prevent clearing of new land most of them consist of good forest, which may be on unreserved, or some time cause encroachment of forest reserve. Kaoneka and Monela (2000) found that most of the observed forest degradation is due to government failure to enforce property rights in its forest.

2.3 Historical Perspectives

Records indicate that along with slave and ivory mangrove made a major regional trade by the 9th century between east Africa and treeless towns of southeastern Arabia and Persian Gulf. Due to its importance the German administration established the first forest ordinance dealing with mangrove of Rufiji in 1898 (Semesi, 1991). After the end of German colonial era the British expanded the mangrove reserve to cover the entire coastline. After independence the then Tanganyika government maintained the reserve and managed them as the central government forest reserve.

For many decades, Tanzania's forest resources had been controlled by the state with management policies being characterized by centralized decision-making process. This classical management system did not lead to proper protection as illegal harvesting continued in the forest reserve and in general lands (Luoga *et al.*, 2005).

Natural resources management was basically based on sectoral interest; this conventional management was viable and appropriate when the resources base could support unrestricted exploitation. But as population and economic activity increases and natural resources become scarce, the existing sectoral management was no longer effective to resolve the mounting problems related to resources use conflict and increasing erosion of the resource base (Chua, 1995). Most of the forests in Tanzania are highly degraded as a result of poor control, shortage of manpower, corruption and financial constraints (Kajembe and Kessy, 2000). Biological resources have the important character of being renewable, however when the level of human use exceed their capacity for renewal the diversity and productivity of the system, which they occur, may be reduced (Luoga *et al.*, 2002).

Tanzania went through political change in which different forest management institutions emerged, either by design or as necessity (Bakari, 2005). Experience in India revealed that moves towards decentralization can be explained as the experience-induced outcome of failed centralized management over natural resources and evidence of worsening poverty–environment linkages (Baumann and Farrington, 2003). Kajembe and Kessy (2000) outlined a number of reasons that have engineered this shift to be; the failure of the states agencies to manage effectively protected areas; the potential for cost effective in managing the forests; the relevance of local knowledge of ecological dynamics to proper management; the increased motivation for local communities to conserve forests following recognition of their critical role in the management of the local forest. As Chua (1995) argued a wealth of knowledge and wisdom exists among the local communities with respect to the functioning of

the natural ecosystem and sustainable use of the resources therein. Through their long association with nature the fisher for example know the productive cycle of key fish species, tidal rhythm, the importance of mangrove and coral reefs to fish and shoreline protection.

In the past much attention in forest management focused on increasing power and responsibility to government (WRM, 2002). According to Kaoneka and Monela, (2000) the biggest constraint was the failure of the government to enforce property rights in its forest and hence indirectly allowing people to use forest under open access regime. This situation called for shift from state based management to community based and joint management partnership (Kajembe and Nduwamungu, 2004). Tanzania government responded to this by reformulating forest policy in 1998 and forest Act in 2002. Participatory forest management, decentralization and privatization are among the salient features of the new forest policy (Ngaga, 2004).

The current Tanzania forest policy recognises explicitly the role of the government, private individuals and local communities as stakeholders in forest conservation. PFM is policy arrangement fundamentally based on devolution of responsibilities, rights and authority from the state to local communities and bodies designated for forest management (Mallik, 2000). The government of Tanzania through various donor including World Bank, NORAD, FINIDA and DANIDA have been supporting PFM activities in various part of the country. However the study conducted by Ngaga *et al.* (2003) revealed that the capacity of local government to implement the

new forest policy and new forest Act is very low in terms of human and financial resources.

Despite the enabling policy for PFM implementation a gap is still exist between practice at the resources users' level and implementation of forest policy (Bakari, 2005). So far there is still a poor understanding of whether and when a community has any incentive to take on responsibility for PFM (Wily and Dewees, 2001). Benefit resulting from PFM can be direct or indirect, in a number of cases, the indirect benefit can eventually be as important as the direct one, but it is often very difficult to demonstrate this to poor communities especially if they are highly dependent on the forest resources and don't have alternative income and livelihood support (MNRT, 2003).

Since 1980s conservation organizations have been implementing approaches that aim at building support among local communities by sharing social and economic benefits from protected areas (Schel *et al.*, 2004). Successful implementation of these approaches depends on government commitment and requires time and resources to (World Bank, 2005b). Transition from centralized forest resource management to Participatory Forest Management (PFM) can be measured by the local level control over socio-economic benefits and revenue flows from natural resources (Alcorn *et al.*, 2002). Nonetheless, it appears that more incentives are needed to persuade local communities from degrading the co-managed forest reserves (Kajembe *et al.*, 2004). However, a crucial lesson gained in most of the project facilitating participatory forest management in Tanzania including mangrove project is that Alternative

Income Generating Activities (AIGA) is an essential accompaniment to many PFM activities (MNRT, 2003).

A livelihood comprises the capabilities, assets and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stress and shocks and maintaining or enhancing its capabilities and assets both now and in the future, while not undermining the natural resource base (Gottret and White, 2001). Valkila (2004) pointed out that poor rural people often rely on a number of different economic activities for their livelihoods and it is the combined effect of these activities that matters for the household economy. Monela *et al.*(2000) identified some of the activities conducted by local people as a means of livelihood for people living adjacent to forest reserve to include agriculture, livestock keeping, forest product collection, beekeeping, fishing and petty business. A Framework for livelihoods analysis by Ellis, (2000) consists of assets that their access is modified by social relations and institutions that all together results into livelihood strategies that encourage participation of local communities in development initiatives such as JFM. Rural livelihoods have three broad options to be improved including natural resources, non-natural resource based activities and migration to other agricultural areas or urban areas (Ellis, 1998).

Majority of Tanzanian living in the rural areas are so poor that they cannot afford an income that can take them even through 24 hours (MNRT, 2003). Barrow *et al.* (2000) argue that poverty is a social problem that discourages conservation efforts. Luoga *et al.* (2000) reported that one way to build capacity for managing natural

resource is to improve farm productivity and help people to engage in alternative income generating activities. IUCN (2003) in Ireland (2004) states "it is unacceptable to carry out conservation activities in areas of high or endemic poverty while turning a blind eye to the needs of the poor people who live there and depend on the same biological resources that are often those that we wish to conserve". Many Conservation organizations supporting protected area in Tanzania, such as WWF and IUCN, are trying to address poverty in their conservation programs as a necessity to ensure successful implementation of conservation programs (Ireland, 2004).

Recognizing that local economies depend intimately on the availability and quality of natural resources, conservation has became an increasingly important component of the rural development activities. For example World Bank (2005a) argue that in order to save the mangroves, it is important to identify and support sustainable alternatives livelihood options for local communities dependent on the mangrove. Where there may be no alternative forest product activities for many, new alternatives which a quite likely to be outside the forest products need to be developed to help people to move out of the forest product activities of declining importance (Warmer 2000). However People perceive that inability to access capital are the most serious constraints to initiating alternative income generating activities (Kisanga, 2005). Accessibility to credit play crucial role in improving livelihood of a poor household by enabling them to fulfills the social as well as economic roles in the society (Mroso, 2006).

2.4 Project evaluation

Projects are principal means governmental and non-governmental organizations use to encourage and shape development (Gregersen & Contreras, 1992). Grundy (1985) define a development project as "any Scheme for investing resources which can be evaluated as an independent unit". In forestry a project can be framed to bring in all aspect of forestry development including programs, which produce goods, and service, which are not sold. From this definition, a range of project may be undertaken in forest and those vary widely in nature, scope and size (Watt. 1973). Major values of forest lies in goods and services it supplies to surrounding populations. Maintaining and improving these values provides an important justification for forest conserving projects such as mangrove conservation project. Timber production was the initial motivation for early mangrove reforestation projects around the world but more recently, benefits from protection against erosion and extreme weather events and direct improvements in livelihoods and food security are perceived as justifications for such restoration efforts (Walton *et al.*, 2006).

According to Sanchez, (2006) an economic analysis is needed to quantify costs and benefits associated with various conservation activities and provide some insight of who benefits, who pays the costs, what sort of costs and to provide some indicators of how benefits from natural resource use might be maximized and the rational management of the natural resources secured. The essence of resource economics hinges on the fact that resources are normally limited while needs for such resources are insatiable. Resources allocation therefore should favor investments which yield maximum net benefits as guided by economic criteria (Kessy *et al.*, 1993). In

practice for a project to be worth of support it must offer a flow of future benefits to those involved or affected which are in excess of the cost (Nautayal, 1988). The purpose of evaluating or appraising project is to ascertain that these projects are viable or are sufficiently attractive to be financed. Economic impact assessments examine the socio-economic and financial impacts of an activity, set of activities, or set of changes in a particular situation. During the project life cycle, three evaluation phases are often identified namely ex ante evaluation or project appraisal, interim evaluation and ex post evaluation (Gregersen & Contreras, 1992). Ex ante prospective financier often accomplished before the project is undertaken does evaluation. On the other hand interim and ex-post evaluation applies to independent projects and the aim is to get information on plans realized, feedback from the work and lesson for future project and to determine whether the project is a failure or success.

There are several methods of project evaluation, Cost –Benefit Analysis (CBA) and Cost Effectiveness Analysis (CEA) being the mostly used methods (Gregersen & Contreras, 1992). CBA is a decision tool, which judges projects according to a comparison between their costs (disadvantages) and benefits (advantages). CBA requires determination of the likelihood that a project contributes significantly to the development of the whole economy and that its contribution is enough to justify using scarce resources of the economy. Scarcity of the resources is one of the most basic concepts of economics; the scarcity necessitates trade- off and the trade of result in opportunity cost (NetMBA, 2005). When economists refer to the opportunity cost of a resource they mean the next highest valued alternative use of

resources (Henderson, 2006). This is because resources that go into a project have alternative uses. If they were not used up in a particular project they could be used for other purposes, some of which would have a positive rate of return (Bann, 1998). The applications of CBA in evaluating projects have been most numerous in developing countries. In Tanzania for example, Kessy *et al.* (1993) applied CBA technique to evaluate the integrated agroforestry project in Legho Mulo, similarly Ngate (2001) used the technique in evaluating forestry resource management Project in Mwanza to mention only a few.

CBA draws a distinction between financial values and economic values. Financial analysis is usually the first step in assessing the monetary costs and benefits of projects or management options. A financial analysis is taken from the perspective of private investors who are typically interested in the actual money costs and returns on their projects. An economic analysis goes beyond a financial analysis to perceive a project's economic costs and benefits on the welfare of society. It examines all of a project's impacts, including its environmental consequences. Economic analysis measures the effect on efficiency objectives in relation to the whole economy. In this instead of using financial prices shadow price are used which reflect opportunity cost, including valuation of externalities when ever practical (Munasinghe, 1992).

In a distorted economy shadow price more accurately reflect the value of factor of production considered in evaluation. It suggests prices that will more accurately reflect the value of factors of production considered in evaluation. Two main approaches are used in determining the shadow price for the shadow prices for

difference components in the analysis. These include the use of revealed preferences and the market prices for the communities in question. According to Dixon and Hufschmidt (1986) the revealed preferences approach assume that the value people placed on commodities such as fuel or fodder which are sometimes collected as a "free goods "must at least equal their cost in collecting these communities include travel time. Therefore the traveling time and time used in collecting it is valued at its opportunity cost in term of the foregone labour. In determining shadow price of employment the approach presented by UNIDO (1972) and Solberg (1988) provide an option. According to this approach, employment is categorized into unskilled, semi-skilled and skilled. Weights are used to convert the market wage rates for these categories into shadow wage. Details about the weighting system can be found in UNIDO (1972).

CHAPTER THRE

METHODOLOGY

3.1 Description of the Study Area

3.1.1 Location and climate

The study was conducted in the three coastal district of Tanga, Muheza and Pangani. Geographically, the three district lies between $38^0 53'$ and $39^0 1$ E and 4^0 and 6^0 S in the North East of Tanzania (Fig.2). Very recently, Muheza district was divided into two districts, Muheza and Mkinga. In this study the two districts were treated as one district (Muheza) due to difficulties in separating information between the two. This study was conducted in four villages situated along the three coastal districts of Tanga, Pangani and Muheza.

The climate is hot and humid with an average temperature of 25^0C. Humidity is high through out a year up to 90% during rainfall. Climate is influenced by two monsoon winds, one of which the North East Monsoon *Kaskazi* blows from October to March and the other, the Southeast Monsoon winds blows from April to October. It has three rainy seasons in a year, the long rain "masika" in March to May light rain "Mchoo" in June-August and shot rain "Vuli" from November to December (Semesi, 1991).

3.1.2 Vegetation type and soil

Natural vegetation of the study area is mainly shrubs, scattered trees and mangrove forests. The mangrove forest occupies the whole of the coastal area with varying status and qualities. Those close to the villages are relatively degraded as compared

to those away from the villages. The soil of the coast areas and the islands are predominantly sand and coralline with poor moisture holding capacity. On the other hand mangrove soil is predominantly silts and mud.

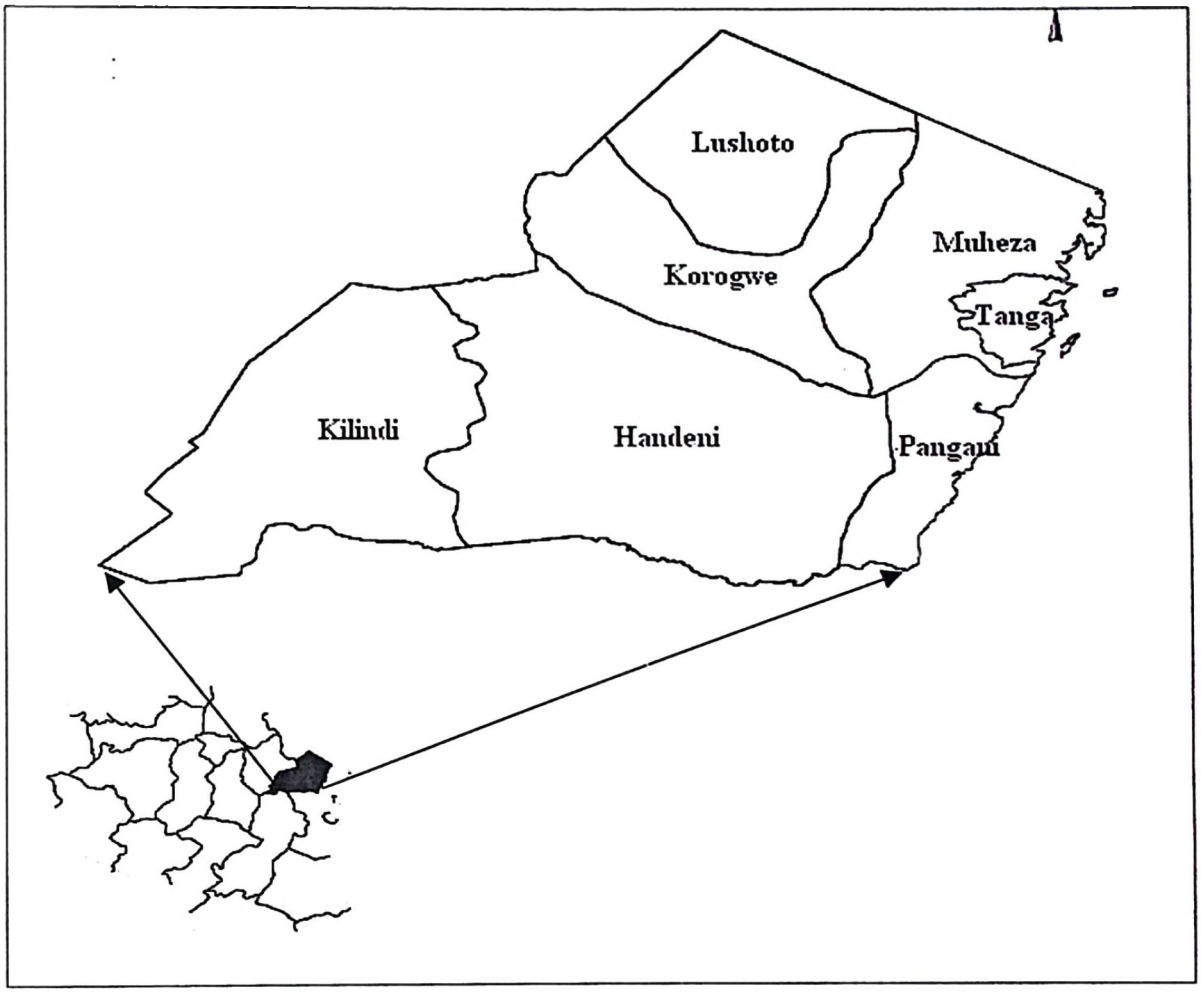


Figure. 2: Map of Tanzania showing the location the three study districts.
Source: Tanga Region Authority.

