Exploring the Feasibility of Implementing Payments for Environmental Services in Tanzania

'A case study of Gwata Village'

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by

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Abstract

Over the past few decades, there has been Several global summits, conferences and agreements including the Kyoto protocol, the Earth charter Initiative, Agenda 21 and the recent Copenhagen Conference that aim to regulate the relations between people and their environment in order to achieve sustainable use of the earth's limited resources and to reduced carbon emissions into the atmosphere in the coming decades. These initiatives demonstrate important recognition of the nature of environmental problems; that they are complex with a lot of uncertainties and cannot be effectively dealt with on piecemeal and ad hoc bases. As such there is the need for a unified effort and a strong political will to be able to make any appreciable strides on solving them. This study in contributing in part towards this global efforts, conducted the feasibility of using Payment for Environmental Services (PES) to support local forest managing communities in Tanzania, the case of Gwata village. This research identified that NDVI change maps for selected periods between 1991 and 2008 showed a progressive decreased of vegetation cover from 1991 to 2008. While the Kimunyu forest suffered much deforestation between 1991 and 2000, the years between 2000 and 2008 show a significant improvement in the forest cover. This could be attributed to the establishment of the Kimunyu forest reserve in 2000. Kintulangalo forest on the other hand remain stable 1991 and 2000, but between 2000 and 2008, there was a significant reduction in forest cover. This was explained during the focus group discussion that there was a wild fire outbreak in 2007. Studies on the willingness and institutional readiness to accept PES was also done. It was realised from related works by Wiley (1999) that the village communities in Tanzania are far advanced in the management of their forests. The interviews indicated that households in the study area were willing to accept PES on condition that lucrative packages better than their current economic activities was necessary to ensure the successful acceptance of PES. Alternatives livelihoods include poultry and pig farming.

Keywords: payment for environmental services, climate change, carbon sequestration

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1.   Chapter One - Introduction

1.1.   Background

There is large and growing evidence that climate change is currently occurring due to increasing global temperatures. According to the IPCC, in the 20th century, global temperatures increased by 0.7^0C due to increasing concentrations of green house gases (GHG) in the atmosphere. These gases include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2 O). It has been estimated, however, that if the concentrations of these gases in the atmosphere continues, the average temperature at the earth surface could increase from 1.8 to 4^0C above year 2000 temperature levels by the end of this century (Houghton, Ding et al. 2001). Studies indicate that CO_2 concentrations outweighs all other factors contributing to changing climate and this is largely attributed to anthropogenic activities as the cause. There is growing concern over the extent to which climate change is influencing our world. Biological diversity is being lost, frequent forest fires are occurring due to high temperatures, and many parts of the world get flooded either due to rising sea level or due to heavy down pours, to name a few (Thomas, Williams et al. 2004). These problems have necessitated a series of global summits, conferences and agreements including the Kyoto protocol, the Earth charter Initiative, and Agenda 21 that aim at regulating the relations between people and their environment in order to achieve sustainable use of the earth's limited resources.

Under the Kyoto protocol, flexible mechanisms including Clean Development Mechanism (CDM) were designed to cover initiatives on improving forest stance for carbon sequestration by adding to existing forest through Aforestation (A) and Reforestation (R) (Minang, Bressers et al. 2007). Aforestation is the planting of trees where there were no trees initially and reforestation is the planting of trees where there was trees initially but has been cleared off by some means. Whiles many works has been done under the CDM, very few were done in terms of forestry(Engel, Pagiola et al. 2008). The reasons include the top down nature of the A/R CDM projects and the bureaucratic and stringent rule which have to be followed for implementation. Also Aforestation and Reforestation produced monoculture forest that lacks biodiversity. Recognising the importance of existing forest, biodiversity and the need to protect existing sink as their removal through deforestation and degradation contribute about 18-20% of global carbon emission, the UNFCCC considered and reached agreements on setting up funds to supporting Reducing Emissions from Deforestation and Forest Degradation of existing sinks the next phase of the Kyoto protocol, held in Copenhagen. This creates opportunity for developing nations to manage and conserve natural forest while improving their livelihood.

The value of the natural forest goes beyond direct uses such as provision of food and harvesting of timber to the provision of ecosystem services which include watershed and biodiversity protection, protection of cultural and aesthetic heritage and carbon sequestration. Ecosystem services are the conditions and processes through which natural ecosystems and the species that make them up, sustain and fulfil human life (Daily 1997). Forest performs critical services to climate by removing CO_2 from the atmosphere and storing it as carbon. The Tropical forests have been found to be of enormous importance to the global carbon cycle since they store up to about 50% more carbon per hectare than temperate and boreal forest (Cramer, Bondeau et al. 2004). The removal of the Tropical forest cover through deforestation and degradation therefore contributes to carbon emissions. It has been argued that the increasing concentrations of CO_2 in the atmosphere can be attributed to tropical deforestation and degradation (Houghton 1990). Studies suggest marked increase in tropical deforestation in the 1980s, with the overall rate doubling from 0.6% in 1980 to 1.2% in 1990 (Barbier and Rauscher 1994; Laurance 1999). According to FAO (2006) about 130,000 – 500,000 hectares (ha) of Tanzania's tropical forest is lost through deforestation each year. However in 1995, the country's forest was estimated at about 32.5 million ha which represents 37% of the total land area.

While environmental services are being lost or degraded, tropical countries also miss opportunities for maintaining and enhancing sustainable livelihoods including sources for income and employment. Measures to mitigate the problem of deforestation in the tropics have been through traditional government policy tools such as conservation by protection using environmental taxes and forest certification processes. Another measure is the Integrated Conservation and Development Projects. Though such measures worked to some extent, they failed to adequately sustained forest, and much was lost through deforestation and forest degradation. A number of reasons have been given for this. Whiles public participation is important in environmental decision making the command and control style fails to make provision for it (Jeffery 2005). According to Kiss (2004), protected areas are often very few, small in size and are highly threatened to be relied upon for conservation. Over the last decade, significant interest has grown in market-based mechanisms including Payment for Environmental Services (PES) for forest conservation. The concept has attracted increasing interest as a mechanism to translate external, non-market values of the environment into real financial incentives for local actors to provide as environmental services (Engel, Pagiola et al. 2008). The concept has been defined as "a voluntary transaction where a well-defined environmental service (or a land use likely to secure that service) is being 'bought' by a (minimum one) service buyer from a (minimum one) service provider if and only if the service provider secures service provision (conditionality)"(Wunder 2005; Engel, Pagiola et al. 2008). PES programs vary in terms of the environmental services they are used to sustain. These include watershed management, forest conservation and carbon sequestration, and protection of endangered species. PES has an advantage of protecting natural resources whiles providing additional income sources for the rural land users, helping to improve their livelihood conditions (Pagiola, Arcenas et al. 2005).

However, most PES initiatives were conducted in developed countries, notably the United States and Australia, but in recent years more activities are emerging in developing countries such as in Costa Rica, Mexico and Kenya (Wertz-Kanounnikoff 2006). Although the benefits of PES on forest conservation and provision of alternative livelihood for rural poor are well documented, very few studies have been identified in literature on adopting PES program in Tanzania (Zahabu 2008). The country is currently practicing collaborative forest management which tries to incorporate local communities in forest management decisions as a mean of ensuring forest sustenance and benefits to local communities. It involves Joint Forest Management (JFM) and Community Based Forest management (CBFM). The approach was initiated in Tanzania in the mid 1990's (Wily 1997).

The rational of this study is to investigate the possibilities and potential for Community Based Forest Management to be included as an eligible carbon mitigation activity under international climate change agreements in the future. The study is in line with and will thus contribute to the objective of Kyoto: Think Global, Act Local project involving Tanzania. This study will make a contribution to the international research agenda which seeks to integrate local knowledge and participatory methods into sustainable resource use and management to improve livelihood and to avoid deforestation, degradation of forest and their link to climate change and global warming.

1.2.   Problem Statement

In Tanzania, so far, communities that have adopted CBFM approach have shown significant improvements in reducing the problem of deforestation and improved carbon sequestration. Despite these improvements, the rate of its adoption in the country is low. The benefits gained by local communities form managing forest are usually non- financial. Zahabu (2008) identified limited financial and human resources as inclusive factors. He estimated the rate of CBFM in Tanzania between 2001 and 2006 to be 304 forests in 1,024 villages reducing the unmanaged forest from about 18 to 16 million hectares. He notes that should this trend continue it will take 40 years for the whole of unmanaged forests to be managed under CBFM. Thus there is the need to speed the process up with PES which will give communities adequate incentive to adopt it. Kyoto; Think Global Act Local (KTGAL) is a research and capacity building program, financed by the Netherlands Development Cooperation, which is investigating the possibilities and potential for Community Based Forest Management of existing natural forest to be included as an eligible carbon mitigation activity under international climate change agreements in the future. It is also exploring the value of CFM as a climate adaptation strategy. It has since 2003 been encouraging communities and educating them in preparation for carbon service payments for REDD in the near future. In order to receive incentives under payment of carbon service (eg. REDD) it is important for a country or project to demonstrate how community manage forestry has served useful in reducing degradation and deforestation (Parker, Mitchell et al. 2008). But, to what extent has CFM areas in Tanzania contribute to reducing deforestation? Are these communities willing to

participate in a PES project? What are the institutional arrangements in place to support the implementation of payments for environmental services?

1.3. General objectives

The general objective of this study is to investigate the feasibility and potential for Community Based Forest Management to be eligible for PES under international climate change agreements in the future.

1.4. Specific Objectives

To contribute to the achievement of the above general objective the study will focus on the following specific objectives.

(1) To undertake a spatio-temporal land cover change analysis as a means of determining the influence of community based forest management on deforestation.

(2) To assess the willingness of local communities to participate in payments for carbon services.

(3) To assess and analyze the institutional mechanisms and capacity to adopt payments for carbon services

1.5. Research Questions

To achieve the above objectives the following research questions were formulated to guide the study.

No.	Specific objective	Research questions
1.	To undertake a spatio-temporal land cover dynamics as a means of determining the comparative influence of forest management on community based forest management area and the Joint forest management area.	• How has both forest changed over the years (1991 – 2008)? • What are the main driving forces?
2.	To assess the perception of local communities to participate in payments for environmental services.	• What are the challenges and opportunities in implementing Payments for environmental services? • What are the alternative livelihood activities
3.	To access and analyze the institutional mechanisms in place to adopt payments for environmental services	• What are the institutional structures in place to support the adoption of payments for environmental services?

1.6. General Procedure

The study reviewed existing official literature and documents as well as peer reviewed articles and journals. Data obtained from fieldwork and other sources was analyzed using tools such as Microsoft Excel, SPSS, Erdas Imagine and ArcGIS Desktop. The general methodology guideline for carrying out the research is illustrated in the figure 3-2. The detailed description of the key procedures is given in the next chapter.
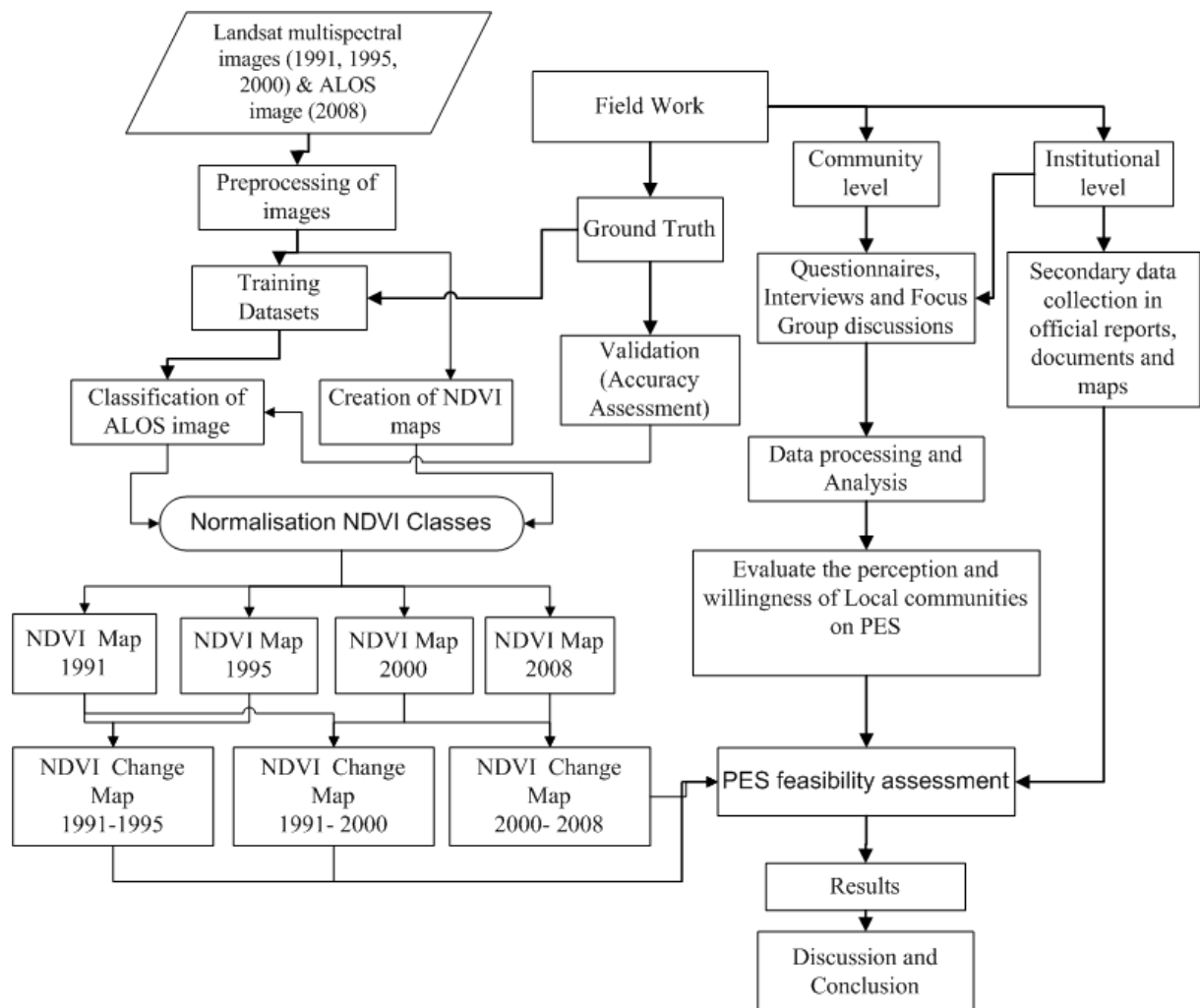
Figure 1-1 Research Methodology

