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Monitoring Costs and Benefits under Conventional and Community-based Approaches used in Forest Management in Iringa District, Tanzania

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Abstract

Involvement of local communities in monitoring forest resources is perceived to lower monitoring costs and reduce burden to the government and ensure sustainability of those resources. This paper compared monitoring costs and benefits under conventional and community-based monitoring methods used in forest management in Tanzania. Specifically the paper intended to identify activities undertaken in conventional and community-based monitoring approaches, explore the perceptions of the local communities and experts on the two approaches, assess and compare monitoring costs in each approach and hence suggest the most effective approach for monitoring forest resources. Data were collected in eleven villages adjacent to Kitapilimwa and Nyang'oro forest reserves, Iringa district. Quantitative data were analyzed using Statistical Packages for Social Sciences and excel computer programs. Results show that under community-based monitoring approach the frequently performed activity was patrolling while in conventional monitoring was boundary consolidation. The average payment for patrolling was Tshs. 1445.46 (≈ 1.45 USD)/person/day while escorting researchers was Tshs. 2522.73 (≈ 2.52 USD)/person/day. About 39% of the respondents perceived that people use much of their time in monitoring activities with little payments. Under community-based monitoring approach the average monitoring costs was Tshs. 11153.85 (≈ 11.15 USD)/person/year and Tshs. 114.78 (≈ 0.11 USD)/ha/year while under conventional monitoring was Tshs. 25755.73 (≈ 25.76 USD)/person/year and 392.08 (≈ 0.39 USD)/ha/year. Conventional monitoring was perceived to be more effective than community based monitoring approach in data collection activities. To ensure sustainability of forest resources in the villages, we suggest the use of both monitoring approaches than a stand-alone approach to complement each other and maximize the potentials. Mainstream it into the existing government structure to avoid duplication of efforts and ensure sustainability of conservation activities. We recommend further research to assess the effectiveness of community based monitoring system on data collection and its quality.

Keywords: Community based; Natural resource management; Management costs and benefits; Monitoring approaches; Local communities; Livelihoods; Conventional monitoring

Introduction

Back ground information

Natural resources are crucial to rural livelihoods across developing countries and they provide both direct and indirect vital ecosystem services to rural and urban populations in many areas [1,2]. In Tanzania, forests contain various biological resources making it among the most richest biodiversity countries in the world [3] and supports many animal species making it among the largest number of mammals, second largest number of plants, third largest number of birds, fourth largest number of reptiles and fourth largest number of amphibians in Africa [3]. It plays an important role in enhancing the livelihoods of both rural and urban communities [4,5]. More than 92% of the population in Tanzania uses wood for domestic energy in the form of charcoal or firewood while less than 15% mainly from urban areas are connected and use electricity [6]. Forests are also important for water catchments, for supporting endemic and threatened species and for contributing to the national economy through sustainable forest harvesting, hiking, ecotourism and nature tourism [7-9].

Despite these importance to the livelihoods of people and the national economy, forests and other natural resources monitoring has not been emphasized in most of the community's and state owned forests. In many drylands where some of these forests are found there has been unsustainable land uses hence requiring rehabilitation programs [10]. Empirical evidences show that deforestation and land degradation is the most relevant biodiversity crisis in most tropical forests regions [11,12]. FAO reports show that the rate of decline of primary forests is the current most global critical issue [13]. In some areas however, monitoring is the methodological focal strategies for management and conservation of forests and biodiversity [14,15]. In the absence of an effective monitoring system, correction measures and control, the stock of natural resources capital like forest will be depleted over time [16] due to the increasing demand of forest products resulting from the population increase, high rate of urbanization and economic growth. All these factors cause considerable stress and pressure to forests and other natural resources in many parts of the country.

In the past, the government assumed the ownership and management roles of natural forests believing that it will be able to manage and control the use of these resources. It was anticipated that through this management system, both the benefits and conservation value would be maximized with the assumption that only the state is capable of undertaking rational and long term management decisions with environmental benefits extended beyond the local communities

[17]. This system is referred as "conventional" natural resources monitoring and management system. In contrast, the Community Based Forest Monitoring (CBFM) system is the system where local communities adjacent to the forests are given power to monitor and manage the resources. In some places they practice Joint Forest Management (JFM) where both the government and local communities are involved in monitoring the forest resources. This aimed at providing land ownership and incentives for natural resources management [10]. However, in the absence of clear incentives and benefits, it is difficult to involve local communities in conservation activities of long term goals. Several factors including illiteracy, ignorance, lack of resources and skills tend to affect the design of the monitoring system to adopt [14]. Generally, community-based monitoring system whereby local communities are fully involved in the resource monitoring is now being promoted in Tanzania [18-20].

The promotion of community based forest monitoring system is challenging due to lack of sustainable funding and incentives to all stakeholders. This is because, the global scientific benefits from the forests in most cases tend to differ from the benefits expected by the communities. There has been different opinions on the reliability and effectiveness of the professional-scientist forest monitoring and community based forest monitoring [15]. The main arguments on the two monitoring technique has been mainly on costs, lack or limited financial resources, quality and reliability of the collected information. In Tanzania, the recent emphasize has been on the community based forest monitoring system where local communities adjacent to those resources are directly involved assuming that it will minimize the management costs and at the same time maintain the stewardship of the resources. The conventional method is believed to give good quality data but is also claimed to be expensive hence difficult to sustain in developing countries like Tanzania where the government resources are scarce and dwindling. However, the community based forest monitoring system is claimed to be cheap but tend to produce poor and unreliable data [14,21,22]. It might be possible to implement locally-based forest monitoring system at much less cost than professional monitoring by scientists but there is a need to understand the cost effectiveness and its sustainability in different settings in the country. Therefore, this study compared the two forests monitoring approaches to examine the differences in expenses, effectiveness and monitoring conditions of the forests in Tanzania.