3.1.3 Population

The main ethnic groups living in the villages are the Waswahili of mixed origins, the Digos, Bondei, Zigua, Gunya, Segeju and immigrant labourers of Mwera, Ngoni, Bena, Safwa and Makonde who originally worked in sisal estates. The majority of

the local inhabitants are Muslims but they're also many Christian in Tanga city. The number of polygamous household is low but the divorce and remarriage rate is very high (Semesi, 1991). The level of literacy is generally low and is significantly low for women than men. The population of the three districts according to URT, (2002) is 249 572 for Tanga, 279 429 for Muheza (Mkinga included) while Pangani district has 44 107 people. Kiswahili is the main means of communication though in rare cases you can hear people speak in their vernacular language.

3.1.4 Socio-economic activities

Agriculture is practiced in most places but at subsistence level as the main economic activities. The main crops are coconut, rice, cassava and cashew nuts. Cashew nuts is the main cash crop but due to fungus diseases and low price many cashew nuts plantation have been neglected, this has resulted in a considerably decline in cashew production. Most men in the coast areas are fishermen apart from the inter-tidal Molluscs, which are collected by women and children. Fish and prawn are important source of income not only to fishermen but also for many people engaged in their processing and trading. Seaweed cultivation has rapidly emerged as another cash crop in the coastal area of the three coastal districts of Tanga region especially for women.

3.2 Methods

3.2.1 Sampling design

This study employed multi-stage sampling technique in which purposive sampling was done to select coastal district and coastal villages. Villages were purposively

selected from the list of coastal villages. Qualitative criteria such as village geographical location, main economic activities and alternative livelihood activities undertaken were used in order to get a sample, which represents the entire population considering the existing variations in economic activities conducted in different village. While both villages represent fisher and farmer community, each of the selected village was picked to represent one main alternative income generating activities namely fish farming, seaweed farming, beekeeping and salt production. Geographically the four villages were picked to cover the entire coastline of Tanga region. Four selected villages included Moa in the far north in Muheza district, Chongoleani and Machui in Tanga District and Kipumbwi in southern part of Pangani district. A sampling unit for this study was a household and in each sampled village register book was taken as sampling frames in which 5% of households were picked at random.

3.2.2 Data collection

3.2.2.1 Participatory Rural Appraisal

Participatory Rural Appraisal (PRA) was conducted to solicit information at the village level. PRA is an approach of sharing knowledge, analysis and for developing practical options. This was used to encourage collective responses and to identify differences of opinions and consensus. The methods used were observing directly, activity profile and daily routines and participatory resource mapping and modelling. The main focus during this stage was local communities participation in the management of mangrove ecosystem, resources uses procedures and conflict in the use of various options offered by the mangrove ecosystem.

3.2.2.2 Structured questionnaire

Structured questionnaire were applied to 5% of the household in the selected village for household surveys to obtain individual household data. According to Boyd *et al.*, (1981) a random sample should at least constitute 5% of the population to be a representative of the population. Both open and closed ended questionnaire were administered to 104 households out of 2082 household in the study area. Questionnaire used in this study is attached as Appendix 1.

3.2.2.3 Participants observations and Focused Group Discussion (FGD)

Much of the information was obtained by observing what goes on. What villagers say and what they do may not necessarily coincide. Observing operations in the field gave an opportunity to discuss with different groups such as farmer, fisher, women and youth on what, why and how things are done. It is always essential to keep ones eye open when visiting farms and to check what you are told against what you see (Metrick, 1993). The method of participant observation was primarily used to tie together and compare information given through questionnaire to crosscheck respondent's answers and to obtain detailed information that was not covered by the questionnaire. Market survey was also conducted to obtain product market price and demands so as to get the value of the products in monetary terms. This was done at the local market in the selected village.

3.2.2.4 Checklist

A checklist is a tool that is used to ensure that a list of items is not forgotten. It is needed due to the limitation of human memory. The checklist was used to guide focused discussions, which were undertaken with key informants. In this study key

informants included village leaders, fisheries officers, district and regional natural resources officers and Project managers from mangrove related project such as TACZDP and SEMMA. A key informant is an individual who is accessible, willing to talk and has a great depth of knowledge about issues in question. Key informants are not only member of the clientele but are most informed outsider (Metrick, 1993). A sample Checklist used for key informant survey is attached as Appendix 2.

3.2.2.5 Secondary data

More information on the subject was further obtained by consulting various relevant documents both published and unpublished. Data were collected from Libraries, Internets, project documents and government reports based on what has been done in relation to the study.

3.2.3 Data analysis

Data collected in PRA phase were analysed with the help of the communities and result were shared with community. Data collected by using structured questionnaire participants observation and checklist were analysed by both quantitative and qualitative methods.

3.2.3.1 Quantitative data analysis

The Statistical Package for Social Science (SPSS) was used as the main tool for analyzing quantitative socio-economic data. Data analysis using SPSS involved preparation of the variable so that they can be in the form, suitable for addressing the research hypothesis and method of analysis used; coding was part of data preparation. Descriptive statistical analysis was done to explore the data for

distribution of responses, central tendency and dispersion, frequencies, tables, and charts were used to summarize the data. Cross tabulation was a used to compute significant Chi- square values to test if there was significant difference between various income generating sources and variation between village's responses in different project activities.

3.2.3.2 Content analysis

Content and Structural-functional Analysis were employed to analyze qualitative information. Verbal discussion with key informants were analysed with the help of content analysis where by recorded dialogue was broken down into smallest meaningful units of information and themes. This type of analysis helped the researcher to ascertain values and attitudes of the respondents.

3.2.3.3 Economic impact analysis

Cost benefit analysis was done to establish whether the project is economically profitable using "Net Present Value" as the criterion. This criterion is widely relied upon as a guide to economic efficiency (Dixon and Hufschmidt, 1986). The time horizon was set at 20 years from 1994/95 when mangrove management project (MMP) was established. This time is considered under the assumption that most of the tree species planted including mangroves will reach economic maturity basing on available literature and can be harvested for various uses at different harvesting cycles. In Tanzania, mangrove is harvested mainly for construction poles and harvesting is done by selecting the required size (selective harvesting). According to FDPM (2000) in Matang mangrove forest in Malaysia where mangrove has been

successful managed as plantation forest, thinning which is carried out at the age of 15 and 20 produce good construction poles. Experience from other plantation and interview with farmer in the study area indicate that 10 years is sufficient for most of the planted non-mangrove tree species to reach harvestable size as construction poles. The NPV determines the present value of the net benefit by discounting the stream of benefits (B) and costs (C) back to the beginning of the base year (t = 0). Mathematically NPV was calculated using the following formula.

$$NPV = \sum_{t=1}^{n} B_t - C_t / (1 + r)$$

Where:

NPV = Net Present Value

B_t = Project Benefits in year t,

C_t = Project costs in year t

r = Discount rate,

n = Number of years in planning horizon

The World Bank recommends a 10% discount rate in project evaluation for development project. (Kessy *et al.*, 1993; Ngate, 2001; Sjaastad *et al.*, 2003). Discount rate of 10% was used in the computation of NPV in this study.

3.3 Cost and benefit components

The financial cost of managing the mangrove forest consists of the capital expenditure on the building, plant and equipment necessary to maintain forest plus

recurrent expenditure such as staffing, maintenance and running cost. The project was initiated in 1994/95 and has undergoes through three phases of four years each. The costs involved in the project operation are;

3.3.1 Costs

Capital: Cover cost of procurement of vehicles and equipments and other development expenditure this data was obtained from the project documents.

Operation costs: Cover the salaries of project staffs, vehicle running, and office running costs, and forest operations costs. These costs were obtained from project reports and records.

Labour costs: the amount of local community's labour used in different activities related to project activities, which had already taken place. The number of Man-day per unit for each activity was obtained from reports and from informal survey carried out during the study. Weights were used to convert the market wage rates into shadow wages. In determining shadow price employment is categorized into Unskilled, semi-skilled and skilled according to UNIDO, (1972) and Solberg, (1988). For the purpose of this study the following weights were used in shadow pricing employment. For unskilled and semiskilled labour market 0.7 to get shadow wage multiplied wage; For Skilled labour market wage was multiplied by 1.3 to get shadow wage rate. All price used were constant 2007 prices.

3.3.2 Benefit components considered

Wood supply: Supply of fuelwood and construction poles from farmer plot and from the mangrove forest was valued based on the proposed harvesting schedules. Available literatures together with the survey result were used to estimate the expected fuel wood from farmer plot and from the mangrove forest under the current management. The reduced time of fuelwood and poles collection was considered as benefit to the society and was valued in term of the alternative use for the labour.

Income from sale poles of tree planted: Under the assumption that farmer would sale their trees as construction poles the revenue from the sale of trees form part of the benefit in the analysis. Secondary data and survey result were used to estimate the expected poles and fuelwood yield from individual plots. The price given by farmer and tree purchaser in the study area was used as market price for trees of the particular species.

Honey and bees wax: Production and price of honey and beeswax was obtained from the interviews.

Fish from fishponds: data on ponds productivity and fish price was obtained from farmers in the study area.

Revenue collection by the Project: the revenue collected as a royalty from mangrove timber, and fines imposed on offender by the government in the three districts were considered as benefit to the project.

Benefits from fisheries: Value was calculated based on interviews, fish catch records and available literature.

3.4 The time horizon and management assumptions

The time horizon for the project was taken to be 20 years. This was based mainly on the following arguments.

a) Available literature shows that by the age of 20 years most of the planted species including mangrove species in the project can be harvested for poles and fuelwood at different rotation ages,

b) With high discount rates characteristics in the third world, events beyond 20 years have little value to farmer and are difficult to promote.

Other assumptions in the analysis

a) It was assumed that tree species planted in the farmland would behave in the same way as if they were planted in a pure stand. Basing on this assumption the total number of tree planted (non-mangrove species) were converted into hectares equivalent of pure stand with 1600 stocking per hectare.

b) Mangroves were planted using 1.2m by 1.2m spacing in rehabilitation zone.

c) Mangrove was planted in rehabilitation zone will follow the categorization and harvesting arrangement as prescribed in the current mangrove management plan. Planted mangrove can be harvested for poles at the age of 15 (FDPM, 2000).

d) All tree planted on farmland will be harvested mainly for construction poles and fuelwood. Basing on field observation and interview made with farmers in the area 10 years will be sufficient enough for most of the planted non mangrove tree to reach harvestable size.

CHAPTER FOUR

RESULT AND DISCUSSION

This chapter presents findings in terms of the population characteristics, economic impact assessment of the projects activities and CBA results. The impact of the mangrove management project was based on how project activities have contributed to improvement in coastal resources for which majority of people in the project area depend together with, project effort in promoting diversified use of available resources and how these efforts have contributed to the improvement in the livelihood of the communities.

4.1 Social-economic and demographic profiles of the community

In any community, social and economic factors play an important role in resource utilization with the goal to improve its livelihood. If carried out without consideration of environmental/ecological impacts, most often it leads to unsustainable natural resources utilization resulting into resource depletion. The main social-economic factors evaluated in this study were demographics, age distribution, household education level, household income, and land tenure and farm size of the respondents.

4.1.1 Respondent age and marital status

Fig 3 shows that 83% of the respondents were in the age of 18 to 60, while 17% of the respondents were old people with age above 60 years. About 91 % of the respondents were married though divorce and remarriage rate is reported to be high

in the study area. Similar observation was also reported by (Von Mitzlaff, 1989; Semesi, 1991).

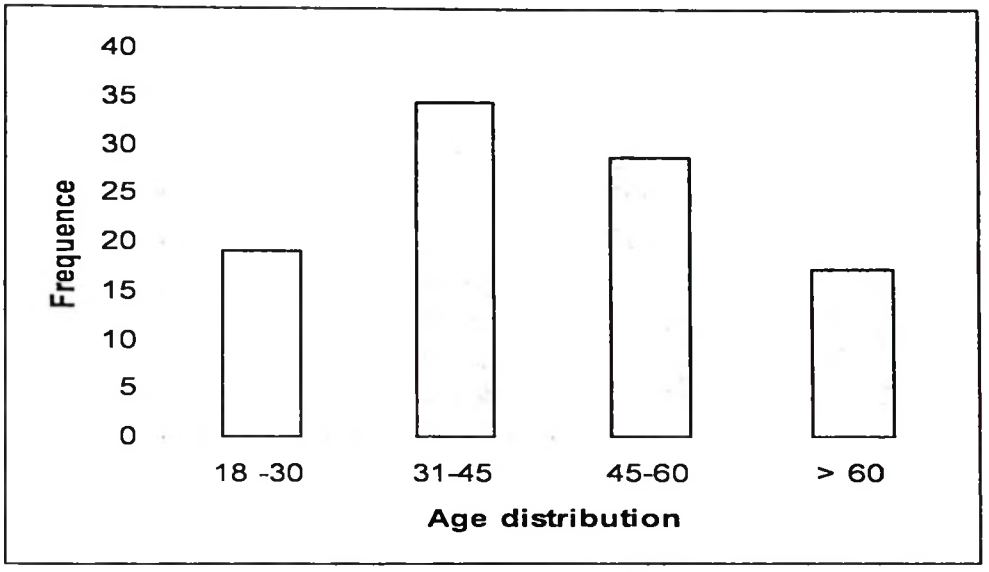


Figure 3: Age distribution of the respondent in the study area

The number of dependants in the surveyed household ranges between 0 for newly married couples to 14 in the big family. Dependants consists of pre schools, primary schools pupils, primary school leavers and those who did not have the opportunity to go to school with the highest group of dependant found to be those out of the schools. This indicates that many children of the school age in the study area do not go to school. Table 2 shows that there is a negative correlation between age and number of tree planted of the respondents. One of the reasons given in the interview for not planting trees was longer period the trees take before trees reach harvestable size, indicating that old age discourages people to invest in tree planting as income generating activity due to time preference.