2.   Literature Review

2.1.   Theory and Concepts of Payment for Environmental Services

Following the agenda 21 and current discussions on climate change, it is obvious that for us to sustainably manage our ecosystems amidst all the development, special care is needed. This is crucial in ensuring that sustainable development is achieved simultaneously with maintaining the vital value of our ecosystems. One of such vital initiatives to reach the sustainability goal is the development of payment for environmental services (PES) concept. The concept, in recent times has been given considerable attention especially with the coming of REDD, REDD plus and low carbon technology transfer. In all, the emphasis underlying this mechanism is its ability to transform external, non-market values of the environment into real financial incentives for local actors to provide as environmental services (Engel, Pagiola et al. 2008). In this way, our ecosystems would not be completely wiped out through direct use at the expense of the extra services they provide. Millennium Ecosystem Assessment (MA) defines ecosystem services (ES) broadly as "the benefits people obtain from ecosystems" (MA 2005). This means that natural resources have some sort of eco-link between them. For instance a forest has more value than its traditional use as a source of timber. Forest preserves soils, water (quantity and quality), keep climatic stability through the absorption of carbon, and social benefits such as medicine for communities and fuel wood for cooking. In other instances, forests are also considered sacred and reserved for religious festivities.

Generally, according to (Wunder 2005), in a PES arrangement, there must be a clear environmental service aimed at or a land use that generates the intended service. There must also be people willing to buy the aimed for service from the providers of that service as long as they secure its flow. The conditional relationship between buyers and sellers is so important because the buyers are certainly not just dishing out money, but to secure a service that though benefit them, its provision is a cost to the providers, making it an unattractive option for them. The beauty of PES, however, is the fact that it creates a "win win" situation where both service providers and buyers benefit more and the environment improves to fulfil its full benefit spectrum. Those who promote the PES concept believe that natural resources have been undervalued and this makes them unattractive for maintenance and sustenance (Engel and Palmer 2008). According to Engel and Palmer (2008), if those extra values are captured and packaged to those at advantage to provide them, then such resources will be sustainably managed. This is one major goal of PES to contribute towards reduction in carbon emissions.

Other studies however, shows that PES is not a panacea to all environmental problems (Engel, Pagiola et al. 2008). They believe that PES should be applied to situations in which ecosystems are not well managed they are an expensive option to their managers. To them

areas where ecosystems are properly managed without PES do not need PES. PES thus seeks to internalize what would otherwise be an externality.

Figure 2-1 below conceptualises the fundamental issues considered in PES. In this diagram, natural resources provide beneficial services to environmental service buyers. PES tries to capture part of the benefits they receive and relay it to the service providers or people who own the land with the resources that generates the environmental services and therefore have control and decision power over its use. However, since the choice of use to which they put their land is influence by profit margin, the greater the profit derived from a particular land use, the higher their tendency to choose land use. So for instance, whiles a land owner has forest on his land but finds converting it to agricultural land more attractive, he or she is more likely to clear down the forest as it becomes the best alternative. This is usually the case. PES, therefore, aims at making environmental conservation more attractive by providing incentives to make it a best choice.
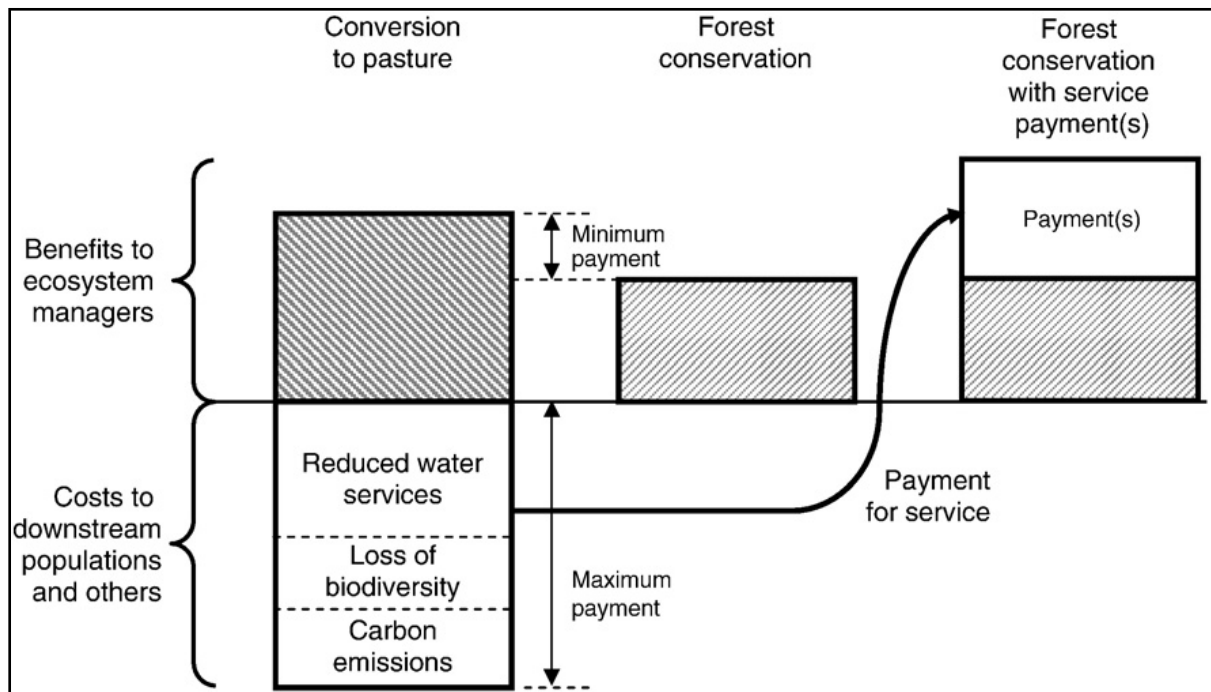
Figure 2-1 Logic of payment of PES

Source: (Engel, Pagiola et al. 2008)

Most PES projects implemented so far has been those on a local scale by private investors, governments, resource managers and non-governmental organisations (NGO's). The most commonly supported environmental services have been biological diversity protection, water quality and quantity preservation and carbon services (Corbera and Brown 2008).

The next section emphasis on the component parts of PES. The section would also present some cases where PES has been implemented – some of the successes and challenges. This would be followed by discussion on forests and its associated importance and challenges in

forest management through a revisit of the forest policy in Tanzania and the feasibility of PES in the study area.

2.2.   What are Environmental services (ES)?

The major categorisation of environmental services include the following
- ✓ **Public goods ES** :-services that users cannot be prevented from benefiting from its provision (non-excludability) and consumption by one user does not affect that of another (non-rivalry)

- ✓ **Non public good ES**:-, services that users can be prevented from benefiting from its provision (excludability). Also the consumption by one user affects that of another.

Since ecosystems provide more than one service, sometimes these services are bundled together for sale. In other situations the various services can be layered for different buyers.

2.2.1.   Who are the players in Environmental services

For PES to be successfully implemented, there are two major players who must be agree to trade effectively with environmental service under consideration. These players include:
- ✓ Environmental Service Buyers
- ✓ Environmental Service Sellers

ES Buyers are the beneficiaries generated by an environmental resource. From this party, PES voluntarily take part of the benefits and gives it as an incentive to persuade resource managers to conserve the resource for the benefit of the buyer. The buyer continues to pay only because the resource manager secures the enjoyed services. In 'government-financed' PES programs, the buyers are a third party acting on behalf of service users. This is typically a government agency, but could also be an international financial institution or conservation institution in the case of global externalities. As the buyers in this case are not the direct user of the ES, they have no first-hand information on its value, and generally cannot observe directly whether it is being provided. They also do not have a direct incentive to ensure that the program is working efficiently; on the contrary, they are often likely to be subject to a variety of political pressures. Because of these factors, previous studies argue that such programs are less likely to be efficient. However, it should be noted that government-financed PES programs may be more cost-effective than user-financed (Engel, Pagiola et al. 2008).

On the other hand, *ES sellers* are those actors who are in a position to safeguard the delivery of the ES. They are usually the land holders. Land holders could be private or government/public landholders. In other situations local communities have joint property rights or have use and management rights in land. PES tries to rely on the knowledge of these providers, of their knowledge of the cost of environmental service providers to seek out those with lower service provision

The basis for the trade between the buyers and sellers is over forest, therefore depending on the value of the forests, buyers and sellers can negotiate properly on how to implement PES. The next section describes this fundamental product that buyers and sellers trade under PES.

2.2.2. The role of PES

PES programmes and projects do not make strong claims about their participatory nature. Often, they evolve as top-down, managerial policies and projects where maximising participation whilst at the same time increasing effectiveness would be a function of setting the right procedural framework (Kosoy, Corbera et al. 2008) **.**

Ecosystems generally provide communities with a range of services – from reliable flows of clean water to productive soil and carbon sequestration. People, industries and communities rely on these services. Therefore, PES plays a critical role in maintaining a flow of a specified ecosystem service such as a forest, water or biodiversity habitat or carbon sequestration capabilities in exchange for something of economic value (PES 2008).

2.2.3. Steps for implementing a PES program

For successful implementation of PES in any community, there are four core steps which need to be followed. These steps were formulated according to (PES 2008) . They include:

1. Identifying ecosystem service prospects and potential buyers: This first step raises some key questions;
   - What ecosystem services exist on lands to which a potential seller has legitimate use rights or ownership?
   - Who benefits and what are associated diminishing problems to neighbours in the community?
   - Which land use management practices will yield the desired ecological outcomes ideally within the highest possible practicality?

   The ability to answer these questions markets the availability of an existing ecosystem service, a potential buyer and how the ecosystem needs to be restored and maintained.

2. Assessing institutional and technical capacity: It is important to clearly understand the all claims related to land and land use rights for proper implementation of PES program. Some critical questions which needs to be considered include the following:\
   - What are the legal rights of ecosystem service sellers to engaging in economic activities on the land towards a PES deal?
   - What are available users on the proposed land?
   - Is there the possibility of people to be impacted by a PES program in terms of their current resource access or land use patterns?
   - Do local norms or laws permit the payment for ecosystem services?
3. Structural agreements: Another important step is that prospective sellers must be clear on the future implications of failure to meet the terms of agreement, either through their own inaction or due to unanticipated activities. Therefore, it is advisable that, to

begin with a "Term Sheet" for both buyers and sellers where the basic components of the project are stated and agreed on by parties involved.

4. Implementing PES agreements: Once an agreement has been accepted by parties involved in the PES program, the next step is the implementation. It is crucial at this moment to:

   - Finalise PES management plan and begin activities
   - Verify PES delivery and benefits
   - Monitor and evaluate the program

2.2.4. Feasibility of PES Scheme

In order to implement PES successfully in community, it is realistic to consider both environmental and economic factors. These factors are necessary and feasible to effectively improve or maintain the provision of an ES (Lee, Leimona et al. 2007). According to works by Lee (2007), at environmental level, a realistic PES scheme requires a clear relationship to have been established between the land use, the basis for the payment scheme and the proposed ES outcomes. This means that management practices by ES providers could actually maintain or improve the ES provisions. Also at an economic level, it is important that the scheme is based on an understanding of the economic costs and benefits accruing to various parties involved. The authors argued that for a PES scheme to work, the payment needs to be adequate and acceptable for: 1) the ES sellers to cover their operational and opportunity costs; 2) the intermediaries to cover their transaction costs; and 3) the ES buyers to be willing and able to pay for all of these costs and still receive a net benefit in ES value. A realistic PES scheme recognizes the need to match the ES beneficiaries' willingness to pay and the ES providers' willingness to accept the offered payment or reward as the basis for negotiation of benefit sharing. In addition, the authors proposed figure 2-2 and table 2-1 indicating conditions and trends that can be analysed to assess the potential for a particular PES scheme implementation.
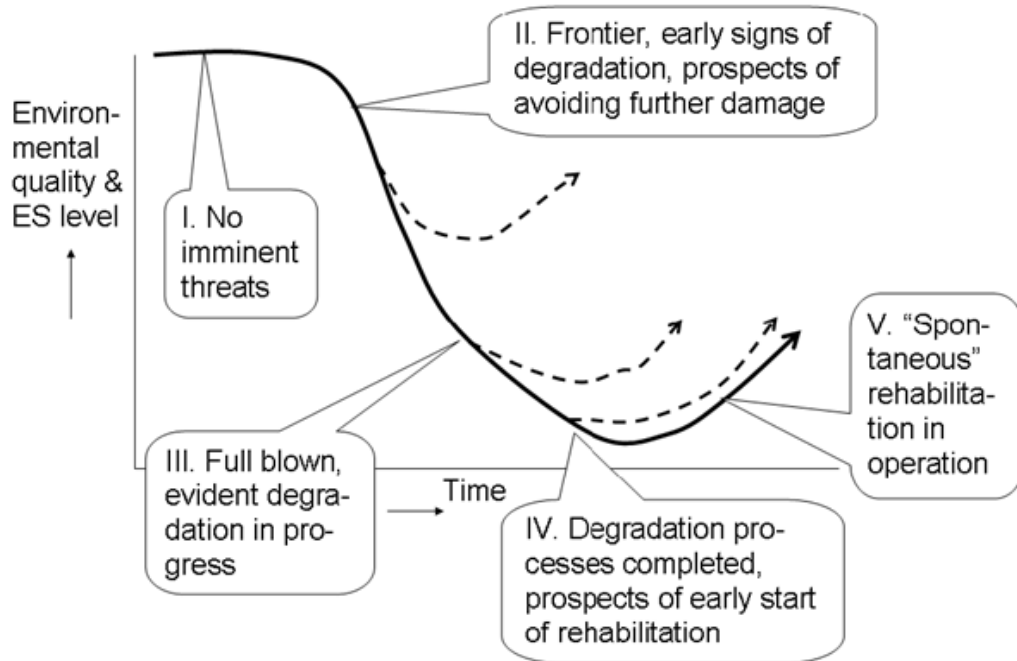
Figure 2-2 Feasible environmental and economic factors for PES scheme implementation