Objectives

General objectives

The overall objective of the study was to compare the costs and benefits and effectiveness of conventional and community-based monitoring approaches as used in forest management.

Specific objectives

The Specific objectives were to:

- Identify activities under conventional and community-based monitoring approaches
- Investigate perceptions of local communities, experts (professional foresters) and other stakeholders on conventional and community-based monitoring approaches
- Assess and compare monitoring costs under conventional and community-based approaches
- Suggest the best and effective approach to be used for monitoring forest resources in Tanzania

Research questions

The study aimed at answering the following key questions:

- What are the true costs of conventional and community-based monitoring system?
- What types of data are collected by community-based and conventional monitoring approaches?
- What are the perceptions of forest professionals and local people on community-based monitoring approach?
- Is it true that conventional monitoring is expensive and cannot be sustained by the governments in developing countries?

Methodology

General overview

The study was conducted in Iringa district which is among the seven districts in Iringa region. It is among the regions with a mixture of both tropical thick forests as well as miombo woodlands and is located in the southern higher lands of Tanzania [23,24]. The total land area in this district is 20,576 square kilometers of which only about 9,857.8 square kilometers are habitable and the rest are occupied by national parks, forests, rocky mountains and water bodies [24]. Among the available land area only about 1,593,825 hectares is cultivated land. The focus of the study was in Kiwere, Mfyome, Kitapilimwa, Itagutwa, Migoli, Makatapora, Izazi, Makuka, Nyang'oro, Chamdindi and Mangawe villages. These villages own South and North Nyang'oro Forest Reserves with a total of 118,700 ha (Figure 1) and Kitapilimwa Forest Reserve with 3697 ha (Figure 2) making a total of 122,397 ha. Basing on the 2012 population Census, the current population is about 254,032 people. The dominant ethnic groups are the Hehe and Bena but other existing minor ethnic groups are Kinga, Ngoni, Masai, Gogo, Sagara, Barbaig, Waukomis, Yao and Sangu. The district receives an average annual rainfall of about 500 – 1200 mm while the average annual temperature is about 15-20°C [25]. The dominant economic activities of the people in Iringa rural district are smallholder agriculture, pastoralism, and semi-pastoralism. Subsistence crops are maize, cowpea, beans and groundnuts while plantation timber, tomatoes, sunflower, and tobacco are the most important cash crops. Animal husbandry and fresh water fishing constitute the main livelihoods of the rural dwellers in the district whereas in montane forest areas animal husbandry and fresh water fishing are on small scale and are mostly secondary sources of income.

The district has about 314,402 ha of forests of which 250,000 ha are under reserves both in woodlands and montane forests while 155,302 ha are under catchments [20,25]. The patches of natural forest cover are found along the hill slopes and some valleys in the midland zone. The lowland zone has a forest cover of about 80% of the total land because agricultural activities are limited in this area. Like in other parts of the country, deforestation is increasingly becoming a serious problem affecting the sustainability of the natural forests in the district. This is due to the increased demands for fuel wood and charcoal in both rural and urban areas as results of increasing population and urbanization rates in the district and other neighboring towns. Anecdotal evidence show that illegal forest harvesting is increasing in the district due to poor returns from farming activities. On the other

hand, tobacco farming in Kiwere division has contributed much to the depletion of most of natural forests in the district.

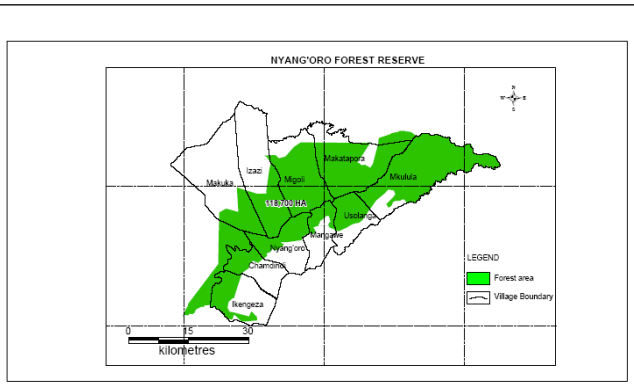

Figure 1: A map of Nyang'oro Forest Reserve and the surrounding villages.

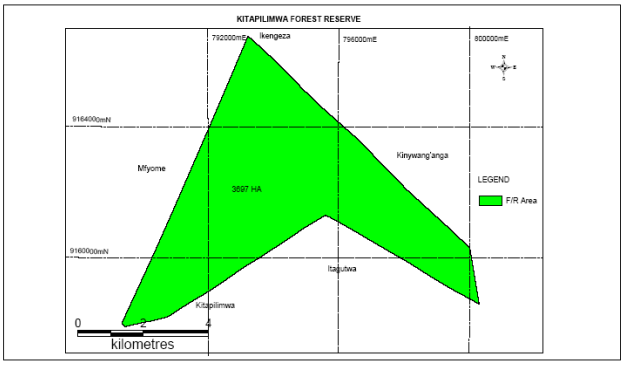

Figure 2: A map showing Kitapilimwa Forest Reserve and the surrounding villages.