Table 2: Correlations matrix for studied variables

	R- A	R-E	F-S	L-S	T-P	I-M	I-C	I-NM	T-I
R-A	1.00								
	-								
R-E	-.**280****	1.00							
	(.000)								
F-S	.**457****	**-.001**	1.00						
	(.000)	(.993)	-						
L-S	**.024**	**.072**	1.00	1.00					
	(.816)	(.480)	(326)	-					
T-P	**-.076**	**.075**	**.060**	**.070**	1.00				
	(.778)	(.781)	(.818)	(.795)	-				
I-M	**-.116**	**-.091**	**.022**	**-.102**	**-.101**	1.00			
	(.261)	(.382)	(.83)	(.707)	(.342)	-			
I-C	**.123**	**.032**	**.084**	**-, 146**	**.240***	**-.099**	1.00		
	(.382)	(.820)	(.552)	(.589)	(.087)	(.511)	-		
I-NM	**-.042**	**.061**	**.045**	**-.176**	**.121**	**.303****	**.096**	1.00	
	(.670)	(.544)	(.651)	(.439)	(.234)	(.003)	(.49)	-	
T-I	-154	.026	.056	-.266	.088	.705(**)	.095	.281(**)	1.00
	(.118)	(.797)	(.319)	(.574)	(.388)	(.000)	(.497)	(.004)	-

NB: 1. 2 –tailed significance **.0.01, * 0.05;

2. Probabilities are shown in brackets

Keys: R-A = Respondent Age, R-E= Respondent education, F-S = Family size,
T-P = Tree Planted, I-M = Income from marine source, I-C = Income from farm crops,
I-NM = Income from none marine sources, T-I = Total income.

Table 2 further indicates that there is negative correlation between age and total family income from fisheries. However, positive correlation though not significant was observed between age of household head and household income from sale of crops. The plausible reason is that as one gets old his working capacity is reduced especially in the community where fisheries activities are the main source of income. These activities need young people who can tolerate harsh and tough working environment of which the most suitable group is the young people. On the other hand

older farmer owns more income generating sources related to crop production such as farms, and human resources (Children and Dependants). As reported by Ngaga *et al.* (2003) old men have more land because they have acquired large plot when population was low.

4.1.2 Household head education levels

Table 2 shows that there is positive though not significant correlation between household head education and tree planted and participation in various economic activities. Result compare well with similar studies done in Tanzania (Ngate, 2001; Machumu, 2001; Katani, 1999; Mayeta, 2004). For example Mayeta (2004) reported that illiteracy is one of the causes of forest disturbances. Mayeta (2004) further revealed that increase in education of the household head tends to increase people's awareness on the importance of natural resources conservation for sustainable development and also increases their willingness to participate in conservation and management of natural resource activities.

The study findings further indicate that there is correlation between education and respondent occupation choice and participation in conservation activities. Table 3 shows that 24% of the respondents in the study area are illiterates of which fishing take the highest percentage (14%). The plausible reason is that in most coastal community fisheries is the first income generating activity a child learns and by earning early income sometimes it became difficult for many children to go to school hence they continue to be fishermen. Subsistence fishing is an attractive activity for the poor in particular, as it does not necessarily require the ownership of any assets

and has very low start up costs. This was also observed by MMP, (2001) who reported that child labour mostly in fishing related activities was the major reason reported by school teachers for pupils absconding schools in many coastal schools.

Table 3: Respondent education vs. Respondents occupation

	Respondents occupations					
Respondent Education	**Farmer**	**Fishermen**	**Employed**	**P. traders**	**Others**	**Total**
Illiterates	7(7)	14(13)	1(1)	1(1)	2(2)	25(24
Class IV	5(5)	11(11)	2(2)	5(5)	0(0)	23(23)
Primary education	21(20)	14(13)	2(2)	5(5)	7(7)	49(47)
Middle School	0(0)	1(1)	0(0)	0(0)	0(0)	1(1)
Secondary Schools	2(2)	2 (2)	0(0)	2(2)	0(0)	6(6)
Total	35(34)	42(40)	5(5)	13(13)	0(9)	104(100)

*Figure in brackets is percentages.

4.1.3 Land size/ farm size

The study findings reveal that 83% households in the study area own land, with an average farm size estimated to be 3.5 ha and the average population of 7 person /household. This gives an average of 0.5ha per person. The farms are normally found with scattered coconut trees and some few cashew nut trees. The area, which is normally cultivated per year, is approximately 1ha. This implies that land is not a problem affecting agricultural production but other production factors. About 44% indicated vermin as a major problem, 27% farming inputs and 25% poor soil fertility and bad weather. However, it is the opinion of the researcher that farm production is low because people prefer fishing to agriculture and a lot of uncultivated farm land became the hiding place for vermin in the area. Results indicate positive though not significant correlation between trees planed and land size of the household. People

with relatively more land have planted more trees. The plausible reason is that individual with larger land can afford to devote part of their land for tree planting. The results are comparable with other similar finding done in Tanzania (Machumu, 2001; Ngate 2001).

4.1.4 Family size

The population in the study area can be categorised as peasant farmer and fisher community. The average family size was found to be 7 people with 2 and 16 being the minimum and maximum of number of people per household respectively. Table 2 indicates positive though not significant correlation between trees planed and family size of the household indicating that people with relatively big family planted more trees. This relation was also observed in family participation in other conservation activities. Result compare well with similar studies done in Tanzania (Ngate, 2001; Machumu, 2001; Katani, 1999; Mayeta, 2004). However, large family size was also associated with utilization of more natural resources. IRA, (2002) pointed out that there is a strong relationship between household size and environmental degradation. According to Mahinya, (2005) large household tends to over-exploit their resource in order to meet their need while also undermining their very resource of livelihood.

4.1.5 Household income

Results indicates that 40.4 % of the household mentioned fishing as main source of cash income while 12.5 % of the respondents are engaged in petty business of which fish also constitutes big part of the commodity traded. Other sources of income include farming 33.7, employment (formal and informal) 4.8 %, and others activities

8.7%. Survey results indicate that income from fisheries activities contribute about 48% of the average total household gross income in the study area as indicated in Fig 4. This implies that any activity affecting fisheries is affecting the livelihoods of the great proportion of the community in the study area. As explained in section 2.1 of this dissertation there is a strong relation between fish catch and the status of the mangrove forest, therefore restoration of the mangrove forest automatically contribute to improvement in the livelihood of the surrounding community. Results further indicate that although farming takes 33.7 of the population interviewed its contribution to average family income is only 8% possibly due lack of good cash crop, low farm productivity and price for cash crops such as cashew nut, which was the main cash crop. Contribution of other source of income including alternative income sources recently introduced to the area such as Beekeeping, Seaweed farming, fish farming and handcrafts is very low. Therefore more effort in terms of technical and financial support is needed to enhance their contribution.

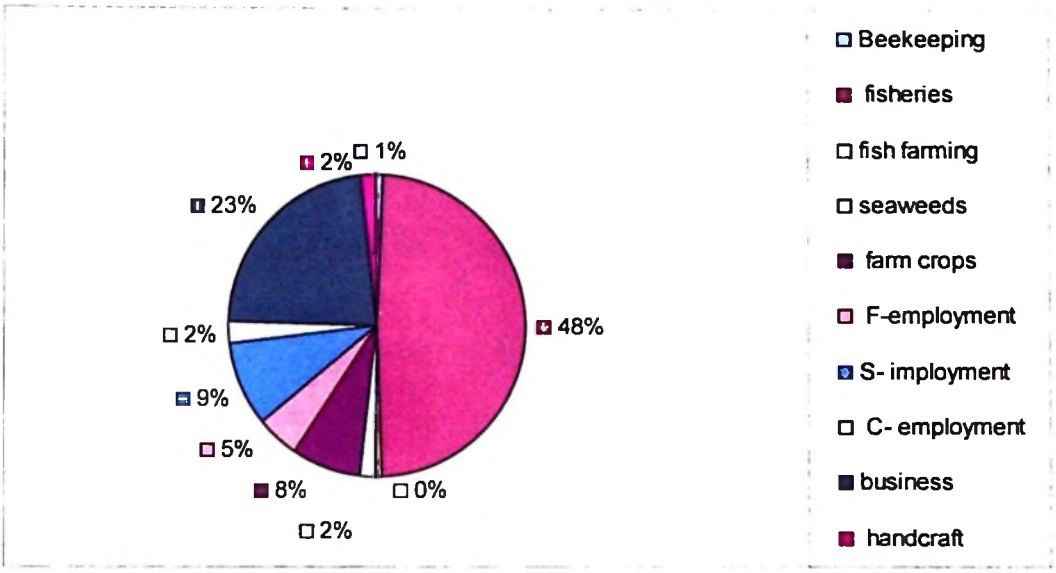


Fig 4: Annual family income from various income sources

Results indicate a positive correlation between numbers of tree planted and total household income. However income from marine related sources was found to be negatively correlation to number of trees planted. The plausible reason is that most of the fisher man do not own farm and for the few who do own farms the size of the farm is smaller compared to farm owned by farmer hence less land is available for tree planting. Another reason may be due to the nature of their duties. Fishermen have less time to spend on the farm while farmer can combine tree planting with other farm work.Finding from this study are comparable with similar study by Machumu (2001) who reported positive correlation between mangrove planting and household income in the mangrove area of Lind district. Arnold (1991) argued that small farmers without alternative source of food and income encounter difficulties in setting aside land for long gestation non-crops such as Eucalyptus.

4.2 Utilization of mangrove resources and their management consequences

Table 4 shows the main source of mangrove destruction in the village surveyed, indicating that mangrove forest was affected differently by various production activities, which were mostly influenced by geographical location of the mangrove area. These are discussed in section 4.2.1 to 4.2.3 of this dissertation.

Table 4: Major destructive activities to the mangrove forest

Activity	Chongolean n=27	Kipumbwi n= 31	Machui n= 20	Moa n= 26	Total n = 104
Uncontrolled harvesting	11(41)	27(87)	14(70)	19(73)	75(68)
Salt production	15(55)	1(3)	4(20)	5(19)	21(24)
Others	1(4)	3(10)	2(10)	2(8)	8(8)
Total	27(100)	31(100)	20(100)	26(100)	104(100)

*Figure in brackets is percentages

4.2.1 Harvesting of mangroves poles

The study indicates that 72% of the houses in the study area were built using construction poles with 68% of them constructed using mangrove construction poles. The average pole per house reported by respondents was 18 scores. These results compare with another study conducted by TCZDP (1995) where average number of construction poles estimated was 17 scores. Market survey indicate that one score (20 pole) of construction pole is sold between TAS 4000- 5 000 i.e. TAS 200- 250 per pole. This gives an estimated value of TAS 8.3 x 10^8 worth of mangrove poles used for construction of houses in the three coastal districts.

About 68% of the people interviewed related forest degradation to uncontrolled harvesting for construction poles, which led to overexploitation of mangrove forest

especially the easily accessible mangrove areas. However, survey indicates that over-exploitation was not due to local use only but highly contributed to illegal mangrove poles trade mostly to Kenya and Zanzibar. Traders from outside the village pay villager to cut the poles and arrange transport. Survey findings indicate that 97% of the sampled population is aware of the procedure required for a person to get harvesting license or permit. These results indicate that awareness made by the mangrove project was effective. All the villagers interviewed are aware that it is illegal to cut mangrove without a license but the need for cash income was reported as a motivation to participate in illegal cutting of mangrove poles. The finding compared with result from similar study conducted by Kajembe *et al.* (2000) who find that about 93% of sampled population in Rufiji delta is aware of the laws and regulations governing the utilization of mangrove resources in Rufiji delta.

Mainoya (1986) related over-exploitation of mangrove by traditional users with the general problem of rapidly expanding population and poverty. The per capita income of a Tanzanian was estimated to be at about USD 282, which was about TAS 26 000 per month (World Bank, 2004). This was an estimate of TAS.867 per person per day, which was also less than one US dollar per day. These poor economic situations are likely to increase hardship in the livelihood systems of the people and bound to pose more pressure on natural resources. Tree planting programme initiated by the project was aimed to reduce the impact.

4.2.2 Salt production

The study found that many of the salt farms established before the project were established in area covered by good mangrove forest. Sutton (1973) In Machumu(2001) argued that the main problem in establishing salt pans in the mangrove area was that majority of the pan are not properly sited or constructed due to lack of knowledge and capital. Tanga region has 44 solar saltpans covering a total area of 857.8ha most of them wrongly sited and some of them abandoned soon after establishment (Appendix 3.) Salt production by boiling was reported as one of the most mangrove destructive activities especial in Tanga district in village such as Congoleani and Ngome Chumvini. However, project progress reports indicate that the number of salt boiling pan has decreased from more than 400 salt boiling pans in 1995 to less than 20 salts in 2006, which is 95% reduction. The decrease in number of salt producer by boiling was due to fuelwood cost which has made salt boiling uneconomical activity after ban on use of mangrove for salt boiling. According to Semesi (1991) $20m^3$ of wood is used to produce one tone of salt this was not economically and environmentally sustainable undertaking. Salt boiling and lime burning is currently done on a small scale using non mangrove wood from general land but also from agricultural residuals such as tree cut during land preparation, old coconut and cashew nuts trees.

4.2.3 Agriculture

Mangrove cutting for agriculture was reported a major threat to the mangrove forest in Pangani district. Farming in the mangrove is practiced along the Pangani River in the area flooded with fresh water during high tides. The major crop grown in the encroached mangrove areas is coconut and to lesser extent rice. Interview with

farmers revealed that coconut trees growth was very good in the first few years but decrease rapidly due to salt intrusion. These results conform to FAO (1994) that mangrove soil is marginal for long-term agriculture due to high salinity and acid sulphate condition. The area clear felled for coconut and paddy farming in Pangani is estimated to be 500ha. This has reduced the area of very important prawn nursery site in Pangan. As reported by Munishi *et al.* (2004) agricultural expansion, in form of both shifting and permanent agriculture reduces forest cover.

4.2.4 Mangrove clearing for urban development

The researcher while working along the edge in the mangrove of Kipumbwi found a big area of mangrove cleared for establishment of local harbor for both fishing and sailing boats traveling between Kipumbwi and Zanzibar. Mangrove cutting for establishment of boat landing was also observed in Chongolean and Machui. Mangrove clearing for local boat landing and for improved visibility was reported in many villages to have affected substantial areas of mangrove near human settlements. Uncontrolled cutting of the mangrove for whatever reason remove natural protection of the mangrove.

4.3 Activities Conducted to Reduce Forest Degradation

4.3.1 Raising community awareness

Raising of public awareness is vital to the success of participatory approach inherent in JFM (Nshubemuki and Mugasha, 1999). Project expenditure records and discussion with project management revealed that a significant amount of funds (20%-40%) were used to raise community awareness. This was based on the fact that

local communities played a significant role in mangrove destruction but also is the same community, which will be mostly affected if mangrove forest is completely destroyed. Community awareness is very important to ensure sustainability of the initiated project activities after the project end.