Source: (Lee, Leimona et al. 2007)

Table 2-1 Feasible environmental and economic factors for PES scheme implementation

	Current ES level +evidence	*Threats*	*Prospects for payment mechanisms*
1	Good ES level	No imminent threats; low accessibility and institutional protection sufficient	No imminent need
2	Good ES level, but early signs of degradation	Frontier setting, interaction of multiple actors; changing institutions	Slowing down degradation, stabilizing at higher level; Willingness to Pay (WTP)and willingness to accept (WTA) may be low
3	Declining ES; evidence starts to accumulate	Full degradation in progress	Slowing down last phases of degradation, early start of rehabilitation, WTP and WTA are increasing
4	Low level, historical decline evident	Degradation processes completed; prospects of early start of rehabilitation	Speeding up rehabilitation, WTP and WTA may be high
5	Low but improving ES level; trend may be unclear	Spontaneous rehabilitation in operation	Increasing the restoration levels attainable, WTP higher then WTA where real trade-offs are concerned

Source: (Lee, Leimona et al. 2007)

2.3. Forest Management

Forests constitute one of the world's most valuable ecosystems in the world and as discussed under previous sections, it is the fundamental block for the implementation of PES. When people talk about ecosystems they refer not only to the ecological components of an area but also the processes of interactions and functions between these components. The components include the living organisms such as plants, animals, and micro organisms of a place, together with the physical and chemical environment with which they interacts (WRI 2009).

Forests have multiple values including ecological, social and economic. For the local communities who live near forests, they rely on it for their livelihood (Bengston 1994). They benefit in terms of obtaining food and medicinal plants, fruits, honey, bush-meat, shelter, and firewood to name a few. The forest also meets their cultural and spiritual needs. Aside these benefits, the forest also benefits the whole world regulating the climate, absorbing and storing CO_2 preventing an increase in the greenhouse effect if they are preserved otherwise they add to the atmospheric CO_2.

However, these benefits from forests are usually impaired over the years as a result of persistent forest degradation and deforestation. According to the World Rainforest Movement, deforestation have both direct or immediate causes as well as indirect or remote causes (WRM 2010). The direct causes include logging, conversion of forest to agriculture land and livestock raising, urbanization, mining and oil exploration, and forest fire. They believe that past efforts to curb the problem of deforestation have not been successful because they focused much on the immediate causes rather than the multiple, interrelated, remote and indirect causes such as macroeconomic strategies that give strong incentives for short term profits rather than long term sustainable benefits, deep rooted social structures that result in inequality in land tenure, discrimination against indigenous peoples, subsistence farmers and poor people in general, lack of participatory democracy, the influence of the military and the exploitation of rural areas by urban elites.

Tanzania for example is enriched with about 33.5 million hectares of forests and woodlands. Out of this total area, almost two thirds consists of woodlands on public lands. However, these lack proper management. Public lands are under enormous pressure from expansion of agricultural activities, livestock grazing, fires and other human activities. About 13 million hectares of this total forest area have been gazetted as forest reserves. Over 80 000 hectares of the area is under plantation forestry and about 1.6 million hectares are under water catchments management (Kihiyo 1998). The forests offer habitat for wildlife, beekeeping, unique natural ecosystems and genetic resources. They are also an important economic base for the country's development.

However, there are no reliable data on deforestation although the estimates range from 130 000 to 500 000 ha per annum. The main reasons for deforestation are clearing for agriculture, overgrazing, wildfires, charcoal burning and over-exploitation of wood resources. It is taking place mainly in the unreserved forest land. Since the village station programme the

government started allocating this public land to registered villages with the aim that land titles to villages or individuals would alleviate the above problems. Due to inadequate resources to implement active and sustainable forest management, deforestation through encroachment and over-utilisation has also been taking place in the forest reserves which are under the jurisdiction of the central or local governments.

To address some of the mentioned challenges in Tanzania, the first National Forest Policy of was enunciated in 1953 and again reviewed in 1963 to detail the manner in which the forest and tree resources would be managed sustainably to meet the needs and desires of the society and the nation. Over the past three decades the perspectives on the role of the forest for the society have changed and broadened considerably as a consequence of social, economic, environmental, cultural and political changes. On the other hand, there have been relentless pressures on the forest resources arising from the ever increasing demand for fuelwood, fodder, timber and demand of forest land for other uses.

The national environmental policy Office 1997, defines the environmental framework for forest policy. The overall objectives of the national environmental policy are the following:

- o To ensure sustainable and equitable use of resources for meeting the basic needs of the present and future generations without degrading the environment or risking health or safety;
- o To prevent and control degradation of land, water, vegetation and air which constitute our life support systems;
- o To conserve and enhance our natural and man-made heritage, including the biological diversity of the unique ecosystems of Tanzania;
- o To improve the condition and productivity of degraded areas including rural and urban settlements in order that all Tanzanians may live in safe, healthy productive and aesthetically pleasing surroundings;
- o To raise public awareness and understanding of the essential linkages between environment and development and to promote individual and community participation in environmental action;
- o To promote international cooperation on the environment agenda, and expand our participation and contribution to relevant bilateral, sub-regional, regional and global organisations and programs, including implementation of conventions.

In summary, forests continue to be a vital component of addressing sustainable PES implementation in any country, Tanzania has been working hard together with local communities and organisations and international organisations since the 1950s towards a sound integrated approach towards this.

2.3.1. Forest degradation and deforestation

During the last few decades, climate crisis has resulted in a number of international, regional and national initiatives on the preservation of the environmental resources. However, these

initiatives have made little progress in addressing the core issues. There is general agreement that this is due to the fact that these strategies were too focused on the immediate causes of deforestation, and neglected the underlying causes which are multiple and interrelated. In some cases they are related to major international economic phenomena, such as macro-economic strategies which provide a strong incentive for short-term profit-making instead of long-term sustain ability. Also important are deep-rooted social structures, which result in inequalities in land tenure, discrimination against indigenous peoples, subsistence farmers and poor people in general. In other cases they include political factors such as the lack of participatory democracy, the influence of the military and the exploitation of rural areas by urban elites. Over consumption by consumers in high-income countries constitutes another of the major underlying causes of deforestation, while in some regions uncontrolled industrialization is at the heart of forest degradation with widespread pollution resulting in acid rain.

The causes of deforestation are many and varied, and it is impossible to cover them all. However some examples can show how these causes are closely interrelated one to each other.

According to World Rainforest Movement (2010), the major causes include:

- ✓ Subsistence Agriculture
- ✓ Fast growing globalization
- ✓ Land tenure policies
- ✓ Consumption and production patterns
- ✓ Global village

2.3.1.1. Subsistence agriculture

Reports of FAO (2006) indicate that large deforestation is caused by the subsistence agriculture. Subsistence agriculture usually results in logging and other farming practices which lead to forest degradation. In some cases matters are more complex especially informing a local community to desist from what it is the norm in the community to suit national and international policies.

2.3.1.2. Fast growing globalization

The fast growing globalisation also has a serious effect on the forest of especially emerging developed countries such as China and Brazil. In Brazil for example, forests have been converted for soy bean production. Similar example like this exists globally (WRM 2010).

2.3.1.3. Land tenure policies & Inequality

The important role of land tenure policy reform to rural development in Sub-Saharan Africa has generated a number of debates. This in most cases result in the lead role of land management in the hands of more efficient farmers (Pinckney and Kimuyu 1994). This usually lead to inequitable distribution of land among the rural and rich farmers. In other

cases, development of new estates such a highway through a community could lead to a conflict, since farmers in some of these communities might not ready to resettle.

2.3.1.4. Consumption and production patterns

The issue of food security continues to be a key factor in providing answers to poverty reduction. However, policy framework of international organisations such as the International Monetary Fund (IMF) and World Bank could result in either increased agricultural imports or exports in a country. Any of these measures obviously have an effect on the deforestation and degradation of the forests to a certain degree.

2.3.1.5. Global village

The growing network of a common pool for countries worldwide in terms of socio-economic development also comes with its challenges especially the decisions of powerful countries on weaker countries. For instance, some possible underlying causes can come from both internal and external countries on a country. International agreements such the Copenhagen Accord These could result in either positive or negative efforts towards sustainable forest management.

Therefore, in responds to the problem regarding deforestation and degradation of forest, the government tried to put in measures to curb the situation. One of such was the use command and control measures, where government gazettes an area and encloses it as a forest reserve with the aim of keeping people away from it. However, irrespective of all these efforts by governments creating reserves, the problem of deforestation still continued to the extent that even the reserved areas suffered encroachments. This is explained by the fact that majority of Tanzanian rely on forest and forest resources for their livelihood. The government, in its bid to create more reserves as a way of bringing much of the general unmanaged lands under management by gazetting more reserves, faced opposition from local communities refusing the move on the grounds that the command and control approach was not working and that they should be given the opportunity to gazette these forest and manage it themselves. The government upon careful reflections on the issue, and with the support of some international donors, undertook pilot studies to experiment with the idea of collaborative forest management approach. The results proved to be a more effective. The government therefore advised its forest policy and to prepared one that embraces the support of civil society, individuals and the private sectors in the management of the resource. Also, Tanzania is currently practising a collaborative forest management (CFM) policy as a means of combating the problem of high deforestation and degradation rates facing the country. There are two management approaches involved, namely *Joint Forest Management (JFM)* and *Community Based Forest Management (CBFM)*. The JFM involves a joint management agreement over a government gazetted forest reserve, between the national /local government and the adjacent communities to it. Gwata Ojebe, one of the villages of Morogoro rural district, adopted this policy in the year 2000. The village, located on the road from Dar es salam to Morgoro , on

the western verge of the Kitulangalo catchment forest, practises both the JFM and CBFM management approaches to date (Zahabu 2008).

2.3.2. Community Based Forest Management

2.3.2.1. Background

The conceptual integrity of community based natural resource management (CBNRM) principles are not always followed and their week application brings the concept into disrepute with criticisms from the academia whiles donor support is shying away (Child 2008). In community based natural resource management, local communities collective put in place institutions that ensure the allocation of land to its highest valued use. During this scheme, local communities are given rights to use manage and allocate resources, especially high valued resources. When such communities are better informed to take decisions and also have strong communal property rights, the allocation of resources is improved because both the cost and benefits from their effort is received by them and therefore serves as encouragement. It is often the case that institutions are improved when they are put together by members of a community through collective action and conservation and developments are possible at the same time. The reason is that such institutions serve as a means to reduce the over usage of the resource ecologically whiles the people get more livelihood benefits. Whiles institutions by local collective action have the ability to sustain and improve conservation and developments at the same time, its tendency to do so and the power behind group action unlike acting on individual effort has most of the time been looked down upon.

The CBFM is sub umbrella under the CBNRM. There are a number of concepts available regarding CBFM. In some instances, CBFM is differentiated from Participatory Forest Management (PFM). PFM stands for the formal rights of communities to take part in the decision making process on the management of forest and this may or may not include formal allocation of rights for a particular forest to a community. In general CBFM is considered to be implemented under community forestry. The next section discusses on this. In other instances too, CBFM is considered as under the umbrella of PFM (Kamoto, Dorward et al. 2008).

In Tanzania for example, communities of forest and woodland management rapidly evolved in the history of Tanzania. The first three successfully community-owned and managed forest reserves were established in September 1994. In recent times, there are more than 400 000 ha are under the direct management in over 500 communities. The adoption of the National Forest Policy (1998) supports and builds upon this development – one of its objectives is that the 19 million ha of unreserved forest land and woodland come under local guardianship, primarily through the establishment of village forest reserves (Wily 1999). Another interesting issue is the perceived participation of local communities in the management of the 12.5 million ha reserved estate (forest reserves under central or local government) in the coming decades within a user-stakeholder scheme (Wily 1999).

2.3.2.2. Implementation

Mexico is one of the good examples of developing countries in the sense that property rights over land and forests are secure and most of the land (estimates range between 53 and 80%) is owned by indigenous communities. To reduce deforestation and forest degradation Mexico has to consider local people's interest and capacities. More so, Mexico has a relatively well established institutional capacity and track record of implementing forestry programs. Also, Mexico has been actively involved in discussions on REDD, participates in the Forest Carbon Partnership Facility (FCPF) of the World Bank and is currently elaborating a REDD readiness plan (Benneker and McCall 2008).