Data collection

Primary data were collected in eleven villages as indicated in Figures 1 and 2. Questionnaires with both closed and open-ended questions, focus group discussions and participant's observation were used to obtain quantitative and qualitative data on community-based and conventional monitoring approaches. The data collected were mainly on the activities performed, frequency of performing, benefits accrued and their associated costs. Other information collected was on the perceptions of the people on the two management systems. Tongco [26] employed purposive sampling and random sampling in order to have unbiased representation in the communities [27]. Three wards, Kiwere, Izazi and Kihorogota were selected purposively basing on the existence of the forest reserves, its accessibility and availability of the village natural resources management committees while the eleven villages were selected randomly by giving numbers and picking them randomly. In each village ten members of the village natural resource committee out of fifteen were selected randomly and each member were interviewed independently. The natural resource committee members were selected because they are the ones who conduct various monitoring activities in the forest reserves. The main sampling unit in this study was the natural resource committee members. The size of the village natural resource committee in each village was fifteen people and ten of them were sampled and interviewed. A total of 110 natural resource committee members were sampled from the eleven villages.

Structured questionnaire with open and close ended questions were designed to capture socio-economic data, monitoring costs under community-based monitoring approach and the perceptions of the local community on conventional and community-based monitoring approaches. Activities performed under community based monitoring approach were listed and the total numbers of participants per activity were identified. To get the total costs incurred in the monitoring process, all the associated costs in each activity were aggregated and summarized in a tabular format to obtain the total costs for all the activities. In the focus group discussions, key villagers of all gender were interviewed using checklist questions in group of about ten to fifteen people. A key informant is an individual who is knowledgeable, accessible and willing to talk about the issues under the study [28,29]. In this research key informants included district forest officer, ward forest and extension officers, village leaders, elders and other villagers who are not in the village natural resource committees but are well knowledgeable about the two management approaches. The aim of the checklist was to guide and get detailed information on activities conducted under conventional and community-based monitoring approaches, costs under these two approaches, perceptions of different stakeholders on these two monitoring methods and the role played by each participant in forest management. Villagers were also included in the focus groups to acquire information on the perceptions of the local community on the two monitoring approaches. On the other hand, old aged people of both sexes were also interviewed purposively to get some historical information and trend on how the two approaches have been implemented and on the observed differences.

Field observation was used to physically identify the real situation in order to substantiate some of the information obtained from the interviewed people. This aimed at getting some insights and hidden information from villagers who tend to avoid open discussions [30,31], due to dominancy, seniority and gender differences of the participants. The information collected through field observations can give real conditions of the forest reserves, actual living standards of the people, infrastructure availability and accessibility, monitoring data availability and reliability. Some relevant information was gained through close observation on what was happening in the villages. Secondary data were obtained from all eleven village offices, Iringa district forest office and Iringa region forest office.

Data analysis

Information collected through questionnaires were coded and analyzed both quantitatively and qualitatively using descriptive statistics. To obtain the descriptive statistics for quantitative data the Statistical Package for Social Sciences (SPSS) and Microsoft excel computer programs were the main computer tools employed. Descriptive statistics such as percentages and frequencies were determined and used for summarizing the results. For the qualitative data, important information and opinions on the perceptions of both local people and experts (government officials) on the two monitoring approaches were compiled and summarized. The comparisons on the monitoring approaches based on the patrol activities in the forest, management activities, the frequency of conducting these activities and the payments for each activity.

Results and Discussions

Economic activities

As revealed from the literature, about 86% of the households in these villages are farmers and have resided in the areas for many years. However, about 4% of the people are practicing farming and pastoralism and 4% earn their livelihoods through fishing activities. Although the area seems to have few pastoralists but their effect to the forests may be very detrimental depending on the size of the herd owned. The numbers and percentages however should be interpreted with care since other groups might be less represented in the sample unit due to random sampling. Since majority of the households are farmers, one would anticipate that the rate of shifting cultivation will be high causing an increase in deforestation. According to the population census of 2012, the average annual population growth is about 3% while in some areas, population can grow by as higher as 5% per annum [32]. Such a population growth rate and high dependency on farming activities and fuel wood from the forest have an implication to deforestation hence need to develop better forest and land monitoring system to ensure sustainability. Therefore, land use plan could be important in order to reduce improper land, management, deforestation and land degradation (Table 1).

Occupation	Frequency	Percentage
Farmer	95	86.4
Fisherman	4	3.6
Farmer and pastoralist	4	3.6
Business	3	2.7
Farmer and fisherman	2	1.8
Employee	1	0.9
Pastoralist	1	0.9
Total	**110**	**100.0**

Table 1: Main occupation of the interviewees.