Table 5 indicated that 73% of household head interviewed have participated in various conservation activities in some way while about 27% of interviewed individuals have not participated in any conservation activities. Participation of local community in mangrove protection can be divided into three categories. The participation of selected member of the community in the patrol organized by the project which some time include payment of some lunch allowances, village organized voluntary patrol and voluntary informers who provide important information which lead to arrest of culprits. Study results indicate that awareness campaigns were effective in mobilizing the communities to participate in mangrove conservation.

Table 5: Participation of local community in forest management forest

Conservation activity	Chongolean n= 27 %	Kipumbwi n= 31 %	Machui n= 20 %	Moa n=26 %	Total n=104 %
Protection	30	19	30	27	28
Mangrove planting	7	13	15	4	8
VNRC member	4	32	15	8	15
Planting and protection	18	10	5	8	12
Protection/ awareness	15	6	0	11	9
Do not participate	18	19	30	42	27
Total	100	100	100	100	100

According to project management one of the advantages used by the project to gaining community support was the existing knowledge among the community on the relationship between mangrove and fish. Chua (1995) argue that local communities are highly knowledgeable with respect to the functioning of the natural ecosystem and sustainable use of the resources surrounding them. For example, through their long association with nature, most fishermen in the study area know the productive cycle of key fish species, tidal rhythm, the importance of mangrove and coral reefs to fish and shoreline protection. As explained in section 4.1.5 of this dissertation, fishing is the main source of income conducted by about 40.4% of the people in the study area contributing about 48% of the total household income. This opportunity was utilized by the project to address issues that causes threat to the mangrove ecosystem and role of the communities in reducing ecosystem degradations.

Project records for example, indicate that fishermen have been very useful and effective partners in reporting and participating in controlling illegal activities as they always path through mangrove forest on the way to and from their fishing ground. Survey results show that that some village have established mangrove planting day, a special day for all people in the village to participate in mangrove planting. Local communities participated in mangrove planting both through paid labour and on voluntary basis. The result compare well with Bann (1998) who reported that in Sumatra, the linkage between fisheries productivity and mangrove area is so strong and obvious that local fishermen have voluntarily replanted

mangroves in places where they have been depleted, in an attempt to re-establish fishery productivity which has been lost.

Village Natural Resource Committee is responsible for supervising mangrove harvesting in their area of Jurisdiction, duties which was formally done by forest staff. This has resulted in reduction of incidence of illegal activities especially in mangrove close to villages. Most VNRC consist of 10 to 15 members who are selected in every two years, therefore there is great opportunity for many villager to participate in mangrove protection as a member of VNRC. The reason given by the 27% of the interviewed people (Table 5) for not participating includes, disability due to disease or age 4%, lack of awareness 17%, other important commitments 4%, and only 2% who claimed that it is not their responsibility.

4.3.2 Forest protection

Participatory forest resources management was the main management strategies used by the project. Mangrove project records indicate that through intensified patrolling and involvement of local communities in protection activities the numbers of boats and dhows which were used to transport the mangrove poles in most cases illegally harvested was reduced from 30 cases per month in 1994 to less than 5 (83%) cases per month in 2005. Project records were supported by interview results where 72% of the respondents indicated that there is a significant decrease in illegal mangrove cutting. Wily (2002) reported reduction of forest illegal activities such as timber and poles cutting, forest fires and animal poaching through JFM in more than thirty national forest reserves in Tanzania. In many areas the forest has recovered after

elimination of the destructive forces. These finding compare with other study conducted in the project area by Luoga *at al.* (2004) and TCMP (2001) who reported that the mangrove forest has actively regenerated due to conservation effort by the mangrove project.

4.3.3 Tree planting

Most communities surrounding natural forest reserves use the natural forest as a sole source of building material. Munishi *et al.* (2004) reported that house construction uses poles and other small round wood from natural forests when these products are not available on the farm. This has revealed that tree planting was carried by the project to addressing two main problems, the first one was to replant degraded area inside the forest reserve and the second one was to reduce the impact wood shortage from the general land by facilitate planting of fast growing non mangrove trees species on farmers plot for purpose of reducing pressure on the existing mangrove forest resources. Munishi *et al.* (2004) reported that on farm tree planting means at least some of the desired forest products such as fuelwood and poles could be obtained from on farm sources. This action will therefore reduce pressure on the natural forests.

4.3.3.1 Mangrove planting

The study findings show that Mangrove planting was carried out in degraded areas that resulted from mangrove clearing for agriculture and salt production In areas encroached for agriculture, meetings involving the farmers, district officials and project staff were conducted to ensure that there is no more mangrove cutting for

expansion of farm and to avoid sabotage to the planted mangroves trees. Farmers were allowed to continue harvesting coconut but without weeding to allow forest to regenerate and colonize the area again. Unproductive and dying coconut trees could still be found mixed with mangrove in some rehabilitated mangrove area as seen in the background of Plate 2. A total area planted by the project through paid labour is estimated to be 1500ha and area planted by the community themselves voluntarily without payment after sensitization is estimated to be 56 ha. Plate 2 further show successive regenerated areas along Pangani River in area resulted from mangrove clearing for coconut farming.

(a) (b)

Plate 2: Mangrove planted in area clear felled for coconut farming in Pagani. Photo Z. Mbwambo (2007)

4.3.3.2 Planting of non mangrove trees

Project records indicates that a total of 193 600 seedlings were raised and distributed by the project. In additional to seedling raised by the project; the project also provided seeds to primary schools and individuals. Table 6 indicates that 15% of the

interviewed households have planted trees; however majority (80%) have planted just few trees in their farm but there was also few individual who planted substantial number of trees.

Table 6: Farmers responses on tree planting in the study area by villages

Responses	Moa n= 26 %	Chonolean n= 27 %	Mchui n= 20 %	Kipumbwi n= 31 %	Total n=104 %
Planted trees	12	15	15	19	15
Not planted	88	85	85	81	85
Total	100	100	100	11	100

Individual responses for not planting trees includes insufficient land 14%, difficult in getting seedling 27%, lack of market information 18%, and long periods before harvesting 13%. Field observations and discussions with various informants indicate that the area is not currently facing a serious wood shortage as compared to other part of the country; this may be one of the reasons contributing to slow adoption of tree planting. Low adoption of tree planting in the region was also observed by Kilenga, (2006) who reported that most households at Amani in Muheza district planted less than 10 trees in their farm while very few planted more than 100 trees.

As discussed in section 4.1.1 through 4.1.4 of this dissertation, there is correlation between some socio economic factors and number of trees planted. Results indicate positive correlation between numbers of tree planted and farm size, family size, family income and education of the household head. Results compare well with similar studies done in Tanzania (Mayeta, 2004; Ngate, 2001; Machumu, 2001; Katani, 1999). However, negative correlation was observed between age of the respondents and number of trees planted. The plausible reasons for the above

findings may be that, households with relatively more land and big family and relatively high income can afford to devote part of their resource (land and human resources) for tree planting as compared to people with small land size and small family size while old age of the respondent seems to discouraged individual to plant trees. Arnold (1991) argued that small farmers without alternative source of food and income encounter difficulties in setting aside land for long gestation non crops such as Eucalyptus.

4.3.4 Environmental education

The study revealed that young people are involved in many cases of illegal activities including the use of dynamite in fishing and mangrove cutting. According to mangrove project management this was one of the reasons that compelled the project to initiate environmental education in primary schools adjacent to mangrove forest reserve. The aim for conducting environment education in coastal schools was to impart environmental knowledge to pupils in order to prepare them to take care of the environment especially after leaving schools. This involved development of environmental education curriculum, training of 108 primary schools teachers three from each of 36 primary schools and provision of teaching materials.

According to Hogarth (1999) future of the mangroves must not depend on isolating the remaining mangrove forest from human influences but on properly regulated interaction with human demands and effective management. For this to happen, the first step must be education. Tree planting was also established in all the 36 primary schools teaching environmental education as part of practical implementation of

environmental education. The area planted in each school varies depending on the availability of land but ranges between few trees to 2ha. Tree species planted are *Eucalyptus, Acacia mangium, Senna siamea, Melia azedrach, Cassuarina equentisifolia, Terminalia spp,* and *Tectona glandis.* Plate 3 shows *Acacia mangium, plot* (a) *and Eucalyptus plot (b)* at Mnyanjani and Mkwaja primary school respectively planted as part of environmental education practical. Schools located close to the mangrove forest were given a portion of mangrove forest to manage as part of environmental protection practice.

Records of the current environmental protection competition namely the "Coastal Environmental Award Scheme" (SEAS) show that schools teaching environmental education have been leading in wining the award in the last five years of the competition in the three coastal district of Tanga, Muheza and Pangani.

(a) *(b)*

Plate 3: School woodlot (a) at Mnyanjani and (b) at Mkwaja primary school. Photo by Z. Mbwambo (2006)

4.3.5 Use of efficient wood stoves

An open fire is said to extract only 10% of the energy potential of wood while well maintained improved stoves could use 20% or more (NAS, 1980). The survey indicates that about 6% of the surveyed household in the study area had improved stove. However, the study revealed that despite of the various training and awareness raising efforts there is a slow adoption of the energy saving technology. The main reason given by the community on the slow adoption of this important technology was the difficult in getting suitable soil for construction of earth type improved stoves and the price of ready made improve fuelwood cook stoves. However, it is the opinion of the researcher that failure of other people to adopt the use of efficiency wood stove was attributed to other factors other than lack of suitable soil and price of read made stoves. Currently the area is not experiencing serious fuelwood shortage and the second reason was on how awareness and knowledge for construction and use of energy saving stove was communicated to the community. Plate 4 show two types of energy stoves found in the study area. Brick type energy saving stove (a) which use burnt bricks and cement is durable but expensive for many individual to afford while earth stove type (b) are cheap but not durable especially if constructed using improper soil type.

(a) (b)

Plate 4: Energy saving stove found in the study area. Photo by Z. Mbwambo (2006)

4.3.6 Alternative income generating activities

The study findings reveal that the improvement in the status of the mangroves forest to the greater extent is a result of the active participation of the local communities. Survey further revealed that in acknowledging the role of the local community in resources management and their livelihood need various efforts were made by the project to develop alternative livelihood for mangrove forest adjacent communities. Alternative livelihood options supported by the mangrove management project include beekeeping, fish farming, solar salt production, tree planting and handcrafts. Other studies urged that an incentive influence forest stakeholders to participate in sustainable forest management must provide more tangible economic benefits to the local communities (Kajembe, *et al.*, 2004).

4.3.6.1 Beekeeping development

Results indicate that about 11% of the surveyed household in the study area practice beekeeping. Although percentage of beekeepers is small, this is taken by the project as a good achievement as there was no a single beehive in the mangrove before it was introduced by project in year 2000. Average production in year 2006 was 10 liters of honey per hive. Supporting beekeeping in the mangrove forest reserves is aimed at increased conservation effort by involving beekeepers but also as an income generating activity to reduce income poverty. The study found that there is no conflict between beekeeping and mangrove conservation because live mangrove does not catch fire easily as for the case of terrestrial forest where beekeepers have been always blamed for the annual wild fires.

According to mangrove project records there is 600 beehives of which 415 is traditional log hive and 185 is modern top bar hives. It was observed that there is a growing use of dead wild palm tree *(Borassus aethiopum)* for production of log hives. There is a lot of dead tree of this species in south Pangani which resulted from wine tapping from the trees. Taping of wine from this tree species kills the tree as taping is done from the tree tops unlike taping of wine from other palm tree such as coconut tree where taping is done from the flower buds.

A total of TAS 2.8 million worth honey was harvest in year 2006 by beekeepers in the surveyed village. Honey production potential of the mangrove forest, if full utilized can contribute both to substantial income to the mangrove adjacent communities. In Cuba for example every year between May and July up to 45 000

beehives are placed under mangrove trees (Hernández *et al.*, 2001). Market survey indicates that there is a good and reliable market for bee products. The current market price of honey in Tanga is between 4000 and 5000 TAS per litre.

4.3.6.2 Mariculture related activities

(a) Salt production

There are 44 salt ponds covering an area of 857.8 in the mangrove area of the three districts (Appendix 3). Salt production industries employ significant number of people in in Chongoleani and Machui two of the four study village. However only 68% of the saltpans in the region are in operation, the rest are either completely abandoned or temporary not in use. Reason given by salt farm owner for abandonment was lack of capital required to rehabilitate them due to destruction caused by El-Niño. Mangrove project provided support to some villages to rehabilitate few.

(b) Fish farming

The abandoned salt pan and part of unutilized pond and reservoir can be used as fishponds. The productive salt ponds can also be used for fish farming during rain season when there is no salt production provided that water intake is properly located and designed to allow free fish fray to inter in the pond as shown in (Plate 5a). Combining salt production and fish farming will improve resource use and will reduce further mangrove cutting for establishing new fish farms. However the study revealed that only three salt farms out of 43 listed in Appendix 3 have tried to combine salt production

and fish farming in their farm but only on a small scale due to lack of awareness.It was found that Mangrove project in collaboration with other institution in the area have been promoting aquaculture as alternative livelihood option in order to reduce exploitation of natural resources. This study revealed that fish farming and crab fattening were among the new income generating activities introduced in the project area and are practiced in 6 villages surrounding the mangroves. Results indicate that 5% of the respondents from the sampled household participate in fish farming. For example Machui village has a total of 10 fishponds, where more than 40 villagers participate in organized fish farming groups. Seven fishponds were found to be newly constructed ponds of which production is expected in next six month. A total of 315,000 TAS was realized in year 2006 from the sale of fish by one fish-farming group in Machui village and shared among members in addition to 1kg of fish given to each member for family use.

The real impact of this initiative is not yet realized because fish farming has just been introduced in the area. According to (Mallya, B.S. 2007 personal communication) an expert from the institute of marine science Zanzibar was invited by the project to provide technical expertise on best practices so as to increase pond productivity. From the expertise provided it is expected that pond productivity will increase and benefit the community. There are many sites suitable for milkfish farming in the mangrove such as salt ponds and bare saline area inside the mangrove. Fish farming can be carried out even

beyond the mangrove forest area provided that the gradient is sufficient to allow water flow.

(c) Crab farming

Plate 5b was taken from a group known as WAKAPA, which is an abbreviation of *Wafugaji Kaa Pangani,* a group that is engaged in crab caging along Pangani River. This group was found to have 600 crabs, which they expect to sale after 1 month at a price of TAS 4 500 Kg^{-1}, which will bring a total of TAS 2 700 000 to the group. According to SEAGAAD, (2005) an individual household could take care of an average of 4 cages; which could bring in turnover of TAS 1 540 000 per annum. The study revealed that there is a memorandum of understanding between Mangrove management project and SEMMA project to enable the two projects to work jointly in providing technical support and regular monitoring for fish and crab farming activities in the mangroves. Seed for the cage are collected from wild crab catch from the mangrove forest, which is crabs natural habitat (SEMMA, 2006). Discussion with the crab farmer revealed that there is substantial increase in crab catch from mangrove due to improvement in the mangrove forest in the area.