On a more regional focus, West and Central Africa countries have adopted CBFM as it has become an increasing means to protect forest (Wiley 2002). In many instances, these communities are helped from international organizations on forest so that they can have their fuel wood and practise agroforestry and have non-timber products. In general this is facilitated by government and international institutions to expand programmes and to reduce the additional cost that would be borne by government if they try to manage the resource alone.

Over the years, Tanzanian villages have developed an adequate capacity of electing their own governments, or village councils. These bodies in turn have the good characteristic of being independent legal communities and able hold property and enter contractual arrangements. In addition to this, the local government law ensures that village councils have considerable executive and even legislative powers. In general, the Tanzanian local communities has one of the best smallest democracy in the world (Wily 1997).

2.3.2.3. Problems of CBFM

According to Chun and Tak (2009), some of the common problems leading to poor implementation of CBFM schemes in communities include:

- The assumption that community refers to a homogenous and cohesive group of users has often pose problems as in
- The issue of illegal logging
- The frequent use of benefits by local communities
- The ambiguous role of external support who guide the community in establishing and managing the community forest.

3.   Methodology

3.1.   Study area

The study was conducted at a village in the eastern part of Tanzania called Gwata Ojembe in the Morogoro region. Specifically, it can be located at about some 50 km east of the Morogoro municipality. It can be situated at Mikese ward in the Morogoro rural district. With a total population 1868, Gwata village has household and manpower populations of 368 and1500 respectively. Gwata Ojembe was selected for the study because it is uniquely involved in both Joint forest management and community based forest management is practiced. The site is considered as part of the wooded land which forms the most dominant land cover type in the country. It also one of the project sites of the Kyoto Think Global act local which is trying to help such communities to prepare themselves so that they can access funds such as REDD+ in the future.   The specific forest sites studies are the KSUATFR (here forth called SUA forest) forest and the Kimunyu forest. The SUA forest refers to the eastern part of the Kitulangalo catchment reserve forest that is jointly managed between the central Government as the owner, University of sokoine and the Gwata Ojembe village who have stakes in this forest. This arrangement started in the year 1995. The forest consists of 600ha of miombo woodlands. The Kimunyu forest, located some 14 km north of the SUA forest and engulfed in the east an north by the Ngeregere river, refers to that part of the public land registered in the name of the name Gwata village, of which the village has been demarcated as a village forest reserve with the aim of protecting it for production. It is covers an area of 420ha of miombo woodland. This reserve was created in year 2000.

The map below shows a landcover map for the study area.
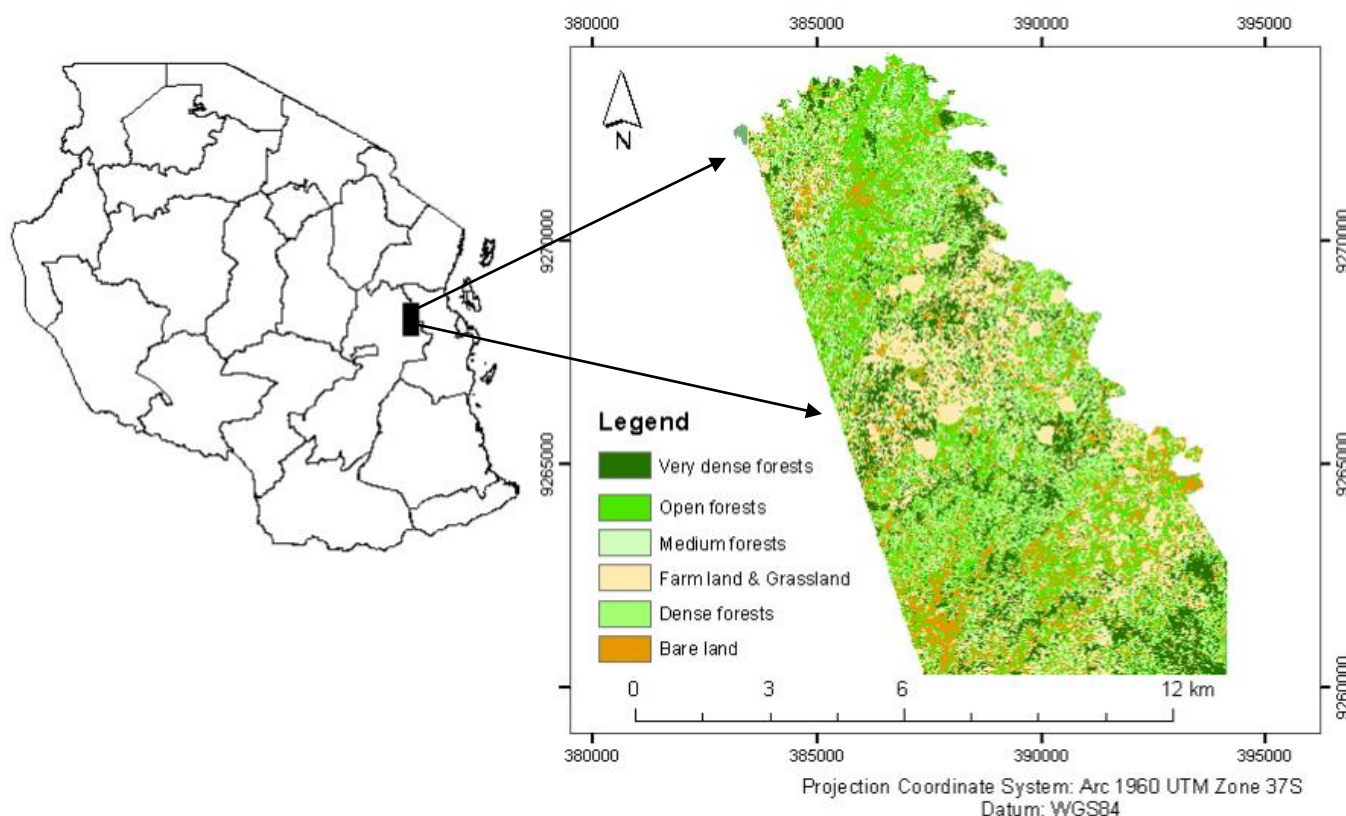
Figure 3-1 Study area showing landcover map for 2008

The average annual rainfall relatively 900 mm which is seasonally distributed, providing a wet season from November to May and a dry season from June to October. The annual mean temperature is 24.8°C while the mean annual minimum and maximum temperatures are 18.6°C and 28.8°C, respectively. The main staple crops grown in the study area are maize, millet and peas. The main vegetation type is open dry miombo woodland dominated by *Julbernardia globiflora*, *Brachystegia boehmii* and *Pterocarpus rotundifolius* having a canopy height of up to 20m The heterogeneous understorey includes as most common woody plants *Combretum* species, *Diplorynchus condylocarpon* and *Dichrostachys cinerea (Nduwamungu, Bloesch et al. 2002).* The topography varies from 267 - 440m as shown in figure 3-2.
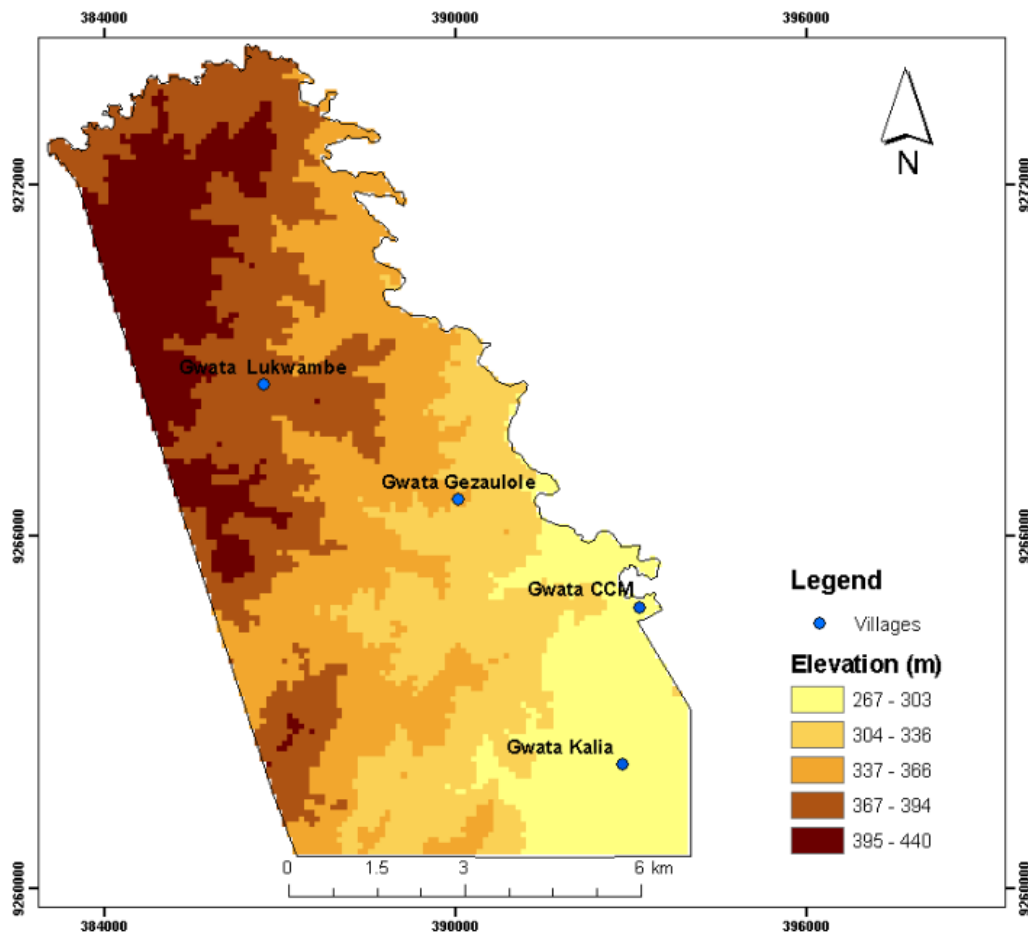
Figure 3-2 Digital elevation model of study area

Derived from SRTM 90m DEM

3.2.   Methods

This section of the report provides a detail description of the research approach applied on the field. It describes the various field techniques and strategies that were employed to collect the required and necessary data that will be used in this research. Data collection techniques and strategies are of enormous importance in research. The reason is that they have an important link to answering -systematically and objectively- the research questions we pose. The data collection has to be systematic so as to ensure that the research questions are conclusively answered. This opportunity will be missed if data are collected haphazardly. As such data

collection techniques are very critical to the research work. Whiles there are various field techniques for data collection; in this research we employed remote sensing techniques using satellite images. This was coupled with actual field survey of forest, interviews with structured and unstructured questionnaires, checklist interviews, focus group discussion, contingent valuation and desktop search through relevant documents for required information. The selections of these techniques were inspired by the research objectives and context.

3.2.1. Interviews and discussions

A well educated person eloquent in both English and Swahili was selected as the interpreter with the help of the project manager. Prior to the commencement of the research work, and also during the research work (as need arose), the researcher and the interpreter had sessions to discuss and to clarify the research aims and objectives; as well as the contents of the questionnaires to ensure they operated on the same platform. Structured and semi-structured questionnaires were used to elicit information from households on socioeconomic data, their observation of changes that has occurred in land use and land cover, their perception and willingness to accept livelihood changes if payments carbon services should be implemented and the alternate livelihood sources they would prefer. Information was also collected on their role in forest management as well as other stakeholders involved and their knowledge of forest management rules regulations and bylaws. A sample of the questionnaire can be found in the appendice.

In all, 30 households were chosen from the total household population of 368. This sample is representative of the population. Another reason that inspired the sample size was the limited time and budget available. The simple stratified random sampling technique was used so that the samples were well distributed over the village and representative enough. Gwata has 5 sub-villages including Gwata CCM, Gwata Shuleni, Gwata Kalia, Gwata Gizaulole and Gwata Lukwambe. Six samples each were picked randomly from each of these sub-villages so that the samples are well distributed. The village council provided a guide who took us round to sub-villages, first to have a word with the sub-village heads on what we intend to do and to meet the various households we selected to interview in those communities.