Activities performed under CBFM approach

All the villages adjacent to forest reserves had natural resources committee and they participate in managing the forest reserves. The committee members in all villages are actively engaged in various forest monitoring and management activities. The awareness on the different forest management and monitoring approaches used in managing the forest reserves were high among the committee members (Table 2). During focus group discussions, most of the participants preferred the community based forest monitoring approach because of the engagement and participation of all the stakeholders adjacent to forest reserves. Some interviewee revealed that under conventional monitoring approach, local community members were not involved in managing the forests. They did not participate in the decision making process but they were rather getting orders from the government officials for them to implement. Once the decisions were made, they had no power to change or improve during implementation. However, empirical evidence show that, if local community members are trained, educated and provided with the necessary supports it is possible for them to engage in monitoring and managing the forest reserves in a more sustainable manner. Some community members revealed that, a number of people in the villages do not participate in village forest management activities perceiving that the village natural resources management committee members get more benefits than the mere community members. Information flow need to be improved to avoid such unnecessary discernment. Other scholars have found that clearly defined and secured boundaries for each village, clearly defined rules, appropriation, provision of proper facilitation and trainings, protection and management of village forest reserves and good collective choice of Village Forest Committees representing all stakeholders are among the factors which are likely to motivate local communities to participate fully in forest monitoring, management and conservation activities [33,34].

Activities	Frequency	Percentage
Patrol	90	81.82
Patrol, fire line construction, escorting vehicles, Boundary consolidation, Escorting researchers	15	13.64
Patrol, fire line construction, escorting vehicles, Boundary consolidation, Escorting researchers and fire extinguishing	2	1.82
Patrol, escorting vehicles, Escorting researchers	2	1.82
Escorting researchers	1	0.9
Total	110	100
Source: Field data		

Table 2: Activities performed under Community Based Forest Management approaches.

Different activities can be performed by local community members under the community based monitoring approaches. About 82% of the interviewee revealed that the only activity mostly performed under CBFM was patrolling followed by escorting researchers and vehicles entering the reserve (Table 2). Other activities like fire line construction and clearing, boundary consolidation, fire extinguishing, evaluation and tree planting are conducted on occasional basis. A substantial number of vehicles/lorries were coming to carry charcoal and firewood from the village's forest reserves meaning that there is a high rate of harvesting in the general land. With the high harvesting rate of timber and fuel wood, the sustainability of these forests reserves will be questionable in the long run. The patrol activities were conducted only once per week with a fixed specified day in each village. The fixed patrolling schedule is dangerous because encroachers can use the rest of the days for illegal activities hence degrading the forests. In all villages, the patrolling teams had no transport facilities such as bicycle leading to futile patrol. Patrol equipments and facilities are potential for ensuring thoroughly and effective patrol by the committee members. Having proper patrol equipments will reduce the probability of bribery to the patrol team. In the absence of motivation to the patrol teams, some illegal activities may be undertaken inside the forest reserves hence hampering the overall objective of the reserve [35]. With a patrol schedule of once per week a total of about 50 man-days per year were required. These findings differ from Jorgensen et al. [20] which indicated that the patrol team will require about 300 man-

days per year. The differences has a significant implication in the monitoring costs and effectiveness. As the patrol team spend more days in the field, it implies higher monitoring costs but may implicate good quality of the forest since encroachers will be scared. Furthermore, in order to reduce the challenge of illegal harvesting in community based forest reserves, Kajembe et al. [34] suggested the use of controlled harvesting of mature timber species to motivate people and increase villager's participation in the management and patrolling activities. Equitable distribution of revenues accrued from the forests and provision of social services such as communication and health facilities can also be among the best incentives for local communities' participation. On the other hand, promotion of beekeeping activities in line with market promotion for bee products could help in increasing the value of the forests and stakeholder's participation. Further, the current carbon trade could be an additional value to the intact forest hence increasing tangible benefits to local communities.

Activities performed under conventional monitoring approach

The conventional monitoring approach is the forest monitoring system in which the government owns the forest resource and all the management activities are controlled by the state. Most of the village natural resources committee members were aware about some of the activities mostly performed when the forest reserves were under the government. Boundary consolidation was the activity mostly performed (45%) followed by fire line construction and clearing (42%) under the conventional forest management system (Table 3). Under this approach local community members were hired and supervised by the forest officers and paid on daily basis. On the other hands, about 14% of the interviewees were not aware of any activities undertaken under conventional monitoring system. Although local communities were involved in some of the activities under conventional monitoring but the decisions were centralized and made by the government.

Activities	Frequency	Percentage
Boundary consolidation	49	**44.54**
Fire line construction and clearing	46	41.82
I don't know	15	13.64
Total	**110**	**100.0**
Source: Field data		

Table 3: Activities performed under Conventional Forest Management approaches.

Anecdotal evidences from the field revealed that conventional monitoring approach improved the conditions of the forest reserve in terms of biodiversity and species richness in a short term. This monitoring approach emphasized on protection of biodiversity and nature while the community based monitoring approach is interested on other tangible benefits to local communities which means allowing harvesting the resources to accrue some money for village development activities. Patrols, monitoring and evaluation of the management plans, provision of technical advice on various issues to the VNRC's and the community in general are the activities mostly conducted by foresters under the conventional monitoring (personal communication). Other activities such as boundary consolidation, fire line construction and clearing were conducted occasionally due to lack of funds from the government. These field works are normally conducted monthly depending on the availability of fund, transport and staff. While the patrol team under community based monitoring had no transport facilities, the patrol team under conventional monitoring used vehicles, gun boots and other sophisticated equipment's. These differences definitely results into the variations in the monitoring costs. Subjecting these teams into similar conditions in terms of equipment's and motivations for field work, community based forest monitoring approach might be far expensive due to the large number of participants in each village.