(a) (b)

Plate 5: Mariculture activities in the mangroves (a) fish farming and(b) crabs fattening. Photo by Z. Mbwambo (2007)

(d) Seaweed Farming

Seaweed farming is practiced in the entire coastline of Tanga region. Survey indicates that 22% of people interviewed do seaweed farming as the main or additional source of income. Mean annual income realized from seaweed farming in 2006 was TAS 58 456 from 23 practicing farmers interviewed. Seaweed faming is not directly related to mangrove forest but it has two main economic contributions to mangrove management. The first and may be the most important contribution is that seaweed faming provide alternative income to coastal communities this is likely to reduce pressure on other coastal resources including the mangroves. The second contribution is that Mangrove forest is the main source of pegs and stakes used in tying the ropes therefore coordinated efforts are needed to ensure that the two complement each other.

4.3.6.3 Use of coconut by products

It was found that about 8% of the respondent in the study area do carry out handcraft as one way of earning a living. The product mostly produced is mats from raffia, but very recently new technology which uses coconut fiber as hand craft raw materials was introduced. This technology was imported in the area by the mangrove project where a trainer was contracted to teach selected individual from selected villages on how to process coconut fibers and mat weaving. Mangrove management documents in Tanga office has shown that a total of 40 villagers were trained on processing of coconut fiber and mats production from coconut fibers. Five set of specially designed machine for door mat weaving and rope making were provided to five organized group by the project after training. The training objective was that the trained villagers would spread the knowledge to other villagers in the village where they come from. However, the study found that only 2% of the respondents who are engaged in hand craft produce products from coconut fibers.

Survey revealed that the cumbersome process involved in the processing of fiber from raw coconut husks was the major constrain to this initiative. It was further explained that for easy extraction of the fiber the husks must be buried for at least five months in saline water before washing and drying process starts. Plate 6(a) shows a group of women digging out buried coconut husk before washing to extract coconut fiber shown in plate 6(b).

(a) (b)

Plate 6: Women preparing coconut fibers Photo by Z. Mbwambo (2006)

Mangrove project has also provided financial support to promote production of various products from coconuts shells some of the products are displayed in plate7a.

a) b)

Plate 7: product from coconut by products. Photo by Z. Mbwambo(2006)

Products produced from the coconut shells includes flower vessels, pens holder Ash trays, Mug, wine cup, women purse/bags, ear rings, bangle, and necklace as displayed in Plate 7(a) while some of products produced from coconut fiber are displayed in plate 7(b). Support involved procurement of working equipments and training. This was done to promote and to improve efficiency use of coconuts by

products as a means to reduce income poverty. There is a good market for products made from coconut fibers and shells. Market survey shows that doormat produced from coconut is sold at TAS 5 000 to 10 000 in Tanga depending on the design and labour work involved.

In some countries coconut husk is used to produce organic soil conditioner known as coco peat, which is a 100% natural biodegradable environmental friendly natural growing medium, widely used around the world for growing of foliage plants and vegetables. Tanga Regions is very rich in coconut production therefore if fiber extraction and processing technology is improved these initiatives could be among the potential source of income especially to women in the area hence contributed to poverty reduction.

4. 4 Local community's involvement in mangrove management

One of the strategies adopted by the project was to join the effort between the government and the communities on forest management and protection through JFM. Though institutional aspect and incentives system for active community participation in forest management are inadequately defined the study found that participation of local communities and linkage to other sectors was highly emphasized by the project. Results reveal that 47 villages adjacent to the mangrove forest have been facilitated to formulate Village Natural Resources Committees (VNRC), which is responsible for day-to-day supervision of mangrove resources utilization. To ensure active participation of local community in decision the role of VNRC and community as a whole in forest management was translated from the forest Act no 14 of 2002 and copies distributed to village leaders and VNRCs.

Project reports, indicate that 64% of all villages adjacent to the mangrove forest in the three district was facilitated to develop village based management plan, management agreement and by laws though some of them not yet approved by high authority. Mangrove project progress reports and records at zonal office indicates that a total of 400 villagers and 327 VNRC members from 47 villages received training on various management practices such mangrove ecology, law-enforcement procedures and record keeping as part of preparation of the community to take over management responsibility. About 84% of the respondents interviewed supported approach used by the project of involving VNRC in day-to-day mangrove management activity. When asked about effectiveness of the system in controlling illegal activities, 64% indicated that the system was effective but there was still a need to strengthen VNRC. Villagers appreciate the role played by VNRC in reducing time spend by communities in acquiring harvesting permit and reporting illegal activities both contributing to decrease in illegal activities. However, most of the interviewed individuals (78%) were worried by the speed taken by the government in implementing JFM approaches. After almost ten years of JFM, still there is no formalized system of cost-benefit sharing mechanism between the government and the communities. It is the government, which decides what to share with the community, and in most cases entitlements, which are granted to local people participating in forest management, are too trivial to save as incentive for effective participation.

However, survey results found out that some important initiatives have been taken by the project to provide tangible benefit to community participating in forest

management which includes, supporting various income generating activities in additional to free mangrove products for local use as incentives. Out of 68% of the respondents who have used mangrove pole to construct their house only 10% of them paid government royalty the remaining 58% obtained them freely. Many researchers have found that sharing of benefits from resources jointly managed between community and the Government is an important incentive for active participation (Kajembe *et al.*, 2004; Ranthore, 2005; Emerton and Tessema, 2001).

Compared to what was the situation before the project, the situation now represents a move towards effective community participation. The level of community participation is encouraging possibly due to the existing hope among the community on the good intention of the government to involve the community in forest managements through PFM. However as stressed by many authors (Woodcock, 2002; Leach, 2002; Wily and Dewees, 2001) the main problem is that the implementation of the forest policy by forest division still reflect the philosophy of seeing participation as a means to reach an end (conserve forest resources) and not as a goal in itself where substantial power, rights and responsibilities are placed squarely in the hand of local communities, letting local communities become custodian rather than recipients of particular and often predetermined goods and services.

4.5 Impact of Project Activities

4.5.1 Ecological Impacts

The immediate impact of the project intervention is the restoration of the mangrove forest in many places as confirmed by satellite photos reported by TCMP, (2001). Luoga *et al.*, (2004) also reported active regeneration of mangrove in Pangani as a result of effective management of the forest under the project. Field observation and interview revealed that there is a significant change in the status of the Mangrove in terms of trees quality, and quantity from a highly degraded forest to a closed forest. The survey results indicate that the sampled population perceived that the current forest condition has improved as compared to before the project (Table 7).

Table 7: Perception of the respondents on the current Condition of the forest

Forest condition	Chongolean n= 27 %	Kipumbwi n= 31 %	Machui n= 20 %	Moa n=26 %	Total n=104 %
Closed forest	41	45	50	46	45
Closed but dominated by young trees	41	48	40	39	42
Slightly better than before	18	7	10	15	13
No changes	0	0	0	0	0
Total	100	100	100	100	100

The observed variation in perception is probably influenced by the condition of the forest at the beginning of the project in different village and the main destructive forces. For example, for villages where major forest degradation was due to over-exploitation such as Moa closing the forest for 10 years is enough to turn the forest to closed forest with mature trees while for clear felled forest such as in Chongolean closing it for the same period even after supplementing it by planting give a closed

forest but dominated by young regenerating forest as shown in plate 8(a) artificially regenerated and 8b natural regenerated

(a) (b)

Plate 8: Young regenerating mangroves at Chongolean (Photo by. Z. Mbwambo (2006)

4.5.2 Socio-economic impacts

4.5.2.1 Reduction in protection cost as result of local participation

The study findings show that about 85% of all the respondents interviewed were well informed of the existence of the project and 73% of them managed to list major project achievements. This indicates that most people in the study area were involved in the project implementation. When asked to mention one most important value of mangrove, which justify why they participate in mangrove protection. 56% of respondents said that mangrove forest is valuable because it provides wood product, 27% fisheries product, and 17% protection. Results further show that about 61% of the respondents felt that if forest destruction was left to proceed as it was before the project the forest could now seen as forest patches of small mangrove shrub and bushes and in some place big part of mangrove could have been converted to other land use. Fig. 5 shows how communities perceive the impact brought by the project

in terms of resources availability and uses. More than 90% of all fishers interviewed regardless of where they fish, believe that mangrove provided protection and act as a nursery site and should be protected. The knowledge and understanding of the value of the mangrove ecosystem by the community have created an incentive for them to participate in mangrove protection.

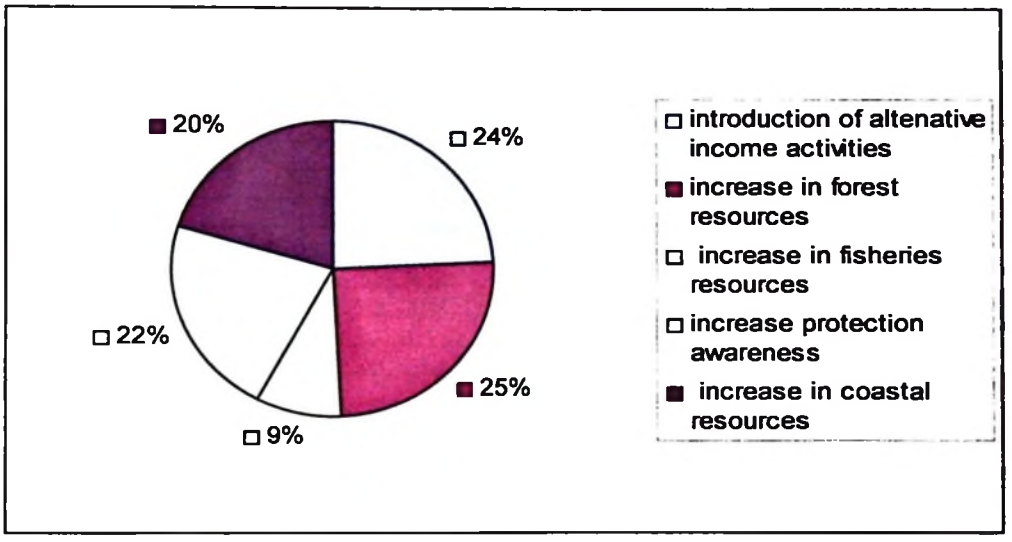


Fig. 5: Respondents perception on project impacts

Analysis of forest protection costs indicates that through involvement of local communities through VNRC in forest protection operations there is a reduction of up to 60% of the forest protection cost in terms of fuel and allowances for staff. Participation of local communities have made the forest patrol to be more focused as in most cases they are organized based on the information received from VNRC. This observation is similar to what was reported by Makoloweka and Kalombo, (2005) who also found that community participation in the development of fishing regulations and joint patrol operations, enhances compliance with such rules and reduces enforcement costs.

4.5.2.2 Increase in availability of wood products

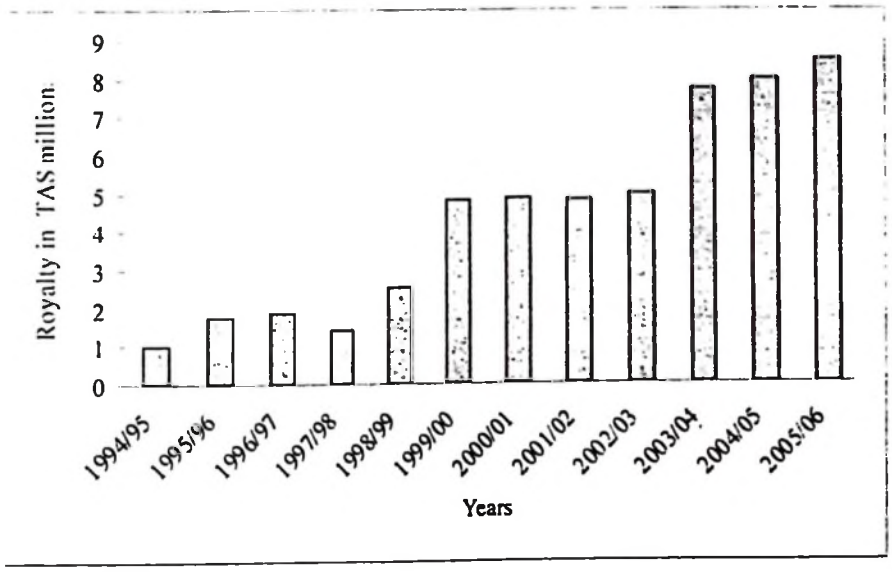
Management of the mangrove in Tanzania mainland is based on the 1991 mangrove management plan. Despite of the weakness in implementing rules and regulations the plan enabled the forest to supply the necessary wood materials for the communities while maintaining its basic ecological functions. As indicated in section 4.2.1 of this dissertation there is a significance increase in mangrove wood products both in quality and quantity as a result of proper management of the forest. Field observation indicates that mangrove poles will continue to be the main construction material in the study area as many of the newly constructed houses found in the study area were constructed using mangroves poles probably due to the prevailing economic hardships in the study area.

Table 8 shows variation in house construction materials between the sampled villages. Chi-squire test indicates a significance differences in building materials between villages ($p< 0.05$). Kipumbwi showing lowest poles constructed house and Chongolean the highest. The plausible reason may be due to their historical background and geographical location. Kipumbwi is a local harbor used for trade between Zanzibar and mainland this provides better income sources for many villagers to construct brick houses.

Table 8: Source of house construction materials by villages

Construction materials	Chongolean n=27 %	Kipumbwi n= 31 %	Machui n= 20 %	Moa n= 26 %	Total n = 104 %
Poles (Mangrove)	93	52	65	57	66
Poles(non mangrove)	0	6	10	8	6
Block house	7	42	25	35	28
Total	100	100	100	100	100

Fig. 6 shows that there is a gradual increase in government revenue from the sale of mangrove from 1,034,750 in 1994/95 to 8 472 700 in 2005/06. From this trend it is expected that revenue collection will continued to increase if government open the forest for commercial harvest as big part of forest which was close to allow for the forest to regenerate have reached harvesting stage after being closed for more than ten years.



Source: MMP records.

Fig 6: Royalty collection from mangrove products

According to Semesi (1991) it is possible to sustainably remove 300 poles/ha of class I-II; 400 poles /ha of III- IV and $10m^3$ of fire wood per hectare through selective harvested from the productive zone annually if the forest is divided in to 10 years coupe. Table 9 shows the potential royalty that can be obtained from the 7069 ha of the area categorized as productive zone (formal area classified as recovery zone included).

Table 9: Potential royalty from the productive zone

Products	Harvest ha^{-1}	Annual coupe	Royalty $score^{-1}$	Total revenue
Class I-II	15 scores	706.9	4000 $score^{-1}$	42 414 000
Class III- IV	20 scores	706.9	2000 $score^{-1}$	28 276 000
Fuelwood	10 m^3	706.9	1000/ m^3	7 069 000
Total				77 759 000

Source: Adopted from Semesi, 1991

From the above Table 9 and based on the current market price of construction poles in Tanga of TAS 4500 per score (average price irrespective of poles classes) mangroves poles worth a total of TAS 111 336 750 can be sustainably harvested through selective harvest annually[(15+20) score ha^{-1} x 606.9ha x TAS 4500 $score^{-1}$]

The study findings indicated that 3.46% of respondents use mangrove wood as the main source of energy. However none of the house was found to use fuel wood exclusively from mangrove forest only. The plausible reason for this low percent on community depending on mangrove fuelwood is lack of dry wood as young growing trees dominate most forest and people are not allowed to cut live trees. On average each household collect an average of two head load of wood per week. Average volume of the normal head load in the study area was estimated to be $0.148m^3$. The

study further revealed that a head load of good mangrove wood is sold between TAS 200 to TAS 1500 in the village and Tanga city respectively. Other source of fuel wood includes general land and farmland from old tree crops and cleared vegetation during land preparation.