An interview was conducted a member of the village council and the village forest committee to discuss how the policy is carried out, the challenges faced and the way forward. At the district and regional levels, we held an interview with the district catchment reserve protection and enforcement office and the regional resource person in charge of forestry on the forest act and policy, its implementation, the challenges involved in the implementation and the way forward. In all the data that was reached include satellite images, household socioeconomic data, willingness to accept payments for carbon services, forest management practices, forest policy and regulation, their implementation, challenges and the way forward.
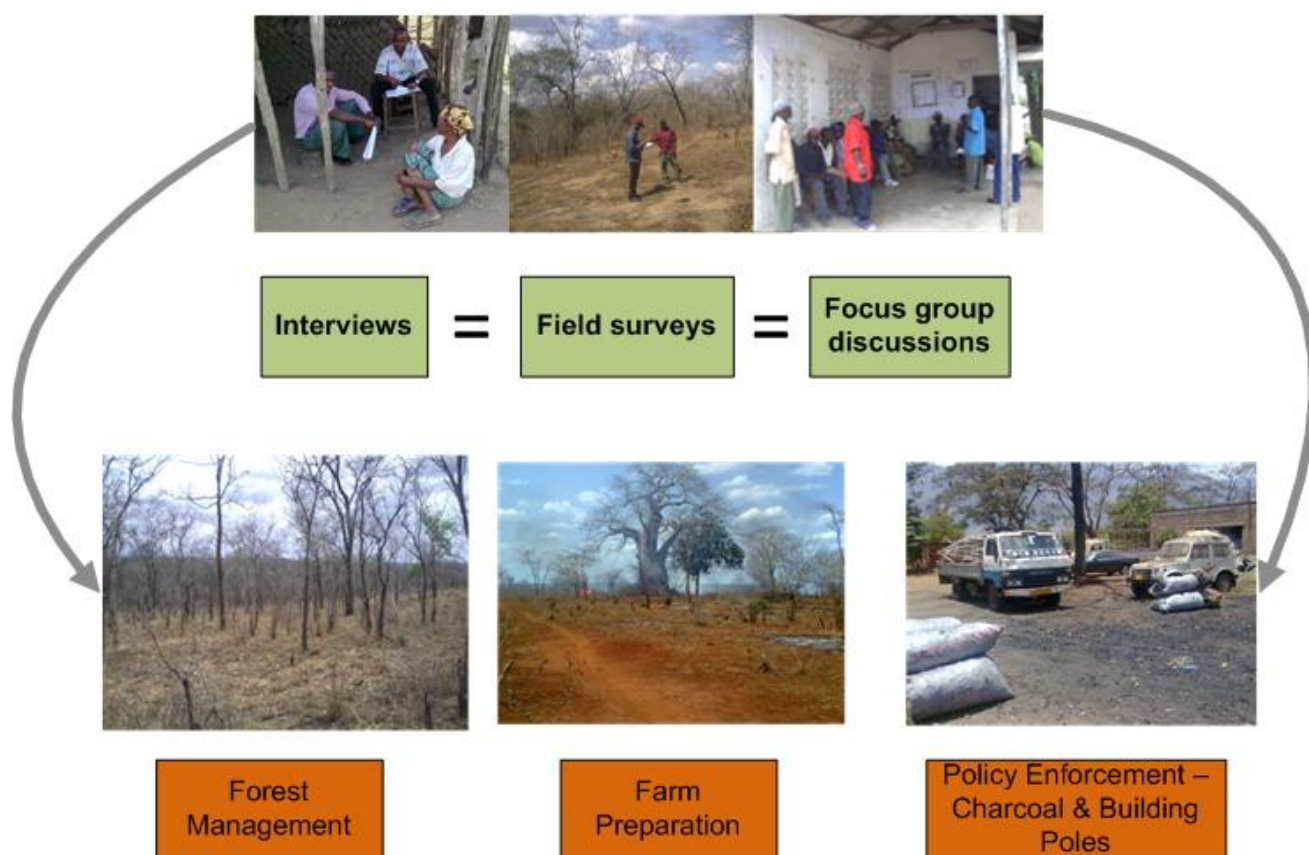
Figure 3-3 Field interview procedures

3.2.2. Post-field work

3.2.2.1. Image Acquisition and pre-processing

The images used include a 10×10 meter resolution image from the Alos AVNIR-2 sensor. Others are Landsat-7 image from Enhanced Thematic Mapper, and Landsat 5 images from the Thematic Mapper sensor. Details of these images are shown in the tables below. With the exception of the 2008 ALOS AVNIR image which was obtained from the ITC RSG lab, all the Landsat images were downloaded from the USGS web site (http://glovis.usgs.gov/).

Satellite	*Sensor*	*Date of Acquisition*	*Path /Row*	*Resolution (m)*
Alos	AVNIR	2008/06/12		10×10
Landsat-7	ETM	2000/07/07	165/65	30×30
Landsat-5	TM	1995/01/07	165/65	30×30
Landsat-5	TM	1991/06/05	165/65	30×30

Sensor/ Swatch width	Bands	Wave length(um)	Spatial resolution(m)
Advanced Visible and Near Infrared Radiometer type 2 (AVNIR-2) /70km(At nadir)	Band1	0.42 – 0.50	10
	Band2	0.52 – 0.60	10
	Band3	0.61 – 0.69	10
	Band4	0.76 – 0.89	10

Sensor/Swatch width	Bands	Wave length(um)	Spatial resolution(m)
Enhanced Thematic Mapper, Plus (ETM+)	Band1	0.45 – 0.52	30
	Band2	0.53 – 0.61	30
	Band3	0.63 – 0.69	30
	Band4	0.75 – 0.90	30
	Band5	1.55 – 1.75	30
	Band6	10.4 – 12.5	60
	Band7	2.09 – 2.35	30
	Band8	0.52 – 0.90	15

These images were chosen given based on a number of reasons. They cover the study areas both in terms of space and the time frame with appreciable resolution for the intended land cover classification and change detection. They were also available free of charge which is good for this study as there was very limited funds available for this research. The images also had limited or no clouds. The seasons in which these images were acquired was also taken into consideration but unfortunately it was not possible to have all of them from the same sensor.

The ERDAS 9.3 software was used. The ALOS AVNIR image of 2008 was imported into ERDAS image format. The image was already geo-corrected and projected to UTM zone 37 with datum and spheroid of GRS 1980. The Landsat images consisted of individual bands saved in tiff format and gunzipped. They have been geo-referenced to WGS84 UTM zone 37 north from source. The bands were unzipped and stack together into an image using Erdas software. The 6th and 8th bands were omitted because the 8th is a panchromatic data with a 15 meter resolution whiles band 6 is a thermal band with a coarser resolution relative to others and could influence the image quality for our purpose. Moreover, these bands will not be used in this in this study

The images were then re-projected to Arc1960_UTM_ zone37S, with clacke 1880 as spheroid. During the re-projection, the nearest neighbour re-sampling method was used to re-sample them to exactly 30×30 meter resolution since some of the images had slight to significant variations in cell sizes. For instance the Alos AVNIR had a special resolution of

10×10 meters and thus it was necessary to resample it to fit that of the Landsats for our purpose. The above projection was used because it is a local projection that best fits Tanzania.

In this research the image differencing change detection technique was adopted to assess landcover characteristics over the period of study. Generally, this technique involves the the process of identifying changes in the state of an object or phenomenon by observing it at different times (Singh 1989). As a result, multi-temporal data sets (Landsat and Alos) were used to discriminate areas of land cover change between dates of imaging. Usually, images taken at the same season of the year are used to minimize sun angle and seasonal differences (Lillesand and Keifer 1994). This technique was used because it provided a change matrix where different transfers from one land-use cover system to another could be seen and the percentage change calculated.

3.2.3. Supervised Classification

The Alos image of 2008 was classified using maximum likelihood resampling method in Erdas. The accuracy of the classification was then done using the remaining 80 points collected from the field. The overall accuracy obtained was 70.8%. The low accuracy obtained could be a result of the fact the temporal differences between the field data collected and the Alos image used for the classification purpose.

3.2.4. NDVI Maps

It was difficult to find land use maps to assist with the classification of the 1991, 1995 and 2000 images. As a result, it was realised that it would be better to create normalised NDVI maps for each image to provide an objective bases for comparison. Previous studies have shown the possibility of using NDVI to study land cover dynamics eg (Li, Zhao et al. 2008). The NDVI maps were created for the said years with built in functionality in erdas imagine. However, a land cover map was created for the 2008 image using the collected sample point collect during the field walk through the forest reserves classifying it into the various forest types encountered. The obtained classes were adopted for the previous images based on the assumption that these classes would not change so much over the years.
The land cover map of 2008 together with its NDVI map were subsequently cross in ILWIS software in order to find which NDVI classes belong to which land cover class. This was to give an estimated corresponding forest types with the various NDVI classes.

Based on the result of the cross in ILWIS, table 2-1 was constructed to give guideline to the possible NDVI ranges and forest types in the study area. This was the only possible way out for this since there was not enough time to consider other options. The NDVI maps were also normalised in the range difference of 0.1. This means that on a scale of 0 − 0.1 and so on. Each NDVI map was classified into 10 classes (see maps in appendix and table 2-2). This was done to allow for easy comparison for the various years and also for the image differencing

for the periods. Therefore, table 2-1 was then used as the fundamental basis against which normalised NDVI maps could be compared with to indicate which land cover type is changing or unchanged in the process of community forest management activities in the reserves.

Table 3-1 Estimated NDVI ranges for designated landcover types

Classes in Landcover map	Designated landcover type	NDVI ranges estimated
0	Dense forest	0.58 -0.68
1	Medium forest	0.46-0.58
2	Open forest	0.48-0.46
3	Farm land / Grass land	0.20-0.35
4	Bare land	0.00-0.20
5	Very dense forest	0.68-1.00

Finally an image differencing was done for the periods of 1991-2000 and 2000- 2008 for Kimuyu forest reserve and 1991 – 1995 and 1995 – 2008 for Kitulango forest reserves. These dates were chosen as a result of the different community management practices in each of these forest reserves.

4.   Results & Discussions

4.1.   Background

This section has been divided into three parts. The first part presents results on the land cover change for both forest reserves- the jointly managed government reserve (Kitulangalo) and the village forest reserve (Kimunyu) - comparing the changes that have occurred. The second part looks at the willingness of the community to participate in a PES scheme. The last section looks at the capacity of institutional setup in terms of policies and regulations and local arrangements as the context within which a future PES could be implemented.

4.2.   Land cover characteristics

Figures 4-1 and 4-2 represent the land cover maps for the two forest reserves in the study area. It is realised that as at June 2008, there was relatively more dense forests in Kintangalo forest than at Kimunyo. In Kimunyu forest reserve, it is characterised generally by open and medium forests with patches of very dense forests especially along its left boundary with the Ngeregere river.
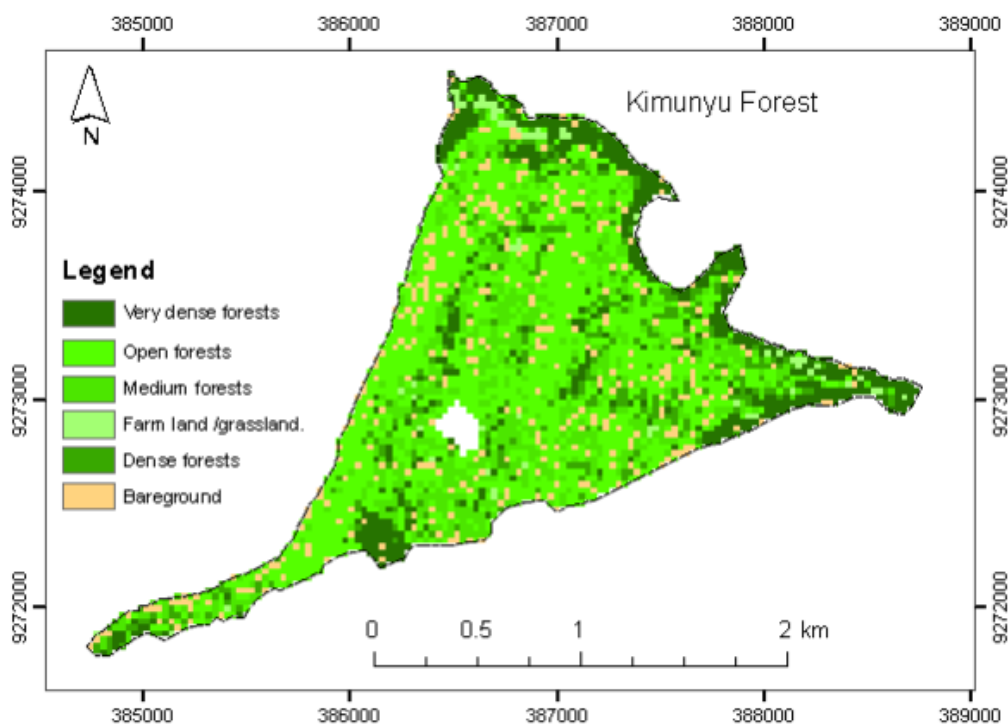
Figure 4-1 Land cover map of Kimunyu Forest reserve
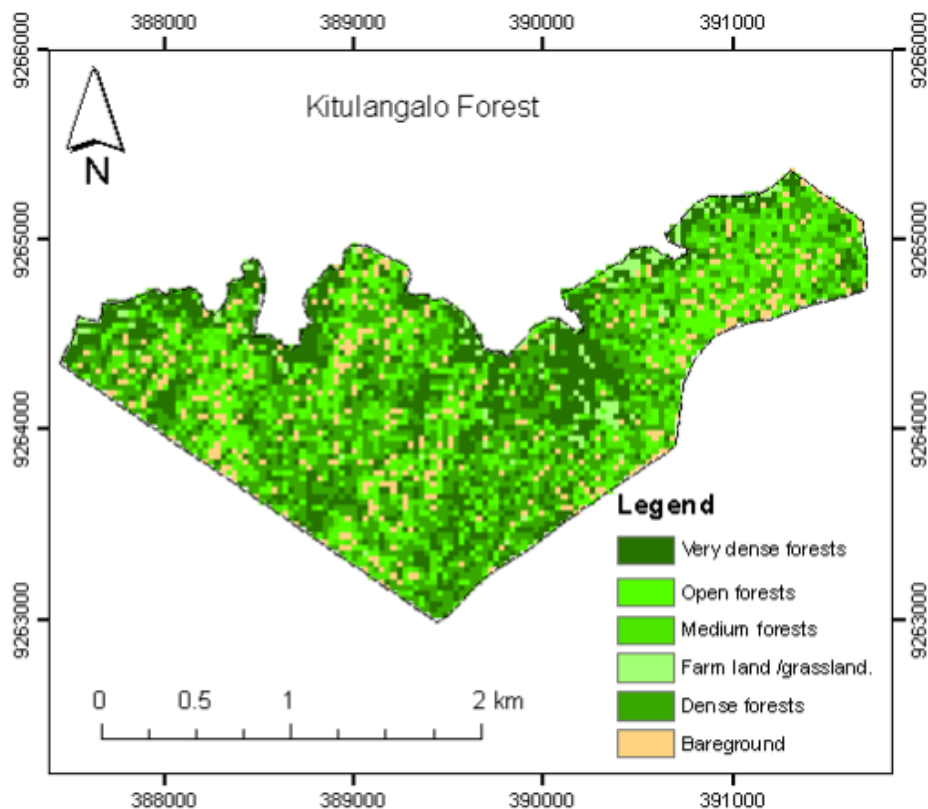
Figure 4-2 Landcover map of forest reserves for Kitulango forest reserve

4.3. Land cover change dynamics of forest reserves

As explained in previous chapter, the normalised NDVI maps created were used to study the land cover dynamics because it was difficult to get data such as detailed land use maps to classify the older images. The NDVI maps show areas with increase or decrease in vegetation. The change in vegetative cover could represent either an increase or decrease in dense forest, medium forest, open forest, bare land or grassland. Hence, a classified increased area indicates that there has been an increased in vegetation cover and possibly management practices could have contributed to this. Though, this study realises the short comings of the approach in informing policy and decision makers precisely the exact causes and contributions towards this, it is worth mentioning that the information provided still backs up the research idea of understanding the land cover dynamics for the study period. The study periods have been regrouped into 1991-1995, 1991 – 2000 and 2000 – 2008. This grouping takes into consideration the established periods of the various community forests for the two forest reserves.