Monitoring Costs

Costs under community-based monitoring approach

Monitoring costs vary considerably between conventional and community-based monitoring approaches. The reported minimum payment per person per day was Tshs. 500.00 (≈ 0.50 USD) for different activities. In many activities, the natural resource committee members had to volunteer for several days in some villages. The highest amount paid per person per day was Tshs 3,000.00 (≈ 3.00 USD) depending on the activity and the working hours per day (Table 4). The monitoring cost also varies widely between villages because each village had its own scheme for paying the scouts and other village natural resource committee members. There were no explanations for the variations in the payment rates but were subject to the availability of funds. In some occasions, in the same village the committee members received different rates by performing similar activity. Some villages contacted the patrol in the forest reserves twice per month while others patrolled four times in the same period. The variations in the number of patrols per month, the number of workers and working days caused the differences in the monitoring costs among the villages and between the monitoring approaches. In some villages the patrol team were paid Tshs 500.00 (≈ 0.50 USD) per person per day while in others were paid Tshs 1,000.00 (≈ 1.00 USD) per day. Few villages paid about Tshs 3,000.00 (≈ 3.00 USD) per person per day (Table 4). The weighted average payment for patrolling was about Tshs. 1,446 (≈ 1.45 USD) per person per day. This payment is rather small compared to the time spent and the amount of work undertaken per day per person. Most of the committee members complained about the time spent and the payments received because the official public minimum wage is supposed to be between Tshs. 1,500.00 (≈ 1.50 USD) to 2,500.00 (≈ 2.50 USD)/= per person per day.

The participation of community members in managing and monitoring forest reserves depends on many factors but economic incentives are the main ones. Community based monitoring approaches is claimed to be cheaper but the lower total monitoring costs results from underpayments of the local people undertaking those activities. In a long run, community based forest monitoring approach will be challenging if no tangible benefits will be realized by local community members adjacent to these reserves. According to Danielsen et al. [14], the monitoring costs tend to vary basing on the intensity of data being collected, accessibility of the area, density of the government staff at the field level and type of participation of the stakeholders. With the lower payments provided to local communities engaged in the monitoring activities, the opportunity costs to these local community members becomes relatively high and may affect significantly the forest management and conservation efforts. The lower payment rates are likely to be the motivates for village natural resource committee members to engage themselves directly in illegal

activities. It may also indirectly motivate them to bribery from illegal timber harvesters and traders. According to Jorgensen et al. [14], allowances for attending patrols or other VNRC activities ranged between USD 0-1.75 (≈ Tshs. 0-1750) per day.

Activities and payment rates in Tshs (USD)	Frequency	Percentage
Patrol (per day)		
500.00 (*0.50*)	20	18.2
1,000.00 (*1.00*)	41	37.3
2,000.00 (*2.00*)	39	35.5
3,000.00 (*3.00*)	10	9.1
Boundary consolidations (per day)		
No payments at all	33	30.0
500.00 (*0.50*)	27	24.5
1,000.00 (*1.00*)	48	43.6
2,000.00 (*2.00*)	2	1.8
Field escorts (per trip)		
500.00 (*0.50*)	63	57.3
1,000.00 (*1.00*)	45	40.9
2,000.00 (*2.00*)	2	1.8
Escorting Researchers (per day)		
No payments at all	1	0.9
500.00 (*0.50*)	9	8.2
1,000.00 (*1.00*)	11	10.0
2,000.00 (*2.00*)	5	4.5
3,000.00 (*3.00*)	84	76.4
Total	**110**	**100.0**
Source: Field data		

Table 4: Payments rates for different activities.

Boundary consolidations is among the important work in forest management and it contribute significantly to the total monitoring costs. Majority of the committee members (44%) revealed that the payment for these activities was about Tshs 1,000.00 (≈ 1.00 USD) per person per day. Few committee members asserted to receive Tshs. 2,000.00 (≈ 2.00 USD) per day (Table 4). However, a large number of interviewed people (30%) claimed that they are not paid but they are rather exempted from some village communal works. Some village natural resources committee members (25%) revealed to receive a daily payment of Tshs. 500.00 (≈ 0.50 USD) for boundary consolidation. The calculated weighted average payment per person per day was Tshs. 595.45 (≈ 0.60 USD) which is far small and unrealistic. The amount paid differ significantly from the official government daily payment which ranges from Tshs. 1,500.00 (≈ 1.50 USD) to 2,500.00 (≈ 2.50 USD)/= per person. To motivate community members to participate in monitoring activities, the payments should at least be equal or more than the normal official government daily payments rates. The payments for escorting various people including charcoal producers and firewood collectors in the forest ranged from Tshs. 500.00 (≈ 0.50 USD) to 2,000.00 (≈ 2.00 USD) per person per day. The majority of the committee members (57%) claimed to be paid Tshs. 500.00 (≈ 0.50 USD) for each trip they escort somebody to the forest for either firewood or charcoal collection and very few (2%) indicated that they were paid about Tshs. 2,000.00 (≈ 2.00 USD) per trip. The weighted average payment was about Tshs. 731.81 (≈ 0.73 USD) which is still small compared to the time they spend in the field. There is no specific payment rate for this activity but rather depends on who is going to the field and the person being escorted. This differences creates room for unnecessary conflicts and favoritism between the scouts and other members in the village natural resources committee. It may cause double standards and results into corruption to the scouts and other members of the natural resource committees by colluding with the charcoal and timber producers.