The impact of fuel wood shortage on mangrove forest reserve was reported in Pangani. Reports indicate that there is serious mangrove debarking in the mangrove forest adjacent to Pangani Township. Debarking of live mangrove trees is done to speed drying, as people are not allowed to collect fuelwood from live mangroves. This is the reason given by the mangrove management officials to initiate planting of fast growing non mangrove fuelwood species and energy saving stoves even to the village currently not experiencing fuelwood shortage. Planting of fast growing non-mangrove wood species such as *Eucalyptus, Acacia mangium, Cassuarina equentisifolia* and *Senna siamea* and use of improved wood stove though slowly adopted is aimed to address the expected fuelwood shortage. Many farmers have not yet benefited from planted trees, as most of tree planted in the sampled village have not reached harvestable size. However use of improved fuelwood stove in Pangani Township has increased the use of coconut husk as source of wood fuel and hence reduced pressure on the adjacent mangrove area.

4.5.2.3 Impact of project activity on fish catch and other ecological functions

Results indicate that fisheries contribute about 48% of the community's annual gross cash income of the surveyed households. Fig.7 shows that about 40% of the resident in the study area are engaged in fisheries activity as the main source of income and

livelihood. Only 5% of the residents interviewed are employed in permanent or temporary employment. Mean annual income from fishing was found to be TAS 1 036 304 as compared to TAS 112 154 from agricultural crops.

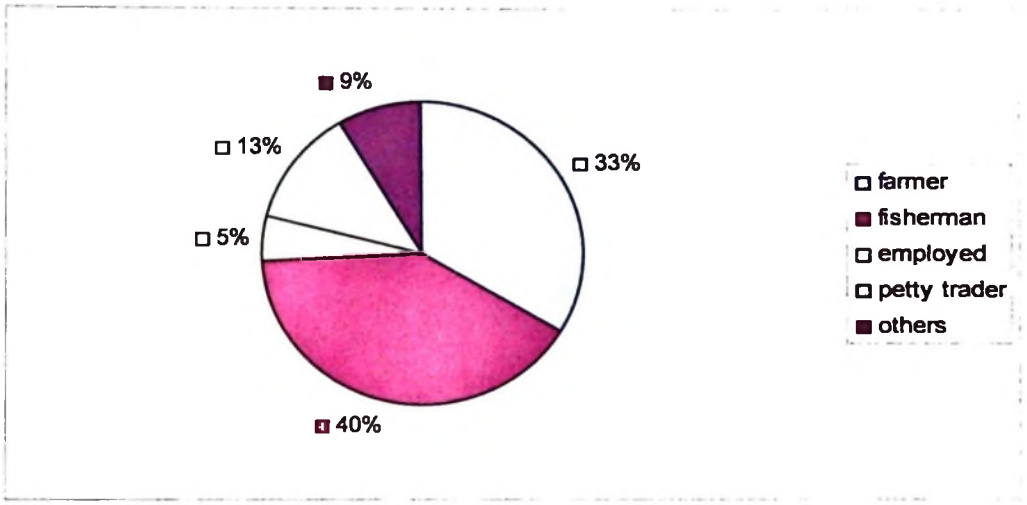


Fig 7: Occupations distributions for the surveyed households.

Table 10 show that about 58% of the respondents reported that there is an increase in fish catch between 10- 30% in the last five years. The Chi-squire test indicated a significant difference in income obtained from fisheries as compared to income from other economic activities in the study area ($p<0.05$). This observation is also shared by Kajembe *at al* (2000) in the study conducted in Rufiji delta. The study findings further indicate that 83.7 of the respondents acknowledge that there is direct relationship between the restoration of the mangrove forest and increase in fish catch. This observation is also shared by Bryceson *et al* (2004) who reported that fishermen have been able to get more income from higher volume of fish caught and that the community has made a direct relationship between the restoration of the mangrove forest in the area and increase in fish catch.

Hogarth (1999) reports that there is a statistically significant linear relationship between mangrove and fish. For instance, in western Malaysia the annual shrimps catch (C) in thousands of tones, was related to mangrove areas (A) in thousand of hectares, by the regression formula $C= 0.6368 + 0.5682A$. According to Hogarth (1999) the relationship between shrimps and mangroves applies equally to that between fish and mangroves. Using the above equation from a total of 11 147 ha of mangrove in the study area we get a total of 6334.4 metric tone of fish worth TAS 6.967×10^9. Ronnback *et al* (2002) reported that in many developing countries the annual market value of fisheries supported by mangrove ranges from USD 90 to USD 12 40 ha^{-1} mangroves with USD 3 40 ha^{-1} as a mean. Therefore by conserving the 11 147ha of mangrove in the project area and basing on above figures, the project is supporting fisheries estimated to worth USD 3.79×10^6 this is equivalent to (TAS 4.662×10^9).

The amount of daily fish catch is controlled by many factors, while status of the mangrove forest contribute to the amount and variety of fish in the water, fishing methods contributes to the sustainability in the amount and the size of fish catch. This is reflected in the variation observed in response on fish availability as presented in Table 10. Respondent from villages affected by dynamite fishing indicated that there is decrease in fish catches observation, which is also supported by fisheries official in Muheza district.

Table 10: Respondent's perception on fisheries availability

Fish availability	Chongoln n= 27 %	Kipumbwi n= 31 %	Machui n= 20 %	Moa n=26 %	Total n=104 %
Increased	59	65	60	46	58
Decreased	30	19	30	50	32
No change	7	13	10	4	8
Don't know	4	3	0	0	2
Total	100	100	100	100	100

Fig. 8 shows that there is a fluctuation in fish catches in the three coastal districts but general indication is that the fish catch has increased with the exception of Muheza district. According to fisheries official in Muheza district the fall in fish catch in Muheza district can be explained by the fact that there has been a prolonged dynamite fishing in the area that has resulted in decrease in availability of fish near the shore. This is supported by observation made by Jiddawi and Othman (2002) who argued that much of the pressure on fisheries in coastal Tanzania has been attributed to the use of fishing gear and techniques that are destructive such as Dynamite fishing. In Tanga, dynamite fishing has destroyed 10 percent of reefs completely beyond recovery (Leon *et al*, 2004). The steady increase in fish catch in Tanga and Pangani district is probably due the restoration and protection efforts made in the mangrove forests and the fact that dynamite fishing though reported was not as serious as for the case of Muheza district.

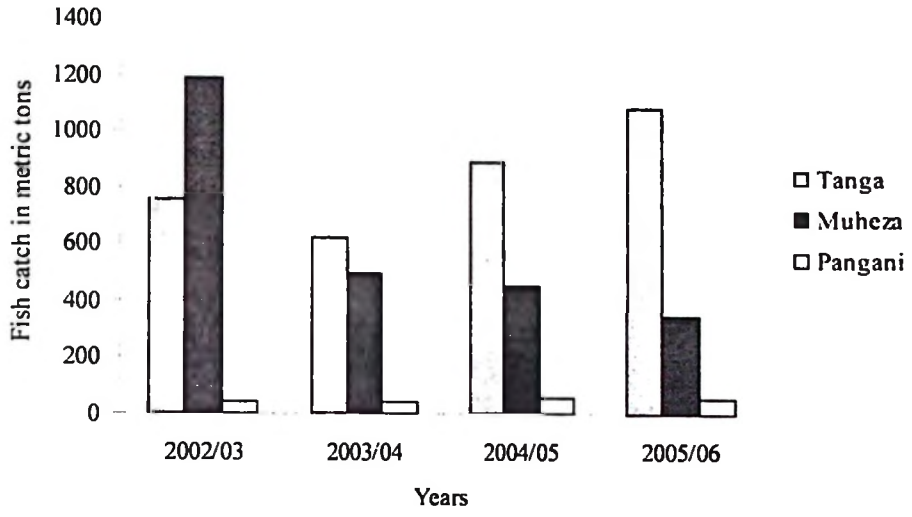


Fig 8: Fish catch Records for Tanga, Muheza and Pangani district.
Source: District fisheries office; Tanga, Muheza and Pangani.

Table 11 shows classification of forest by utilization classes according to management plan with substantial area set aside for ecological benefits including fish breeding sites. Conservation effort has enabled the degraded area to regenerate either through natural or artificial regeneration but also has minimized further degradation of the remaining mangrove forests hence enhanced the mangrove forest to meet its productive and protective roles as intended by the project.

Table 11: Distribution of mangrove by utilisation zones according to 1991 mangrove management plan

District/Block	Zone I	Zone II	Zone III	Zone IV	Total
I (Tanga and Muheza)	3166.5 ha	1944.5ha	3891.4 ha	400.9ha	9403.3
II (Pangani)	356.4ha	919.7ha	313.4 ha	166.1ha	1835.6
Total	3522.9	2864.2	4202.8 ha	567 ha	11 147

Source : Adopted from. Semesi 1991

Other ecological benefits

Study reviled that that only 80% of the interviewed household do not have latrine, this was confirmed by field observation where the researcher observed a lot of faeces along the beaches at low tide indicating that many people use beach as latrine. In additional to the direct use of beach as latrine the study also found that all untreated water in the project area is discharged into creeks lined by mangrove forests. Mangroves in all probability filter this discharged wastewater, thereby limiting coastal sewage pollution. Although no monetary data currently available in the country on the value of mangrove as water purifier, Hogarth(1999) repot that data from Fiji show that this value can be as high as USD $5820ha^{-1}$.

4.5.3 Income from alternative activities

The real impact of most of the introduced alternative activities is not yet seen but gradual adoption and existing potential indicate that they will contribute substantial income if existing constraints are addressed. For example, there was no beekeeping in the mangrove before the year 2000 as compared to 600 beehives found in this study showing an average increase of at least 100 bee hives per year with an estimated annual income of 21.6 millions per year. Fish and crab farming though slowly adopted have indicated substantial income and future potential as observed from crab farming in Pangani and fish farming in Machui village.

Economic impact of tree planting is not yet realized, as many of the planted trees have not reached harvestable size. However, it was reported that some farmers have already started to benefit from supply of construction poles for household use.

Majority (71%) of the people interviewed indicated lack of capital investment as the main constrains hindering establishing and expanding the identified alternatives income generating activities. This conforms with what was observed by Kisanga (2005) that people perceive that inability to access capital is the most serious constraints to initiating AIGA. Accessibility to credit play crucial roles in improving livelihood of a poor household by enabling them to fulfill their social need as well as economic roles in the society (Mroso, 2006). Table12 show responses of people interviewed when asked where they will invest if they obtain credit from financial and credit institution. About 76% of people interviewed mentioned activity they will invest if funds made available while 24% indicated that they will identify area to invest when they are assured of credit. This indicate that community themselves have the capacity to identify project when sensitized as have been done by the project. What is required now is to help the community to access credit facilities.

Table12: Respondents income generating activities preferences

Identified AIGA	No. Individuals	Percentages
Fish related activity	31	30
Business	10	10
Animal/poultry	24	23
Beekeeping	8	8
Agriculture	22	21
Salt production	4	4
Other	5	5
Total	104	100

Experience from related project shows that new sources of employment and income can be created as a result of efforts to promote these AIGA. Successful experience with the introduction of AIGA such as handicrafts, beekeeping, and seaweed farming

at the Mafia Island Marine Park (MIMP) generate income of about US$10 per day for participating members (Ruitenbeek *et al.*, 2005).

4.6 Cost -Benefit Analysis (CBA)

The CBA results are presented in two sections. The first section presents a summary of costs and benefits of the project while the second section present the sensitivity analysis of NPV.

4.6.1 Summary of costs and benefits

The identified, quantified and valued effects of the project aggregated at zonal level are summarized in cost and benefits Table 13. For detailed calculations the reader is referred to Appendix 4 of this work.

Table 13: Summary of costs and Benefits (Value x 1 000 000, Constant 2006 Prices)

Costs	Year 1	year 2	year 3	year 4	year 5	year 6	year 7	year 8	year 9	Year 10
Investment/ operation cost	31.870	56.000	40.675	46.365	64.979	92.060	46.000	65.334	58.165	76.130
Staff salaries	1.733	1.435	3.507	3.507	3.704	3.762	3.981	4.380	4.642	4.778
Protection cost-community		3.066	6.132	9.192	12.264	12.264	12.264	12.264	12.264	12.264
Training/ monitoring- IGA						4.560	0.440	2.560	0.600	0.600
Cost of hives/harvesting							2.490	2.775	1.200	1.200
Seedlings						1.936	1.936			
Tree planting						2.480	2.480			
Tending cost									4.066	
Fish ponds inputs									4.672	1.400
Total cost	33.603	60.501	50.314	59.063	80.947	117.062	69.591	87.313	85.609	96.372
Benefits										
Revenue collected by FBD	1.035	1.793	1.870	1.447	2.556	4.515	4.900	4.850	5.005	7.720
Pole used local construction						40.400	40.400	40.400	40.400	40.400
Fuel wood-mangrove						4.800	4.800	4.800	4.800	4.800
Poles potential not utilized						71.000	71.000	71.000	71.000	71.000
Fuel wood-planted trees						155.773	155.773	155.773	155.770	155.773
Ecological benefits										0.000
Poles from planted trees										
Income from beekeeping									21.600	21.600
income -Fish farming										7.200
Total Benefits	**1.035**	**1.793**	**1.870**	**1.447**	**2.556**	**276.488**	**276.873**	**276.823**	**298.575**	**308.493**
Net Benefits	**-32.568**	**-58.708**	**-48.444**	**-57.616**	**-78.391**	**159.426**	**207.282**	**189.510**	**212.966**	**212.121**

Costs	Year 11	year 12	year 13	year 14	year 15	year 16	year 17	year 18	year 19	Year 20
Investment/ operation cost	44.142	44.142	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000
Staff salaries	4.905	4.905	5.431	5.694	5.956	6.219	6.482	6.744	7.007	7.270
Protection cost-community	12.264	12.264	12.264	12.264	12.264	12.264	12.264	12.264	12.264	12.264
Training/ monitoring- IGA	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600
Cost of hives/harvesting	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200
Seedlings										
Tree planting										
Tending cost		4.066								
Fish ponds inputs	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400
Total cost	64.511	68.577	25.895	26.158	26.420	26.683	26.946	27.208	27.471	27.734
Benefits										
Revenue collected by FBD	8.005	8.473	8.473	8.473	8.473	8.473	8.473	8.473	8.473	8.473
Pole used local construction	40.400	40.400	40.400	40.400	40.400	40.400	40.400	40.400	40.400	40.400
Fuel wood-mangrove	4.800	4.800	4.800	4.800	4.800	4.800	4.800	4.800	4.800	4.800
Poles potential not utilized	71.000	71.000	71.000	71.000	71.000	71.000	71.000	71.000	71.000	71.000
Fuel wood-planted trees	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750
Ecological benefits	155.773	155.773	155.773	155.773	155.773	155.773	155.773	155.773	155.773	155.773
Poles from planted trees					23.232					34.848
Income from beekeeping	21.600	21.600	21.600	21.600	21.600	21.600	21.600	21.600	21.600	21.600
income -Fish farming	7.200	7.200	7.200	7.200	7.200	7.200	7.200	7.200	7.200	7.200
Total Benefits	**309.528**	**309.996**	**309.996**	**309.996**	**333.228**	**309.996**	**309.996**	**309.996**	**309.996**	**344.844**
Net Benefits	**245.017**	**241.419**	**284.101**	**283.838**	**306.808**	**283.313**	**283.050**	**282.788**	**282.525**	**317.110**

4.6.2 Sensitivity analysis of NPV

Table 14 shows variations in the NPV as the discount rate(r) was varied from 10% to 20%. The discount rate, which would approximate the NPV to zero, that is the internal rate of return (IRR), is also presented.