4.3.1. NDVI change for 1991 – 1995

The NDVI change for 1991 – 1995 for the Kimuyu and Kintangalo forest reserves are shown in figure 4-1. The figure indicates that a consideration decrease in vegetation cover was experienced in Kimuyu forest as compared to the Kintangalo forest reserve. During this

period, no forest management scheme was launched in both forest reserves. This decrease could be attributed to general drought and deforestation.

Figure 4-1 NDVI change map for 1991 - 1995
The top and bottom highlighted study areas represent respectively the Kimuyu and Kitulangalo forest reserves

4.3.2.   NDVI change for 1991 - 2000

The NDVI change for 1991 – 2000 is shown in figure 4-2 below. The difference however with the 1991-1995 NDVI change map is minimal. Hence, similar explanation for the difference in less vegetative cover in Kimuyu compared to the Kintangalo could be applied in this case also. It should however be noted that the joint forest management which was launched in Kintangalo did not have significant effect on the vegetation cover over the period of 1995 – 2000.

Figure 4-2 NDVI change map for 1991 – 2000

The top and bottom highlighted study areas represent respectively the Kimuyu and Kitulangalo forest reserves

4.3.3. NDVI change for 2000 – 2008

Figure 4-3 change map for 2000 – 2008 is shown below. The maps show that even though there was a general drought in the area, Kintangalo forest merge out with more decreased in vegetation than in Kimuyu forest. Though joint forest management practices started in 2000, the reason behind the experienced decrease could be explained by that fact that there was a wild fire which burnt almost the entire forest in 2002. The information was obtained during the focus group discussion of community members.
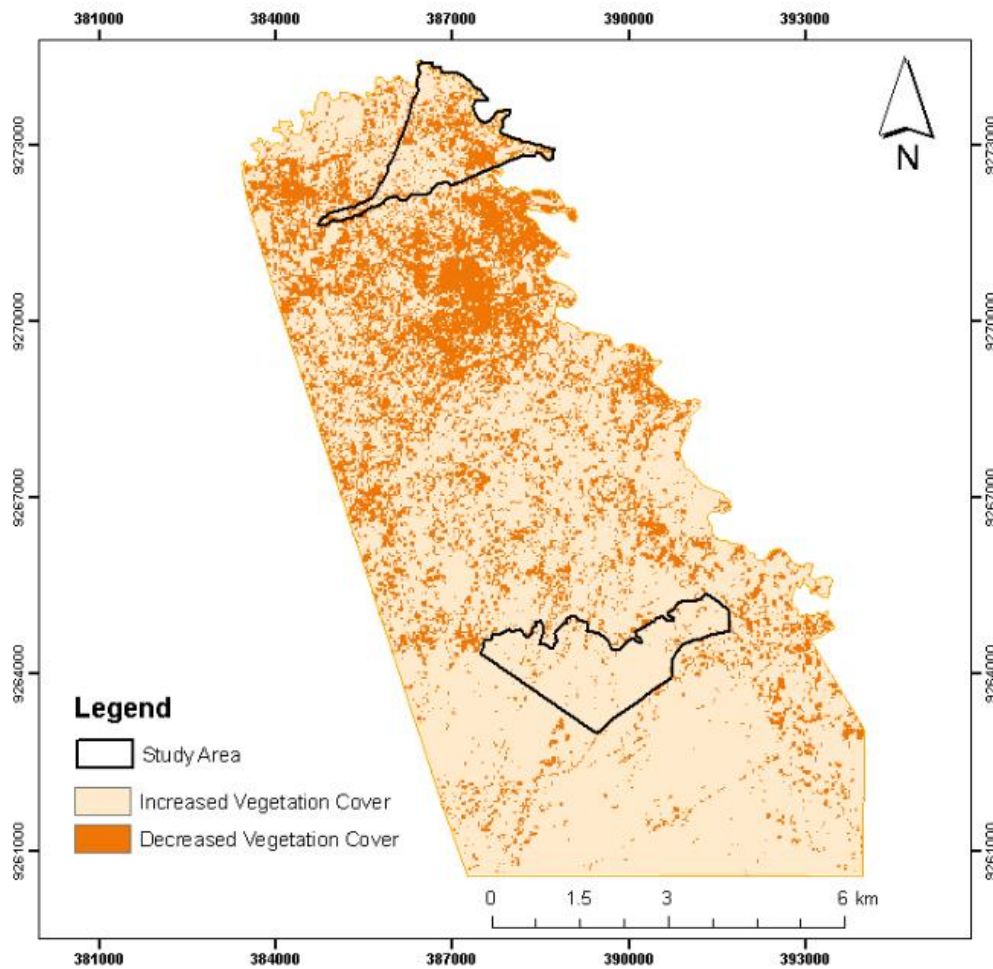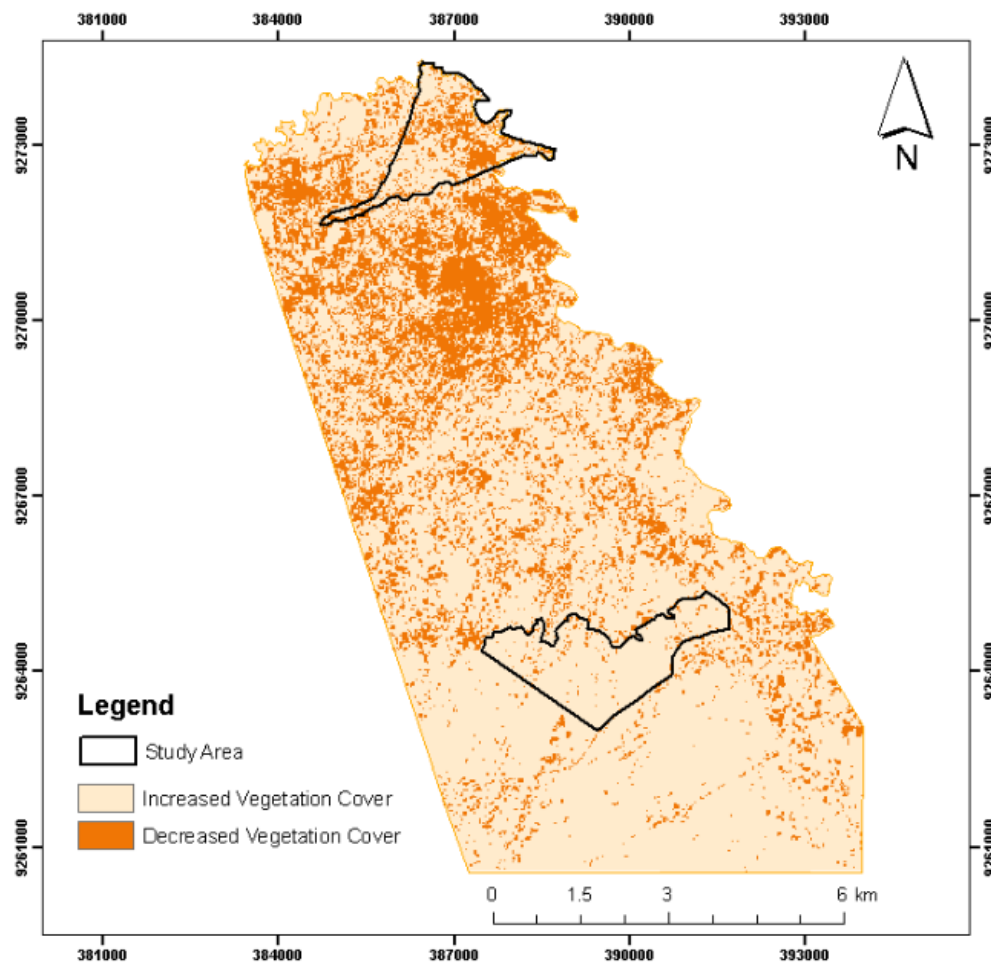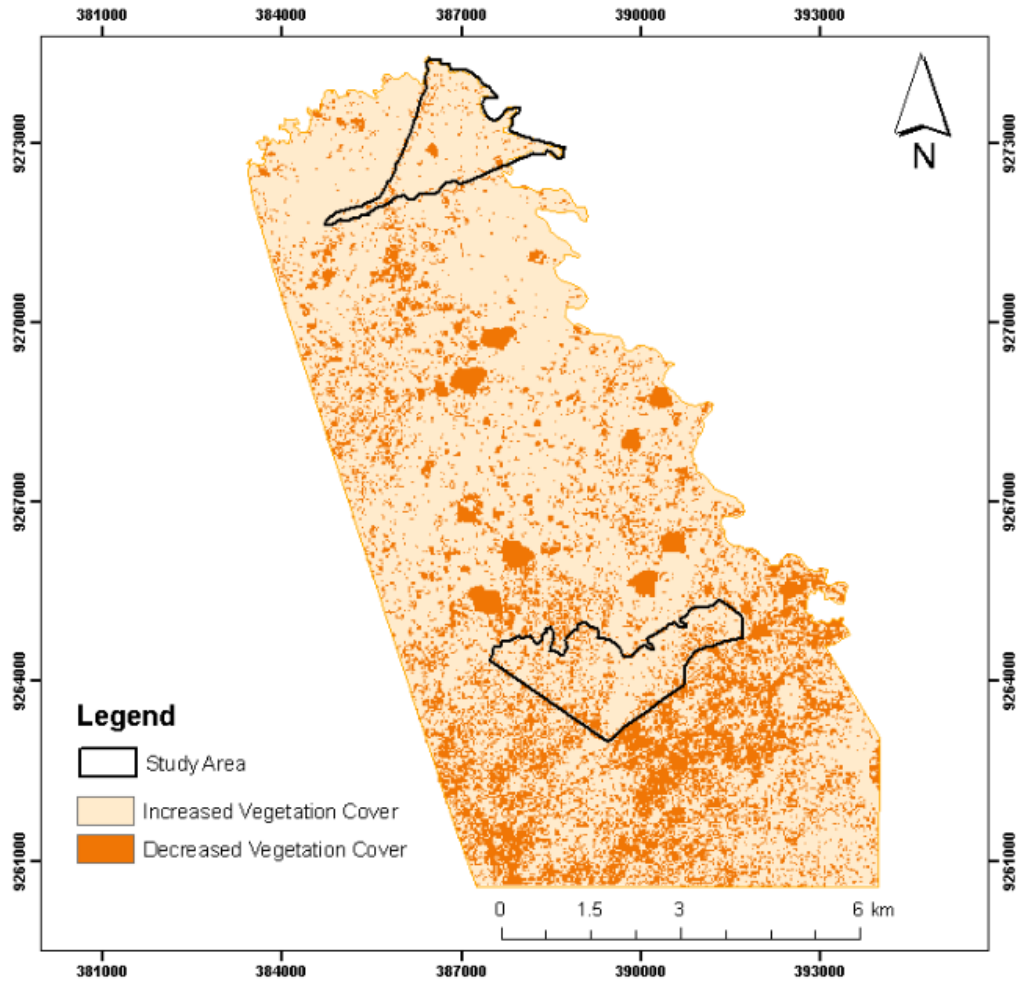
Figure 4-3 NDVI change map for 2000 – 2008
The top and bottom highlighted study areas represent respectively the Kimuyu and Kitulangalo forest reserves

4.4. Willingness of Community to PES implementation

In order to attain the above objective of the study, both primary and secondary data were collected and analysed. Questionnaires, interviews and focus group discussions were used to collect data at three levels – regional, district and household levels – and analysed. For the regional and district levels, informal discussions with the authorities involved served as the basic information for supporting this research. All other interviews were conducted at household levels. At this particular level, a household represented a valid count for each answered inquiry. As a result, the head of the house was the main contact during the investigation. In other cases where the head of the household was absent, an adults above age 20 were interviewed as the needed responses to the questions require an adult with ample knowledge of the household affairs. On the whole, a total sample of 30 households was interviewed. Most of the respondents were males constituting 73%, whiles females respondents account for 27%. This disparity among the respondents is as a result of the fact that, in this community majority of the household heads or representatives are males. The education level for majority of respondents was primary education level (67%). The rest are

persons with no formal education (30%) and only (3%) have had secondary education. This implies that a large proportion of the sampled population have basic level of education to understand fundamental concepts in PES.
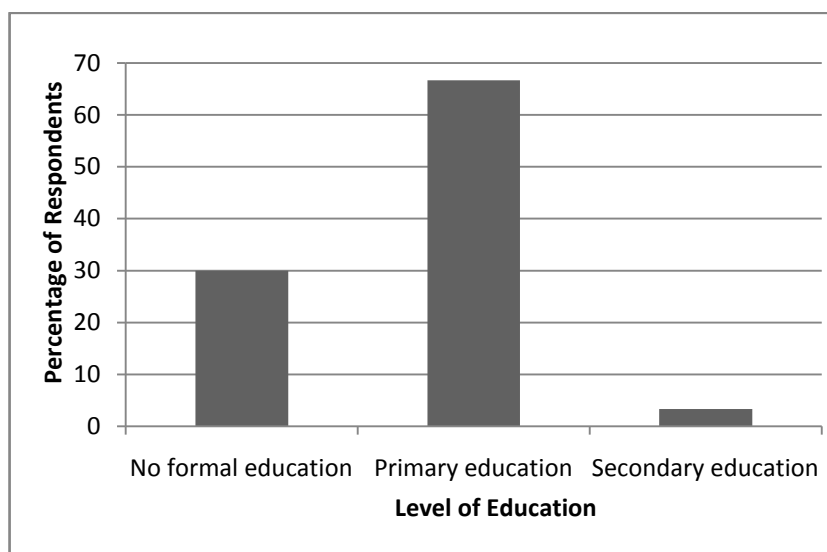
Figure 4-3 Level of education of respondents

The rest of the sections look into the various economic activities that the communities engage in and how much they feel attached to these economic activities. This is followed by the understanding of the communities on the impact of these economic activities towards environmental degradation.