A number of research activities are being conducted in the forest reserves and many researchers are frequently visiting Kitapilimwa and Nyang'oro forest reserves. As a strategy to solicit funds for various development activities in the villages, villagers agreed that all researchers entering the reserve have to pay some fee for such a service. The payments for each person hired ranged from Tshs. 500.00 (≈ 0.50 USD) to Tshs. 3,000.00 (≈ 3.00 USD) per day as indicated in Table 4. The weighted average payment for this activity was about Tshs. 2,522.73 (≈ 2.52 USD) per person per day. However, depending on the type of the research and the objectives of the researcher, specific people were assigned to escort researchers to the field. This arrangements was not proper because other village natural resources committee members may feel inferior hence causing conflicts, poor team work and poor participation in other activities. It causes some of the committee members to participate in activities associated with payments only while avoiding all voluntary works. Compared to other activities, escorting researchers seems to be the only activity with the highest weighted average payment of about Tshs. 2,522.73 (≈ 2.52 USD) per day per person. This amount is charged to local researchers but the rate for foreigners the payments ranged from Tshs. 5,000.00 (≈ 5.00 USD) to about Tshs. 10,000.00 (≈ 10.00 USD) per day.

Based on the secondary data obtained from the villages and district office, the analysis of government costs for community based monitoring reveals that 38% of the total costs were used for patrolling activities followed by awareness meetings in the villages (29%). These awareness meetings were organized by the Village Natural Resource Committee members at village or zonal levels. As indicated in Figure 3, there were no funds allocated for boundary consolidations or fire protection activities. A substantial amount of money (29%) were used for paying seating allowances for committee leaders. Each village conducted two meetings per month with an average of twelve people per meeting. This means they had 48 meetings per year and about four meetings per year at zonal level. The zonal meetings constituted about 45 people from all the villages around Kitapilimwa and Nyang'oro Forest reserves. The total payments per person for meeting allowances averaged to about Tshs. 11,153.85 (≈ 11.15 USD) per person per year for the financial 2008/2009. The forest reserve in these villages has an area of about 131,209 ha meaning that the average monitoring costs per hectare per year is estimated to be Tshs. 114.78 (≈ 0.11 USD) per hectare per year. These monitoring costs are moderately small and could be unrealistic to work as incentives to local community and natural resources committee members. Despite the desire to monitor the available resources at minimum costs as possible, it may be difficult to develop a sustainable community based monitoring system under such a low payment rates. Economic incentives and benefits could motivate local communities adjacent to forest reserves to monitor the resources in a sustainable manner. In Kiwere village for instance it was observed that 21 patrols were conducted per year and in each patrol there were about 4 guides hence averaging to about Tshs 3,965.00 (≈

3.97 USD) per person per year. With these rates of payments, it is evident that in most cases the patrol guides are just volunteering despite the risks associated with their work.

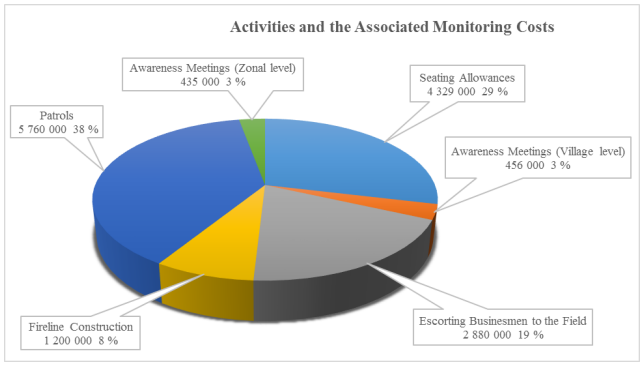

Figure 3: Monitoring costs under community-based approach for the financial year 2008/09.

Costs under conventional monitoring approach

Conventional forest monitoring differs from the community based forest monitoring in several aspects including priorities, routine activities as well as frequencies of these activities. For the financial year 2007/08, almost one-third (28%) of the expenditure was for salary while meetings and staff trainings consumed about 18% (Figure 4). Other expenditure was seedlings production (16%) and internet installation and stationeries costs (15%). For the financial year 2008/09, salary consumed more than half (57%) of the total expenditure while fuel and vehicle maintenance spent 19% and perdiems and seating allowances consumed about 14% (Figure 5). Under this monitoring approach, forest officers seat once per month with about 13 members per meeting making a total of about 156 people per year. However, at departmental level they conduct four meetings per year with about 70 people per single meeting totaling to about 280 individuals per year. The average meeting costs were estimated to be Tshs. 25,755.73 (≈ 25.76 USD) per person per year and the total monitoring costs were estimated to be about Tshs. 523.50 (≈ 0.54 USD) per hectare per year and Tshs. 260.70 (≈ 0.26 USD) per hectare per year for the financial year 2007/08 and 2008/09 respectively. From these costs, the average conventional monitoring costs were about Tshs. 392.08 (≈ 0.39 USD) per hectare per year implying that a small amount of budget is allocated for monitoring activities. Allocating little budget into monitoring activities can imply less priorities to monitoring activities hence promoting deforestation and forest degradation. Forest officers in most cases live far from the reserves, this may stimulate illegal activities inside the reserves since no body will be patrolling in the forest reserves. But if local communities' members are properly incentivized, they might be good custodians of the reserves because they live in the same localities. Fire line construction was another important activity undertaken in this monitoring approach. A total of about 15 km were constructed in financial year 2007/08 costing a total of about Tshs. 1,835,000.00 (≈ 1,835.00 USD) per year. This means that fire line construction costs is about Tshs 122,333.00 (≈ 122.33 USD) per kilometer per year. Sixteen casual laborers were employed for this work and they worked for forty days amounting to an average costs of Tshs. 2867.19 (≈ 2.87 USD) per person per year.