Table14: Sensitivity of the projects NPV to change of discount rate. (Values x 10^6 TAS at constant 2007 prices)

Year	Cost	Benefit	Net benefit	r=10%	r=15%	r=20%	r=35%	r=33
1	33.6	3.1	-30.5	-27.7	-26.5	-25.4	-22.6	-22.8
2	60.5	5.4	-55.1	-45.5	-41.7	-38.3	-30.2	-31.2
3	50.3	5.6	-44.7	-33.6	-29.4	-25.9	-18.2	-19.0
4	59.1	4.3	-54.7	-37.4	-31.4	-26.4	-16.5	-17.5
5	80.9	7.7	-73.3	-45.5	-36.4	-29.5	-16.3	-17.6
6	117.1	169.9	52.9	29.8	22.9	17.7	17.3	18.9
7	69.6	215.5	145.9	75.6	54.6	41.0	17.8	19.7
8	87.3	215.5	128.2	59.8	41.9	29.8	12.9	13.1
9	85.6	240.4	163.6	69.4	46.5	31.7	11.0	12.5
10	96.4	253.7	157.3	60.7	38.9	25.4	8.7	10.1
11	64.5	249.6	185.1	64.9	39.8	24.9	6.8	8.0
12	68.6	250.0	181.5	57.8	33.9	20.0	4.9	5.9
13	25.9	250.0	224.1	64.9	36.4	20.9	4.5	5.5
14	26.2	250.0	223.9	59.0	31.6	17.4	3.3	4.1
15	26.4	273.3	246.8	59.1	30.3	16.0	2.8	3.4
16	26.7	250.0	223.4	48.6	23.9	13.9	1.8	2.3
17	29.9	250.0	223.1	44.1	20.7	10.0	1.4	1.7
18	27.2	250.0	222.8	40.1	18.0	8.4	1.0	1.3
19	27.5	250.0	222.6	36.4	15.7	7.0	0.7	1.1
20	27.7	284.9	257.2	38.2	15.7	6.7	0.7	0.9
Total	**1091.0**	**3679.1**	**2599.9**	**618.7**	**275.1**	**145.3**	**-8.2**	**0.3**

The results in Table14 show the NPV of 618.7, 275.1 and 145.3 at discount rate of 10%, 15% and 20% per annum respectively. The result indicates that the project is economical even at discount rate as higher as 20%. This implies that investment and project cost can be recovered at the end of assumed project life of 20 years. This observation shows that the magnitude of the NPV decreases by 76.5 % with increase in discount rate from 10% to 20%. With the low interest rate therefore it is easier to encourage private companies to invest in forestry because the present value of future

benefits is reasonably high compared to the situation when high discount rate are used. The rate of return (IRR) of this project is 33%. This implies that for the project to recover its investment and operating coast and yet be able to breakeven. and then the maximum interest rate that the project can pay for the resource used is about 33 %. The IRR is much higher than the World Banks rate of 10% and the local bank rate of 18% this is the proof that this project is profitable.

Similar study on forestry project in developing country Tanzania included shows that forest project can be quite efficient in using resource. Evaluating afforestation project in Mwanza in Tanzania Ngate (2001) found a positive NPV of about 4383.6 millions at 10% and 20 years time horizon. Similarly, Kessy *et al.* (1993) reported a positive NPV of about 270.25 millions, at 10% discount rate and 20 years time horizon for village afforestation project in Legho Mulo in Moshi in Tanzania.

4.6.3 The 'Switching Value' approach

According to Gittinger (1982) in carrying project evaluation it is important to find out how much the project economic efficiency will be affected should project change in unfavourable direction before the project would fail to meet the minimum level of acceptance as indicated by measures of project worth, in this case the NPV. In carrying out this the switching value approach was used to establish the value of which would turn the NPV of the project to zero. The variation in NPV when benefits are assumed to be reduced by different magnitudes without varying the discount rate is presents in Table15.

Table 15: The project NPV at r = 10% with reductions in Benefits (values x 10^6 TAS at constant 2007 prices)

Year	cost	Benefit	NPV when benefits are reduced by 50%	54%	54.5%	54.3%
1	33.6	3.1	-29.1	-29.2	-29.3	-29.3
2	60.5	5.4	-47.8	-47.9	-48	-48
3	50.3	5.6	-35.7	-35.9	-35.9	-35.9
4	59.1	4.3	-38.9	-39	-39	-39
5	80.9	7.7	-47.8	-48	-48.1	-48
6	117.1	169.9	-18.1	-22	-22.5	-22.3
7	69.6	215.5	19.6	15.2	14.6	14.8
8	87.3	215.5	9.5	5.5	5	5.2
9	85.6	240.4	14.7	10.6	10.1	10.3
10	96.4	253.7	11.7	7.8	7.3	7.5
11	64.5	249.6	21.2	17.6	17.2	17.4
12	68.6	250.0	18	14.8	14.4	14.5
13	25.9	250.0	28.7	25.8	25.4	25.6
14	26.2	250.0	26.1	23.4	23.1	23.2
15	26.4	273.3	26.4	23.8	23.4	23.6
16	26.7	250.0	21.4	19.2	18.9	19
17	29.9	250.0	19.7	16.8	16.6	16.7
18	27.2	250.0	17.8	15.8	15.6	15.6
19	27.5	250.0	15.9	14.3	14.1	14.2
20	27.7	284.9	17.1	15.4	15.2	15.2
Total	1091.0	3679.1	**50.4**	**4**	**-1.9**	**0.3**

Results in Table 15 indicates that the project would still be economically viable and worth undertaking at discount rate of 10% even when benefit were reduced by 50%. In fact, the project would break even (NPV = 0) when the reduction in benefit was in the magnitude of about 54.3%. Reduction beyond 54.3% would make the project inefficient. The rate could be higher than 54.3 if other benefit offered by the mangrove such as coastal protection, carbon sequestration and water purifications could be calculated and added in to the benefit estimate of managing the mangrove ecosystem. These benefits were omitted in the calculation due to lack or existence of inaccurate data.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

Mangrove ecosystem in the study area supports a number of coastal households and represent base for sustainable economic exploitation of the coastal resources. The study findings revealed that there is increase in mangrove and mangrove ecosystem related products as a result of conservation effort. Results indicates that 40.4% of the people interviewed carry fisheries activities as main source of income and fisheries contributes about 48% of the total family income in the study area. The study findings further reveal that there is a direct relationship between mangrove status and coverage in the study area and increase in fish catch. About 72% of the houses in the study area are constructed using mangrove poles as construction material and field observation indicates that mangrove will continue to be the main construction material in the near future due to observed prevailing economic hardships.

There is reduction in protection cost by 20-40% through involvement of local communities. This demonstrates clearly the importance of Local community's participation in mangrove conservation as a means to ensure the sustainability in the conservation and use of the mangrove ecosystem. More than 90% of all fishers, regardless of where they fished. indicated that mangrove provided protection and act as a nursery site and should be protected. Only direct use benefits estimate from this study was used in the calculations and not intangible benefits such as coastal protection, which paradoxically is perceived by the community as one of the most important functions of the mangrove ecosystem.

The study findings reveal that access to alternatives income generating sources for rural people is very important to enhance protection and sustainable natural resource management but lack of credit facilities is the main constraint to successful adoption of the initiated AIGA. The study further indicate that there are outstanding efforts in supporting alternative livelihood supports but fund set aside for this supports from the project was too small to bring the required impacts. However though the economic impact of the initiated income generating activity is currently seen as negligible there is huge potential for expansion of the initiated livelihood option in the future if community is educated and helped to access the credit facilities.

Under the stated assumptions in the previous sections the project was found to be economically efficient at 10%, 15% and 20% discount rates with NPVs of about TAS 618.7, 275.1 and 145.3 million respectively. The internal rate of return was found to be 33 %, higher than the World Bank recommended rate of 10% for donor funded projects and the current bank charge rate indicating that the project is economically efficient. The study identified a number of uncertainties, which may likely affect the project profitability. Using the switching value approach in sensitivity analysis it was found that the project would still be economically efficient even if the uncertainties would reduce the project benefits by 50 %. It is therefore concluded that the decision to undertake the project as opposed to the do nothing alternative was worthwhile.

5.2 Recommendations

The foregoing discussions have led to the logical conclusion that the mangrove management project is profitable to both local communities and the economy as a whole. In order to make the achievement made by the project sustainable the study has come out with the following recommendations.

a) Involvement of local communities in mangrove forest management has proved to be effective in reducing illegal activities and forest protection cost. Therefore there is an urgent need for the government to speed up putting in place mechanism for equitable cost benefit sharing.

b) Forest resource assessment is needed to update the existing management plan, which is long overdue.

c) Reforestation of degraded mangrove area should be continued to recover the remaining degraded mangroves as restoration effort in the formally degraded mangrove area has already demonstrated the feasibility of mangrove reforestation.

d) Credit provision is required to improve capital availability and enhance self-employments in the newly identified alternatives livelihood option in order to reduce pressure on natural resources.

e) More research is needed to study the contribution of indirect benefit of the mangrove ecosystem to community's welfare.

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APPENDICES

Appendix 1: Questionnaires

A: Household particulars

1.1 Name of interviewer.....
1.2 Name of respondents.....
1.3 Respondents identification number.....
1.4 Village Name.....
1.5 Ward.....
1.6 District.....
1.8. Household characteristics

Respondent name	Sex	age	Marital status	Education level	Main occupation	Household head sex

1.9 Total number of people in the house.....
1.10 Dependants

Pre-school	Primary school	Secondary school	Institute	others	Total

B: Products obtained from the Mangrove ecosystem

2.1 What benefits do you get from the mangrove ecosystem?

Mangrove ecosystem product /services	Consumptive (subsistence)	Productive (for sales)

2.2 Was mangrove poles used in the construction of your house Yes/ No?....
2.3 If yes how many poles (*boriti* and *pau*) were used?.....
2.4 How do you get mangrove poles (1) Free access (2) permit but free (3) permit with payment.....
2.5 Do you now procedures required for a person to get harvesting license? Yes/No
2.6 If yes mention them.....
.....
2.7 Where do you get fuelwood for house hold use ?.....
2.8 What is the status of availability of the mangrove and related product now as Compared to 10 years ago?

Availability	Mangrove poles/wood	Bee Products	Fisheries products	Seaweed	Salt production
Increased					
Decreased					
No change					

2.9 What is the most important value of Mangrove forest to you?
(01) Provide forest products (02) Provide protection (03) Has scenic value
(04) Provide fisheries products .....

C: Ownerships of properties and economic assets
3.1 Do you own land? YES/NO.....
3.2 If yes what is the total area of the land owned in hectares .....
3.3 If no where your family drives its livelihood (01) Grow crop on borrowed land
(02) We grow crop on clan owned land (03) We don't farm we buy our food.....
3.4 Is land a constraint for you in crop production? Yes/ No.....
3.5 What are the other constraints for agriculture development?
(01) Vermin (02) Lack of farming inputs (03) Weather (04) Lack of extension staff
(05) Soil fertility.....
3.6 What equipment among the following do you own?
(01) Bicycle (02) Powered Boat (03) Sailing boat (04) Canoe .....

4.0: Family income generating sources

4.1 How much is earned by each member of the family from the sale of mangrove and mangrove related products per year in TAS

Product	Farther	Mother	Sons	Daughter	Tot income
Poles					
Fuelwood					
Bee products					
fish					
seaweeds					

4.2 What is your level of dependence on the mangrove ecosystem?

(01) Very high (02) High (03) moderate (04).....

4.3 What type of crops generated cash for your family last year (2005)?

Crop/animal	Last year's production	Crop used for food	Crop sold	Cash generated

4.4 Income obtained last year (2005) from non farm income sources?

Item	Income per month	Total income per year
Formal employment		
Casual labour		
Business		

4.5 Are you satisfied with your current income Yes /No .....
4.6 What is the reason for your current income to be at this level? .....

5.0: Impact of the current conservations programs

5.1 Which mangrove related income generating activity you and or your family practice? (01) Beekeeping (02) Seaweed (03) Fish farming (04) Forestry (05) selling marine related products(06) Salt production.....
5.2 Do you think there is any relationship between fish catch and mangrove condition Yes /No.....
5.3 If yes list species associated with mangrove.....
.....
5.4. What is the status of mangrove associated fish species to non mangrove associated fish in normal fish catch in the last 5 years?
(01) Increased (02) decreased (03) not changed (04) I don't know.....
5.5 Do any member of your family practice aquaculture Yes /No.....
5.6 If the answer is yes which species do you farm (01) Fin fish (02) Prawn (03) Crabs (04) Oyster .....
5.7 If the answer to no 5.5 is no what is the reason (01) Lack of awareness (02)Technology (03) Lack of good site (04) Lack of capital.....
5.8 Do any member of your family practice seaweed farming Yes/No.....
5.9 How much seaweed did you produce last year in kg.....
5.10 How is the market situation Reliable /not Reliable.....
5.12 Do you own solar salt production farm Yes/No.....
5.13 If the answer is yes when was it established.....

Name of farm	Area	No of employees		Production kg /year	Income /year
		permanent	casual		

5.14 What was the establishment cost.....
5.17 Do any member of your family practice beekeeping Yes/No.....if yes how many Beehives do you have.....
5.18 If the answer to question no 5.17 is yes how many beehives do you have .....
5.19 How much was produced last year.....liters of honey and .....kg of bees wax
5.20 What was the price for each product .....Tsh/ liter and .....Tsh / kg of bees wax
5.21 Have you ever secured any loan/financial support from any institutions to undertake any income generating activities Yes/No.....
5.22 If the answer in no 5.21 is yes what the loan/support was used for.....
.....
5.23 If you are given a loan today to invest which activities do you think will be the best for you to invest the money.....
5.24 Why do you think your choice is the best option.....
.....
5.25 Have you noticed any resource use conflict between user groups Yes/No...?
5.26 If answer to 5.25 is yes what was the conflict about.....
.....
5.27 What was the condition of the forest before the project.....
.....
5.28 What has bee the major destructive activities to forest resources before the project.....
5.29 What is the condition now as compared to the status before the project.....
.....
5.30 Is the current management of the mangrove ecosystem effective Yes/No?.....
5.31 What do you think can be done to make it more effective.....
.....

5.32 Erosion has been observed to destroy some properties like farms and building in some places along the coast have observed any destroyed properties in your village Yes/No.....
5.33 If yes can you list some of the destroyed properties you have observed?
(01)..... (02)..... (03)..... (04).....