4.4.1. Economic Activities of the communities

In order to understand the perception and willingness of the communities to adopt PES, households were asked to specify from a set of activities which one they engage in for income. The results show that on the whole the people rely on activities such as crop farming, livestock rearing, charcoal burning, timber harvesting, petty trading, casual employment, crafting, credit/loans and remittances for livelihood. Each household is at least engaged in one activity. The dominant income earning source selected by majority of them are crop cultivation, livestock rearing and remittances from family and friends. The least selected sources on the other hand are income from timber and income from credit/loans. With the exception of livestock rearing which was ranked to be of medium priority all the others scored high priority for the people.

This is demonstrated in the table below. The figures shown in the table 4-1 are all sampled out of 30 population size. This means that for a selected activity, the number of respondents who economically gain from such a venture are recorded. In addition, from among the selected population for a particular activity, their perception of the priority of the activity was also sought. Originally, the activities were ranked on a quantitative scale of 1-10 but in this table this has been recalibrated qualitatively as 1-3 as *high priority*, 4-6 as *medium priority*

and 7-9 as *low priority*. For instance, the harvesting timber and credit/loan activities yield lowest in number of respondents but still rank high priority. This is because, the few population who depend on this consider this a crucial component for their livelihood.

Table 4-1 Income sources of Communities

Activity	*Respondents*	*Rank*
Crop farming	27.00	High priority
Livestocks*	18.00	Medium priority
Harvesting trees for charcoal	9.00	High priority
Harvesting timber	2.00	High priority
Petty trading	8.00	High priority
Petty casual employment	9.00	High priority
Craft	9.00	High priority
Credit/Loan	2.00	High priority
Remittances	10.00	High priority

**Livestock here is more biased towards poultry than cattle raising. This is because most of the cattle raising are immigrants from other villages but not the indigenes.*

4.4.2. Average Earnings from economic activities

One important component for successful implementation of PES is the monetary aspect. Therefore, for a population to diversify their way of lives to conserve the forest reserves, it is mandatory to consider how much they are economically gaining from their existing activities. Table 2 gives estimated earnings per month for the sampled population. It is obvious that the biggest earner is timber harvesting. However it should be noted also that in table 1, there are very few people engaged in this economic activity. With crop farming which is the highest engaged economic activity, the estimated earnings per month is USD 45.62. For instance, if crop farming is considered a vital threat to forest reserves, this means that an amount of USD 45 per household per month should be made available to allow for a complete change of livelihood and hence safeguard the forest reserves and successful implementation of PES.

Table 4-2 Estimated earnings from activities

Activity	Earnings per month (TSZ)	Earnings per month (USD)
Crop farming	60,000.00	45.62
Livestocks	25,000.00	19.01
Harvesting trees for charcoal	120,000.00	91.23
Harvesting timber	1,000,000.00	760.28
Petty trading	16,500.00	12.54
Petty casual employment	6,000.00	4.56
Craft	50,000.00	38.01
Credit/Loan	10,000.00	7.60
Remittances	60,000.00	45.62

*rate from oanda.com --1dollar =1,315.30TZS (January 12, 2010)

4.4.3. Threats to Forest Reserves Conservation

Another obstacle to the implementation of PES is the potential threat or resident from the communities to adjust their activities to safeguard the existing forest reserves. To provide some indirect answers to this, activities were again ranked their potential threat to forest expansion. It was observed that the highest ranking threats included wildfires, settlement expansion, livestock grazing and charcoal making. The rank remark is based on the same logic as in section 3.2. Harvesting of firewood and honey making were ranked low. Table 3 gives more information on this.

Table 4-3 Threats to Forest reserves conservation

Activity	Usage(Number of people)	Rank
Farming	26	High threat
wild fires	29	High threat
Settlement expansion	27	Medium threat
livestock grazing	25	High threat
Charcoal making	29	High threat
Timer logging	18	Medium threat
Harvesting building poles	26	Medium threat
Harvesting firewood	24	Low threat
Honey making	16	Low threat
Honey making	20	Low threat

Given the rich environmental resources of the Gwata due to its location coupled with the fact that the international road leading from the city of Dar Es Salem through Morogo passes through the village. This brings Gwata some advantages and disadvantages to the people living in this village. According to earlier studies in the country, biofuel-mainly charcoal and firewood- constitute 90% of total energy use. Charcoal is mainly used in the cities whiles firewood is used predominantly in the rural areas. This high demand for charcoal in the city is usually sourced from the nearby villages of which Gwata is one. This can be used to explain

the consistent reliance of the people of Gwata on charcoal making as one of their main sources of income and the high scores awarded it as threat to society as the findings show in table 4-3 above.

As there are more mouths to feed with growing population (not only in Gwata but also elsewhere) agriculture which is predominantly the main occupation in the village is growing and villagers are expanding the frontiers of their farms into the open forest areas reducing the forest area of the village. The local people usually have small acreages of land because their income is low and they can not afford high implements for large farms. However, recent investments by rich city dwellers in agriculture is contributing to agricultural expansion and clearing down of more forest.

Yet other contributing factor to the invasion of forest invasion in the village can be attributed to the frequent bush fires and the influx of population to the village because of its advantageous location. Among such people are the Mbulu trides men who are mainly pastorialist. It come out from the interviews and the group discussions that this pastorialist usually graze their flock in the forest roving the under-story vegetation or grass that carpet the forest floors from the action of runoff water, causing erosion in the forest. This was also confirmed during our transect walk through the forest observing its nature. The signs observed include the biting-off short grasses and defecations of cows at most places in the reserves. At places where forest tree canopies are more open, under-story grasses can be very tall and dense. This helps in keeping the forest closed from invader though community members need permission to enter into these forests. Their removal therefore paves way for invaders by increasing their tendency to do so.

4.4.4. Willingness towards PES scheme

The existing threats promoting forest degradation in the communities coupled with foreseen drought in the communities may trigger the early realisation of the benefits of PES. According to Lee et al (2007) early signs of forest degradation may low down the efforts of a community with a well organised community based management forest to accept PES scheme. Regardless of the persistent drought in the two village communities, it was generally realised during the interviews, the people are willing to accept PES on condition that, there are equally lucrative livelihood alternatives aside their current economic activities. In studies conducted by (Wily 1997), it shows that in general the Tanzania village communities are autonomous in terms of decision making and handling the management of their natural resources.

4.5.   Institutional readiness for PES

One of the key requirements for the successful implementation of PES in a community is institutional readiness in terms of capacity, policy and awareness. Previous studies conducted by Wiley (1999) and Wiley (1997) indicate that community forest management at the village levels in Tanzania is advanced. For instance, the adoption of National Forest Policy (1998) led to the empowerment of village communities 19 million ha of unreserved forest land and

woodland come under local guardianship, primarily through the establishment of village forest reserves. Therefore, village communities are well informed regarding community forest management.

4.6.   Summary

The NDVI change maps for the Kimunyu and Kintangalo forest reserves indicate there is a progressive decrease in forest cover the 1991 to 2008 period. The resultant sharp decrease of forest cover especially for Kintangalo was a result of the wild fire outbreak in 2007. Regardless of the natural disasters that are making it difficult to assess of the performance of the community forest management scheme in the two villages, it was generally agreed from the interviews and related studies of Wiley (1999) people are far advanced in terms of the understanding and readiness towards of community forest management. Institutional readiness for PES also follow a similar case in that, villages in the Tanzania are also far advanced. However, the people in the study area are willing to accept PES scheme towards their community forest management on condition that there are better options for their livelihood aside the earnings they obtained from the economic activities mentioned.

5.   Conclusions

Climate change has been realised in current global debate a priority in the global and national he spagenda of both developed and developing countries. Existing policy framework such as Kyoto protocol among others has provided a number of options through which reduced carbon emissions to the atmosphere could be achieved in the coming decades. One of the key target areas has been the community based forest reserve. Natural forest continues to be a critical source of food and harvesting of timber to the provision of ecosystem services which include watershed and biodiversity protection, and carbon sequestration. To be ability to balance the benefits of socio-economic development and reduced carbon emissions from our forests, several measures have been proposed over the last decade. One such approach is payment for environmental services (PES). Therefore, this research assesses the feasibility of payment for environmental services in Tanzania using the case of Gwata village in the Mrogoro Rural District.

This research studied the land cover dynamics in the area. Due to unavailability of images for the older years, NDVI maps were used for the understanding the land cover changes for the two forest zones – Kimunyu and Kintangalo. These two village forest reserves were chosen to compare the level of efficiency of the different forest management approaches. The approaches are (i) joint forest management between the village and government in the government catchment reserve of Kintangalo ii) community based forest management for by the village in the village reserve of Kimunyu. It was generally realised there was progressive decreased of vegetation cover from 1991 to 2008. On the other hand, before the year 2000, Kimunyu area suffered from deforestation but after this year when the Kimunyu forest reserve was created, the forest cover improved significantly there after. Kintangalo forest was more stable between 1991 – 2000 than Kimunyu forest. But between 2000 - 2008, Kintangalo forest reserve show a sharp decrease in forest cover unlike Kimunyu forest reserve. This was explained during the focus group discussion as a result of wild fire outbreak in 2007.

Studies on the willingness and institutional readiness to accept PES was also done. It was realised from related works by Wiley (1999) conducted during the study that the village communities in Tanzania are far advanced in the management of their forests. The interviews conducted during the study also indicated that households were willing to accept PES on condition that lucrative packages better than their current economic activities was necessary to ensure the successful acceptance of PES. Some of alternative livelihood options they willing to undertake include poultry farming and piggery.