In this study, the costs for most of the activities are relatively lower than those reported by Danielsen et al. [14]. According to Danielsen et al. [15], the monitoring costs under conventional approach was about 3.6 USD (≈ Tshs. 3,600) per hectare per year. Although this amount is higher than we observed but is still lower if we value the benefits which forest reserves provides at local, national and international level. Other scholars revealed that the costs of monitoring protected area in developing countries ranged from roughly 0.2 - 10 USD (≈ Tshs. 200-10,000) per hectare per year [36,37]. The variations of the findings between the current study and those obtained by Balmford et al. [37] and Danielsen et al. [14] may be due to inflations, changes in priorities and hence budget allocations, poor access to information and other managerial factors. It may also be due to the differences in the type and nature of the resource being monitored. The monitoring costs in this research focused on miombo woodland while those by Balmford et al. [36] and Danielsen et al. [15] focused on protected areas particularly national parks and game reserves. The differences in the resources being monitored can also explain the observed variations in the monitoring costs.

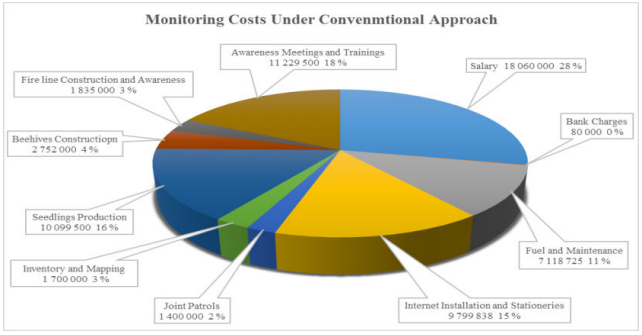

Figure 4: Activities and monitoring costs under conventional approach for year 2007/08. Source: Iringa district forest office.

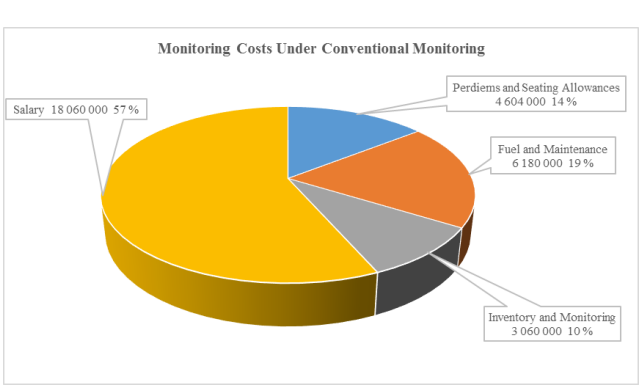

Figure 5: Activities and monitoring costs under conventional system for year 2008/09. Source: Iringa district forest office.

Perceptions of the Local Communities and Experts on the Monitoring Approaches

Conventional monitoring approach

Local community members had different perceptions on the conventional monitoring approach (Table 5). About 36% of the interviewee perceived that under conventional monitoring approach, the adjacent communities did not get any direct benefits from the forest reserves. On the other hand, about 14% mentioned that the adjacent communities were not involved in all the activities conducted in the forest reserves while about 16% claimed that people adjacent to forest reserves lost their sense of ownership hence did not cooperative with foresters and other government officials. Anecdotal evidences from the villages show that under conventional monitoring, less attention were given to these forest reserves by foresters. Although some people mentioned about conventional monitoring being expensive but the main reason was misallocation of funds. The money budgeted for different monitoring activities in the forest could easily be allocated into other non-forest activities of high interest to the government depending on the existing situation ignoring and neglecting the community's priorities and needs.

Weakness	Frequency	Percentage
Poor participation of the adjacent local communities	15	13.6
Poor sense of ownership to the local communities	17	15.5
Poor direct benefits by local communities from the forest	39	35.5
Unmanageable expenses and unsustainability	3	2.7
Lack of staff for frequent field works	5	4.5
Poor participation of local community, lack of sense of ownership and poor direct benefits	16	14.6
All the mentioned above	15	13.6
	110	**100.0**

Table 5: Perceived weaknesses of conventional monitoring approach.

Neglecting the community's needs can result into negative perceptions and attitudes among the community members. Conventional monitoring approach is potential in ensuring sustainable forest monitoring and management but need some modifications to capitalize and maximize the presence and use of the available human resources in the local communities. The participation of all stakeholders in monitoring and managing forest reserves can be challenging due to multiple and different interests and priorities. This may result into emergence of some conflicts causing negative impacts to the resource being monitored. This can be handled through awareness meetings and trainings to all stakeholders in the villages. The provision of technical trainings and involvement of local community members in conservation activities tend to increase the sense of ownership and hence stewardship. It is alleged that the sustainability of the community based monitoring system will depend on the participation of communities in managing and monitoring these resources and how these resources contribute to the improvement of their livelihoods. Developing a strong and direct link between conservation and improved livelihoods on itself can motivate local communities to participate in conservation and monitoring activities. Conventional monitoring however is used worldwide and realistic in the sense that it employs scientific monitoring tools and methods not only in analyzing the information gathered but also during data collection.