5.34 What do you think was the main cause.....

5.35 What have been done to reduce the impact and by who.....

5.36 Is dynamites fishing common in this area Yes/ no .....

5.37 How many in a month can you hear dynamite blast.....

5.38 How can you compared it with the blast five years ago (01) increased (02) decreased (03) no change.....

5.39 Do you participate in any natural resources conservation activities Yes/No?.....

5.40 If yes in which activity do you participate and how frequent.....
.....
5.41 If no why.....

5.42 Have you planted trees in your home garden or farm Yes /No.....

5.43 If yes how many .....and of what species.....

5.44 What is intended end use of the planted trees.....

5.45 What type of hand craft activities do you do .....

5.46 What raw material do you use for handcraft.....

5.47 Do you know any conservation project working in village Yes/No?.....
5.48 If yes list them (a)..... (b)..... (c)..... (d).....
5.49 List three main activities performed by Mangrove Management Project
(a)..... (b)..... (c).....
5.50 How do you rate the project as regards to their support to conservation of coastal Resources (01) Very effective (02) Effective (03) Very little .....

5.51 How have you benefited from the mangrove management project activities? (01) Knowledge (02) Financially (03) availability of mangrove resources (04) Increased availability of fish (05) Protection against bad weather.....

5.52 What is the main /outstanding project impact in your village.....

.....

5.53 What could be the situation of the forest without the project.....

.....

Appendix 2: Checklist for key informants

A: Regional Natural Resources Officer

1. Link between Regional and Districts
2. Coordination between Organization and Projects working in the two districts
3. Regional strategies on the use of natural resources for poverty reduction
4. Region investment opportunity as regards to coastal tourism
5. Comments on capacity and performance of the institutions working in the Districts

B: Project managers (MMP, TCZDP, SEMMA)

1. Objectives of their projects and how it was implemented
2. Approach used in implementing project programs
3. Effectiveness of the approach used by the project in helping the communities
4. Problems experienced in implementing programs
5. Outstanding impacts of the project in sustainable use of resources and Livelihood support
6. Financial/technical support provided by the projects to local communities in Initiation of small scale income generating activities
7. Coordination of the activities of the three projects
8. Collaboration between the project and other stake holders
9. Tourism potential
10. Project funding (investment, development and operational cost)

C: Checklist for fisheries officers

1. Major threat to fisheries
2. Effectiveness or failure in law enforcement
3. Relationship between fish catch and mangrove (species quantity, quality)
4. Change in fish resources availability in the last five years
5. Marculture development, its potential and problems
6. Forum for solving conflict between seaweed farmer and fisherfolks
7. Market situation for marine related products (fish, crabs and seaweed)

D: Village leaders and VNRC

1. Involvement of local communities in mangrove ecosystem management
2. Existence of mangrove management plan and management agreements
3. Cost-benefit sharing arrangement between village and FBD
4. Existing livelihood options both mangrove and non mangrove related
5. Resource use conflict between different user groups
6. Changes in the resources status (in terms of quantities and qualities)
7. Forum for resource users expresses views on the utilization of the resources
8. Policy and regulation as regards to the use of mangrove ecosystem resources
9. Effectiveness of the law enforcement in dealing with illegal activities
10. Revenue from the harvesting or any use of the mangrove ecosystem resources
11. Environmental destruction Erosion, Encroachment, pollution
12. Impact of donor funded conservation project working in Tanga /Muheza
13. Governments Roles in support participate in mangrove ecosystem management
14. Marine related investments in the village.

E: Investors /project directors in mangroves and marine related projects

1. Land title acquisition procedure
2. Regulations and monitoring procedures as regards to impact of the project
3. Establishment cost including acquisition of land
4 Operation cost of the project
5. Sources of funds, own money or loan
6. Employment opportunities and Labour cost
7. Duration before harvesting and life span
8. Production capacity of the project
9. Marketing as regards to reliability and price

Appendix 3: Salt Farms in the mangrove area of Tanga Region

S/No	Farm name	Area in ha	Remarks
1	Jasin salt farm	20	Productive
2	Burhan Salt	172.5	Productive
3	Manoti and Partiners	17.8	Non productive
4	Fakhiri Salt farm	53.4	Productive
5	Esry salt distributors	7.8	Non productive
6	Amour Abdala	17.8	Productive
7	Dibwa Mpango	15.6	Non productive
8	Z. Babu salt farm	17.8	Productive
9	Bausi Salt Farm	10	Non productive
10	Manza salt farm	10	Productive
11	Mwangala salt farm	4	Productive
12	Vuo salt farm	10	Productive
13	Ukombozi salt farm	14.4	Productive
14	Alfan Mohamed salt	15.0	Productive
15	A. Almoyo salt farm	15.3	Non productive
16	K Mohamed salt farm	14.4	Non productive
17	Adbala Sudi salt farm	14.6	Non productive
18	A. Mote salt farm	17.8	Productive
19	Msengo Salt farm	10	Productive
20	Sodawala salt farm	13.2	Productive
21	Chongolean salt farm	53.4	Productive
22	Mnyipolo salt farm	4.0	Non productive
23	Albait salt farm	6.5	Productive
24	Kisosora salt farm	4.4	Non productive
25	Nasoro salt farm	4.0	Productive
26	Kombo salt farm	4.0	Productive
27	Mustafa salt farm	5	Productive
28	Meimusa salt farm	12.5	Productive
29	Hussein salt farm	12.5	Productive
30	Maere group salt farm	12.5	Productive
31	Kivindani salt farm	50.2	Productive
32	Maere kijiji salt farm	9	Productive
33	Kiwavu salt farm	12.5	Productive
34	Kiwavu salt products	15.5	Productive
35	Mtangati salt farm	10	Productive
36	Snadi salt farm	6.5	Productive
37	Eleck salt farm	6.8	Productive
38	Mwarongo salt farm	15.1	Productive
39	Abushiri salt farm	10	Productive
40	Sadan salt group	17.8	Non productive
41	Tomms salt farm	68.2	Non productive
42	Buyuni salt farm	10.4	Non productive
43	Kusabi salt farm	17.8	Non productive
44	Jumaa salt farm	17.8	Non productive
Total		**857.8**	

Appendix 4: Calculations and assumptions

Community protection costs

According to project records in each of the 47 villages surrounding the mangrove forest there is a VNRC established to take care of day to day protection of the forest. The number of people involved per day is not constant, but if we assume that on average at least 2 members participate in protection activities for at least 2 hours per day. Therefore we have 4 hours spent on protection activities in each of the 47 villages. A normal working man-day is 8 hours therefore: 4 hours village^{-1} x 47 village/8 hour's manday^{-1} = 24 man-days

The labour cost per day is therefore 24 man-days x TAS 2000 man-day x 0.7 = TAS 33,600/= per day as community protection cost which give us a total annual protection cost by the community of TAS 12 264 000/=

Beekeeping products

Results indicates that there is a total of 600 hives in the mangrove areas in the three coastal district

- Average production per hive last year was 10 litres of honey and 1.5 of bees wax per hive
- Market survey revealed that a litre of honey is sold at TAS 3000 litre^{-1} while beeswax sale at TAS 4000 kg^{-1}
- Therefore income generated from bee's products is as follows
  10 litres hive^{-1} x 600 hives x TAS 3000litre^{-1} = 18 000 000
  1.5 kg hive^{-1} x 600 hives x TAS 4000kg^{-1} = 3 600 000
  Total income from bees products = TAS 21 600 000

Fish farming

Survey indicates that 5% of interviewed household head participate in fish farming (fin fish and or crabs). Survey result shows that there are a total of 17 fish ponds and three salt farms carrying out fish farming. Fish harvesting is done every six month (Twice a year). Average fish production per pond was 350-360 kg per pond per year. Market survey indicates that a Kilogram of fish is sold between TAS 1000 to 1500 with a mean of TAS1200/kg. (350+360)/2 = 426 000. Total revenue which can be gained from this initiative is therefore (350+ 360)/2 x 1200 x 17 ponds = TAS 7 242 000

Fuelwood collection from the mangrove forest:

Results indicate that 3.46 of respondent use mangrove as main source of fuelwood but also supplement it from the fuelwood collected from farm lands. There is a total of 1284 household in the village 4 village sampled out of 47 villages adjacent to the mangroves. If we assume other village adjacent to mangrove forests will have the same population size per village. Then total household using mangrove as a source of fuel wood is 1282/4 x 47 x 3.46/100 = 522 household. Average volume of wood of normal head load according to this study was 0.148m^3. Survey indicate that on average a family collect fuelwood twice a week that means 0.148 x 2 = 0.296 m^3

Therefore a total of 522 x 0.296 x 52 weeks = 8034 m^3 of fuelwood are used annually. The family using mangrove fuelwood also get addition wood supply from farm and general land. It is estimated that fuelwood from farm land contribute about 40% of family wood requirements and mangrove wood contribute 60% then: Total annual mangrove wood collected is 0.6 x 8034 m^3 = 4820.4m^3 x TAS1000/m^3 = 4

820 400. By rehabilitating and conserving degraded mangrove area project ensure constant supply of fuelwood of $10m^3$ x 7069ha = $7069m^3$ of wood which is above the currently exploited volume , the volume which could not be obtained if the forest was not protected.

Mangroves construction poles

According to Semesi (1991) if the productive zone can be divided into equal ten year coupe it is possible to harvest sustainably 35 scores of mangrove poles per hectare(15 scores/ha of class I-II; 20 poles /ha of III- IV) through selective harvested from the productive zone annually. The total area under productive is 7069 ha this include area formally classified as recovery zones. This give a total of annual allowable pole cut of 35 $scoresha^{-1}$ x 706.9 ha = 24 742 scores. Valued at 24 742 x 4500= 111.3 x 10^6

Results indicate that 68%of respondent have mangroves constructed house of which 35% was constructed during the project. Survey results indicate that an average house need 18 scores of mangrove poles. If we take the assumption made above in calculating fuelwood the total number of poles used for house construction 0.35 x 15080 x 17 (No of scores $house^{-1}$) = 89 726. This is the amount of poles used in the period of 10 years which is equal to 8972 scores per year. If we value the amount of construction poles used for constructions of local house using the current market price of TAS 4 500 we find that poles used worth 8972 x 4500= TAS 40.3 x 10^6 per year. The harvested volume of poles of is far below the permissible volume according to mangrove management but this constant volume can only be obtained because of the good mangrove management as indicated by many respondents in the survey. Potential unexploited poles: 111.3 x 10^6- 40.3 x 10^6 = 71 x 10^6

Wood products from Planted Species

It was not possible to get data on total number of tree planted from other sources and from the seedling raised from village nurseries. These calculations are based only on seedling provided by the project and reported survival percentages. Total number of tree planted was 193 600 interview indicate that at least 60% of the planted trees survived therefore: 193 600 x 60/100 = 116 160. To convert the number of tree planted into hectare we assume a spacing of 2.5m x 2.5 m of which the number of tree ha^{-1} using this spacing is 1600. Therefore: 193600/1600 = 72. 6ha

It is assumed that half of trees planted will be harvested as construction poles and the remaining as fuelwood and all the harvesting cost is paid by the customers. Farmer interview and experience from other tree planting project in the region indicate that most of the planted species can reach a harvestable size as construction poles at the age of 10 -15 years. (Poor soil fertility. At the age of 10 a thinning will remove about 40% of mature trees poles trees species and the remaining 60% will be removed at the age 15. Farmer will sale standing poles and all harvesting cost will be paid by customer. The income to be realized from the sale of poles from the planted trees will be as follows;

At the age of 10 years 58 080 x 40/100 x 1000 shilling $poles^{-1}$ = 23 232 000

At the age of 15 years 58 080 x 60/100 x 1000 shilling $poles^{-1}$ = 34 848 000

Total income generated from the sale of construction poles from the planted species is TAS 58 080 000.

Fuelwood from planted species

It is assumed that there will be no sale of fuelwood but the produced fuelwood will be used by farmers household fuel need. Research result indicated that Fuelwood collector use an average of 2.5 hours to collect one head load of fuelwood from the general land and the household collect fuelwood two time a week. The family planted trees will save this time spent by collecting fuel wood from the tree planted in the vicinity of they house. The equivalent of money saved can be calculate using reveled price and shadow prices as follows.

Time save:

1 head load take 2.5 hours, one head load was estimated to be $0.148m^3$ of stacked volume. Therefore $1m^3$ will take 1/0.148 x 2.5hrs = 16.89 hrs. This is equivalent to 16.89/8hrs x TAS 2000/Monday x 0.7 = TAS 2 955.75. Survey found that a 10 years tree of most of the fuel wood species planted in the area can produce an average of 0.25 to 0.5 m^3 staked volume with an average of $0.437m^3$ stacked volumes. From 58080 trees a total volume of 25380.96 m^3 is expected to be harvested. This volume will save time equivalent to 25380.96 m3 x TAS 2955.75/ m^3 = TAS 75 019 773 If we distribute the monetary value of this saved time equally in the period of ten years we get an average value of TAS 7 501 977.

Mangrove contribution to fisheries

Many scientists indicate a strong relation between fish catch and the status of the mangrove forests. However they differ on the amount of fish that a hectare of mangrove does support. For example Ronnback *et al* report 340 USha^{-1} while Costanza *et al* (1997) and FAO, (1979) have reported the value to be US$ 466ha^{-1} and US$ 130 ha^{-1} respectively. Giesen *et al.* (1991) calculated a net value of $600 per hectare per year, while a study conducted in the United States by Contanza *et al.*, (1989) established an estimated annual economic value of coastal mangrove productivity for commercial fish harvests at $62.66 per hectare. If we take the average of the five values we get 319.7 US$ ha^{-1} which is equivalent to TAS 390 073 .4 ha^{-1}. The total and the mangrove in the study districts is 11 147 ha this give an estimate of the value of fish supported by the mangrove forest to be 4.3481442×10^9

According to Hogarth (1999) amount of fish catch (C) in tons is related to mangrove Area (A) in thousand hectare using developed equation as follows; C = 0.6368 + 0.5682A. The contribution of the mangrove in project area C= 0.6368 + 0.5682 x 11147ha = 6334.36 tons. With the average fish price of TAS 1100 Kg^{-1}in surveyed village therefore mangrove fish catch potential = 6334.36 x 1000 x TAS 1100 = TAS 6.967798×10^9

Calculations based on survey data

A) Survey results indicate that 83.7 of the respondents there is a relationship between fish catch and mangrove restoration. Survey further indicate that about 40.4 % of the interviewed household head carry out fishing as the main income generating activity with mean annual income of TAS 458 365. Districts Records from the districts fisheries office indicates that there about 3480 fisher on average in the three coast districts. This gives an average annual income from fisheries of TAS 1.595×10^9. However it is very difficult get actual figure for fish increase as a result of mangrove

restoration due to lack of baseline data. In this situation if we assumed that management initiative has contributed to at least 10% of the amount fish catch we get contribution of fish catch worth TAS 1. 59 511 x 10^8

B) District fish catch record shows that an average of fish worth TAS 1.52035 x 10^9 per annum was harvested from the three coastal districts. As assumed above we take 10% of the fish record to be the contribution of the good conserved mangrove, which gives us the value of 1.52035 x 10^8. If we take the average of the two value A and B we get (1.59511 x 10^8 + 1.52122 x 10^8)/ 2= **1.55773 x 10^8**