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7.   Appendices

A- 1 Normalised NDVI maps for the various years
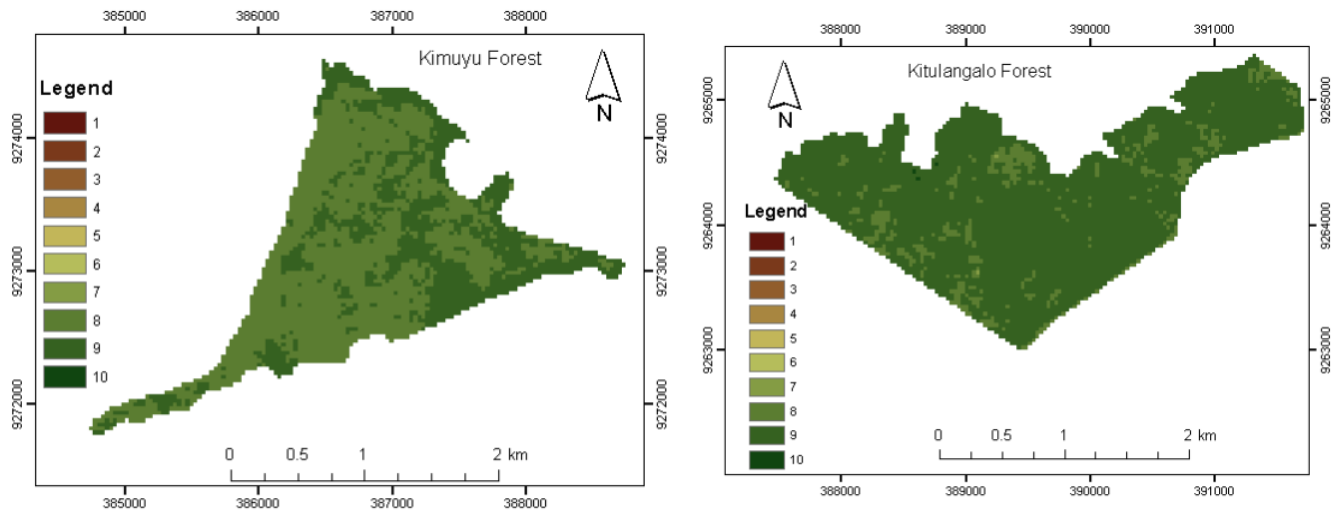
a)   NDVI map for 1991
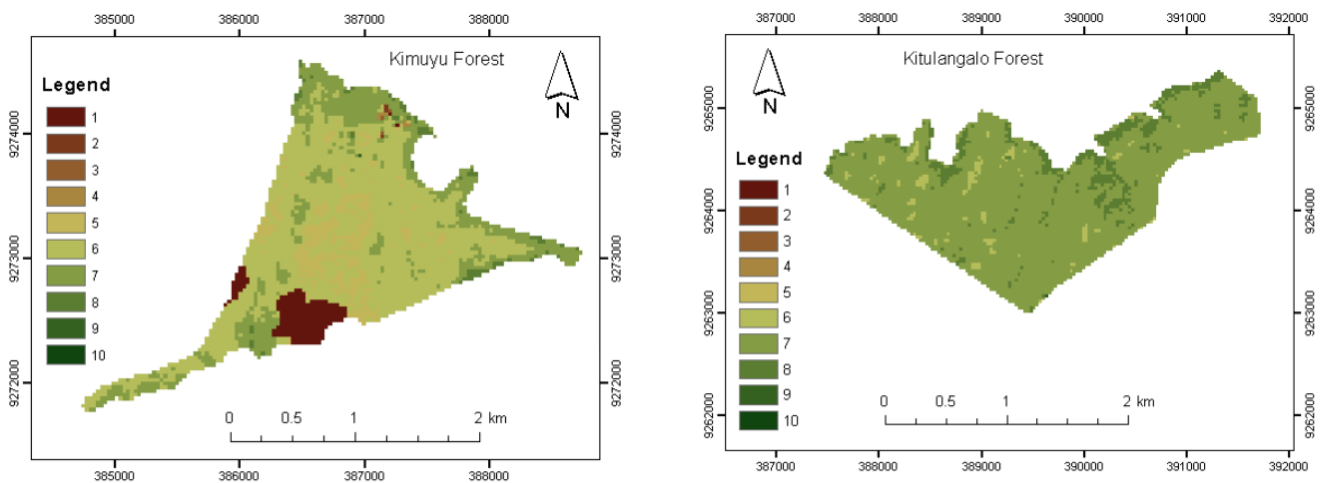
b)   NDVI map for 1995
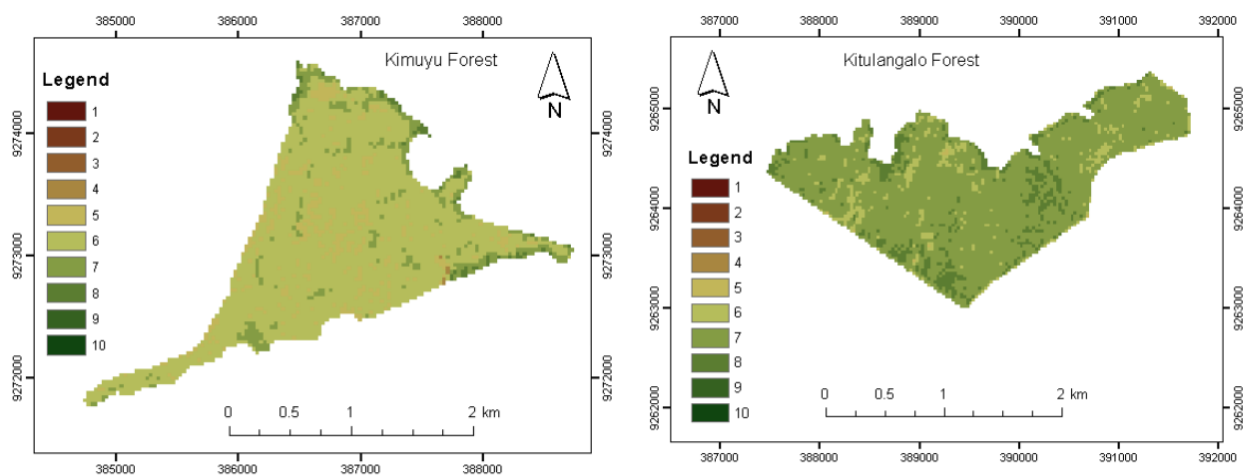
c) NDVI map for 2000
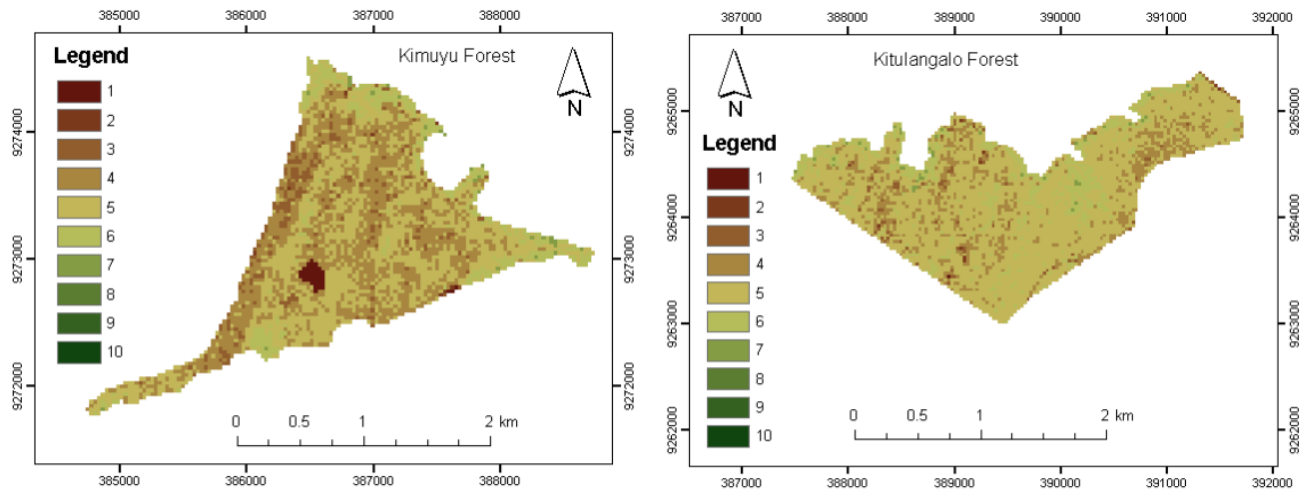
d) NDVI map for 2008

Figure 7-1 NDVI maps for 1991, 1995, 2000 and 2008

A- 2 Household Questionnaire

Questionnaire No………….   Date of interview…………..
Name of village…………….

Part A: Personal/Household information
1. Name of respondent………………………………………. (Optional)

2. Sex: ……………….Male/Female

3. Age……………… Years

4. Level of education;
     (a) No formal education
     (b) Primary education
     (c) Secondary education
     (d) Other: …………………………   (Please specify)

5. Marital status.
     (a) Married
     (b) Divorced
     (c) Separated
     (d) Widowed
     (e) Single

6. Household size…………

7. Household composition

Age	*Male*	*Female*
Bellow 15		
15 – 45		
Above 45		

8. Please specify the type of energy sources you use for the following?

Activity								
	Fire Wood	Charcoal	Crop residue	Animal dung	Kerosine	gas	Electric	other
Cooking								
Brewing beer								
Warming								
Lighting								
Other								
Amount Spent/wk on energy sources								
Total energy cost/wk								

Part B: Main Deforestation Driving Forces

9. How long have you lived in this village? ….. Years
10. Are you an indigene of this village or a migrant resident?
11. If migrant, why did you migrate here……………………………………………

Land Use and Tenure.
13. Does your household own a land for agricultural use? Yes/No
14. If yes, specify the following:

No. of Parcels	Dist.form homestead	Total size(acre)	Area cultivated /annum	How obtained

KEY; (a) Inheritance (b) Purchase (c) Lease (d) Allocated by village government. (e) Clearing new land (f) Other…………

15. Do you consider your land to be enough? Yes/No

16. Is it possible to get more land? Yes/No Where and how……………..

17. Has any land use changes occurred since the 1980's? Yes/No

18. If yes, which land use gave way to the other?
    (a) Forest to farm land   Where…………………………………….
    (b) Forest to grazing area (pasture)   Where…………………………………….
    (c) Cultivation to woodland/forest   Where…………………………………….
    (d) Cultivation to grazing land   Where…………………………………….
    (e) Grazing land to woodland or forest   Where…………………………………….
    (f) Grazing land to cultivation   Where…………………………………….
    (g) Other………………….   Where…………………………………….

Crops and Livestock
19. What kind of crops do you grow on your farm?

Crop	Yield\ season	Market price	Number of bags/bundles	
			Consumption	For sale

20. How long do you farm the same parcel of land before it looses fertility? ....years
21. How long is the fallow period? ....years

22. How would you describe the productivity trend of your farm over the past few decades?
        (a) Increasing. Why? …………………………
        (b) Decreasing. Why? ....
        (c) Constant.   Why? ....

23. Which cropping system do you use?
        (a) Agroforestry   Why? ………………………………...
        (b) Monoculture   Why? ………………………………...
        (c) Mix cropping   Why? ………………………………...
        (d) Shifting cultivation   Why? ………………………………..

24. How do you prepare your land?
        (a) Clearing all vegetation down
        (b) Clearing all and burning the bush
        (c) Burning the bush
        (d) Leaving some trees on farm

25. Do you have any livestock? Yes/No

26. If yes

Type	Number		Market price
	Domestic use	sold	

27. What is your mode of keeping livestock's?
        (a) Paddocking
        (b) Zero grazing
        (c) Free range grazing

28. What are main sources of household income

Income source	Availability*	Average income per month/Year	Rank(1,2,3..)
Crops Livestock Charcoal Firewood Timber Petty trading Casual employment Craft Wild fruits Credit/Loan Honey Remittance Other			

*Availability: 1=seasonal, 2=Constant throughout the year, 3=unreliable

29. Are you able to save part of your income? Yes/No

30. If yes, how much? ....

Forest resources use

31. Do you have any natural forest around your community? Yes/No

32. If yes, what types of forest are there?

> (a) Government reserve (Catchment forest)
>
> (b) Open access (Msitu awazi)
>
> (c) Joint Implementation (SUA forest)
>
> (d) CBFM (Kimunyu)

33. How far are they from the homestead (km/mile/hr).

> (a) Government reserve …………
>
> (b) Joint Implementation …………………..
>
> (c) Village common …………
>
> (d) CBFM………………………….

34. How do you regard the current status of the forest as compared to the past?

Forest	Status* (1,2,3,4,5)	Reasons/Indications
Gov. reserve (Catchment forest) **Village Open access (Msitu awazi)** **Joint Implementation (SUA forest)** **CBFM (Kimunyu)/(**		

Status*key: 1=Very good, 2=Good, 3=Satisfactory, 4=Poor, 5=Don't know

35. Which forest products does your household collect?

Forest product	Source*(1,2,3,4,5)	How far(km/mile/hr)		Availability#		Species most pref
		Past 20yrs	Now	Past20yrs	Now	
Honey **Fruits** **Medicinal plants** **Game** **Firewood** **Charcoal** **Building material** **Timber** **Other (please specify)**						

Key:Source*,(1=Government reserve, 2= Joint Implementation, 3= Village common, 4= CBFM,)

Availability#, (1=Plenty, 2=fair, 3=very few)

36. Which of these activities do you consider a major threat to conservation of the forest?

Threat	*Rank (1, 2, 3…)*	*Possible causes*
Cultivation Wild fires Settlements Livestock grazing Charcoal making Logging Cutting poles Firewood gathering Honey collection Hunting Other (please specify)		

PERCEPTIONS ON AND WILLINGNESS TO ACCEPT PES

37. Do you have any idea about payment for conservation? Yes/No

38. If yes, what do you know about it?

…………………………………………………………………………………………..

…. ………………………………………………………………………………………..

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

39. Are you involved in forest conservation? Yes/No

40.If yes, do you receive any reward for your role in managing the forest and how much…………………………………………………

41. If not involved why?………………………………………………….

42. What in your opinion will convince people to participate in PES for conservation?

…………………………………………………………………………..

43. Do you think if PES is instituted people will participate more if compensated? Yes/No

44.If yes, give reasons ……………………………………………………..…

45. If no, give reasons……………………………………..………………….

46. If you required change your source of livelihood, what alternative will you prefer? Please specify…………………………………..

……………………………………………………………………

47. How do you think payments for conservation should be distributed?

(a) Invested into social services like schools, hospitals etc.

(b) Distributed among individual members.

INSTITUTIONAL STRUCTURES IN PLACE

48. Are there other stakeholders/Institutions involved with forest management in the village

Name of the forest	*Stakeholder(s)*	*Role (s)*

49. Are you aware of any government laws or regulations governing the management of resources from the:
(a) Open access forest? Yes/No If yes please specify………………………..
……………………………………………………………………………...
(b) Government reserves? Yes/No …………………………………………...
……………………………………………………………………………...
(c) CBFM forest? Yes/No …………………………………………………
……………………………………………………………………………..

50. Are you aware of any local bye-laws governing the management of resources from the:
(a) Open access forest? Yes/No If yes please specify………………………..
……………………………………………………………………………...
(b) Government reserves? Yes/No …………………………………………...
……………………………………………………………………………..
(c) CBFM forest? Yes/No …………………………………………………

51. Do you think people follow these rule? Yes/No

52. If no why…………………………………………………………………...

53. Could you please tell us how you think the current forest management rules could be made more effective successful for conservation?
……………………………………………………………………………..
……………………………………………………………………………..
……………………………………………………………………………..
……………………………………………………………………………..
……………………………………………………………………………..