Community-based monitoring approach

Perceptions of people on community based monitoring system differed among individuals in the villages. Majority (49%) of the people perceived that the approach is good and it provides direct benefits to the local community adjacent to the forest, ensure full participation of communities and increase the sense of ownership and biodiversity value in the forest. About 26% of the interviewee revealed that community-based monitoring approach allows full participation of all community members while about 10% asserted that it increases the sense of ownership to the local community (Table 6).

Strength	Frequency	Percentages
Direct benefits to the local community adjacent to the forest	2	1.8
Full participation of communities in forest management	29	26.4
Sense of resource ownership to the local community	11	10.0
Increases Biodiversity value in the forest	14	12.7
All the mentioned above	54	49.1
Total	**110**	**100.0**

Table 6: Perceived strength of the community-based forest monitoring.

The involvement of local community members in the decision making process and activities undertaken in the forest reserves tend to increase the sense of ownership and accountability hence improved status and value of the forest reserves. Table 7 indicates that the main perceived weaknesses of the community based monitoring approach

was time consuming with little payments (39%), poor payments to the patrol team-scouts (36%) and lack of direct incentives (17%). The presence of tangible benefits, clear incentives, transparent governance, accountability and autonomy are key areas for the success of the community-based monitoring approach [34]. Therefore, the commitment and participation of individuals in the monitoring activities is closely linked to economic and social incentives. Further, the decentralization, democratization, empowerment and sense of ownership can persuade the local communities adjacent to forest reserve to invest their labour and time in monitoring, conservation and management activities [35]. Although there is a global increased demand for community based monitoring approaches [38] but its success will depend on how clearly the rights, returns and responsibilities for each stakeholder in the monitoring system are defined [39,40]. Despite the advantages of the community-based monitoring approach, it also had some shortfalls including scouts using much of their time in monitoring activities with little payments and lack of incentives and motivation. Compared to the conventional monitoring approach, community-based monitoring system seems to have benefited the community members directly in different ways. The revenue collected by selling various forest produces have been used for community development activities such as building both schools, dispensaries, village offices and other infrastructures. Therefore, the approach can be sustained by providing proper facilities and trainings to community members on the sustainable utilization of forest resources. However, majority (74%) of the interviewed people proposed the hybrid system to capitalize on the advantages of both the approaches (Table 8).

Weakness	Frequency	Percentages
Lack of direct incentives to the community members	19	17.3
Time consuming with very little payments for the work	43	39.1
Poor payments to scouts hence discouragement	39	35.5
The approach has no shortfalls	5	4.5
I don't know	4	3.6
	110	**100.0**

Table 7: Perceived weaknesses of CBFM.

Monitoring approach	Frequency	Percentages
Conventional monitoring approach	5	4.55
Community-based monitoring approach	24	21.82
Joint monitoring (Combining the two)	81	73.64
Total	110	100

Table 8: Proposed effective monitoring method to adopt.

In order to collect proper information and monitor the forest reserves more effectively, the patrol teams were provided with special forms for filling important information or events observed in the field. This information included the time spent for patrolling, observed illegal activities and animals identified in the forest reserve. This information assisted the community to track the trends on problem animals, encroachments and wildlife increments in the reserves. Although one may argue that these data are not sufficient to draw a concrete conclusion on the availability of the resources and species composition but can help in providing preliminary results for predicting some trends. Under conventional monitoring approach, occasional inventories were conducted to capture information on vegetation cover, rare species availability, trees growth rate, vegetation types, soil types and fertility and assessment of the rate of forest degradation. Therefore, it is good to involve local community members in monitoring and managing forest reserves but we have to assist them to collect reliable, effective and good quality data which can be analyzed scientifically. The quality, precision and accuracy of data collected under the locally based schemes are certainly lower than those collected by the technical monitoring experts [20]. It is possible to utilize both technically trained employees and local communities can be used to collect data and monitor the forest reserves hence minimizing the management costs at the same time maintaining the quality of the data obtained [41].

Conclusions and Recommendations

First, both conventional and Community based monitoring approaches have different advantages and shortfalls implying that each approach is complemented by the other one in different ways. It is therefore important to employ both approaches at the same time to maximize the potentials from each one at the same time minimizing the risks of a stand-alone approach. In a hybrid approach, the experts will provides technical support, advice and trainings while local community members offer the relevant required manpower. By utilizing the existing manpower, some activities like fire line construction and boundary consolidation can easily be conducted by local community members under minimal supervision from government officials, trained village leaders or natural resource committee members.

Second, the wages for patrolling, boundary consolidations, field escorts and escorting researchers which averaged to about Tshs. 1,445.46 (≈ 1.45 USD), 595.45(≈ 0.60 USD), 731.81(≈ 0.73 USD) and 2,522.73 (≈ 2.52 USD) respectively are considerably low and hence difficult to attract and motivate local community members to participate in the monitoring and management activities in forest reserves. As stated earlier merging the two approaches and mainstreaming it into a village government system will minimize these risks and also avoid duplication of efforts in conservation activities.

Third, although the two approaches have different costs but the monitoring costs should not outweigh and compromise the reliability and quality of information collected. Further, since community based monitoring approach is less expensive than conventional monitoring approach it is important to find out how it can be scaled up in other places with different natural resources.

Fourth, it is evident that studies for comparing costs and benefits of conventional and community based monitoring approaches in Tanzania are lacking. We therefore recommend further studies to compare the costs and benefits of the two monitoring approaches to ensure sustainable natural resources management in the country.

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