

## Community-based monitoring of natural resource use and forest quality in montane forests and miombo woodlands of Tanzania

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Received 5 April 2004; accepted in revised form 5 November 2004

**Key words:** Community-based, Forest management, Locally-based monitoring, Miombo woodland, Montane forest, Natural resource management, Participatory monitoring, Tanzania

**Abstract.** A community-based monitoring system that focuses on natural resource use and forest quality in montane evergreen forest and miombo woodland areas was developed and implemented in 23 villages in 2002 as part of a participatory forest management regime in Iringa District, Tanzania. The scheme was developed to suit the needs and capacities of locally-elected natural resource committees managing and monitoring natural forests. Rather than measuring biodiversity, the monitoring is focused on resource extraction and disturbance. High levels of commitment to the monitoring were displayed by village level managers, and the preliminary feed-back indicates that the monitoring scheme provides them with the relevant information needed to suggest appropriate management interventions. While external support has been essential to cover development costs, natural resource revenue generated at village level can provide most of the running costs. Once developed, the scheme can, however, be transferred to similar areas at significantly lower costs that can be met by Tanzanian District budgets. Natural resource revenue generated from montane forests is generally much lower than in woodland areas due to restrictions on resource extraction imposed as a consequence of national and international interests. Opportunities to provide economic incentives for montane forest managers through direct utilisation of the resource are limited and it remains to be seen whether other non-economic incentives can sustain long term commitment in these biodiversity rich areas. Findings indicate that the key elements of this local resource utilisation monitoring scheme are simplicity, incentive mechanisms, transparency and accountability, and autonomy for local managers. However, the methods may not provide sufficient data on changes in biodiversity values in the high value forests and may need to be augmented by conventional monitoring by scientists funded by national or international institutions. Elements of the scheme are now being institutionalised within the forestry sector in Tanzania.

### Introduction

This paper focuses on the implementation of a community-based monitoring system as part of a Participatory Forest Management (PFM) regime established in Iringa District, Tanzania. The last decade has seen substantial changes in Tanzanian government forest policy and legislation as a failure to manage

the forest estate using the traditional centrally controlled system necessitated new approaches. A key element of the new Tanzanian Forest Policy (URT 1998) and Forest Act (URT 2002) is the devolution of ownership of and management responsibilities over forest resources to local communities (URT 1998; Wily and Dewees 2001). Local communities have been given an opportunity to obtain lease rights over central or local government forest reserves through Joint Forest Management (JFM) agreements, or the ownership of forest resources on general or village land through Community-Based Forest Management (CBFM) agreements. Both types of agreement are categorised as PFM arrangements.

From 1999 to 2003, the Iringa District Council cooperated with Danish International Development Assistance, Danida to develop and test a PFM scheme through the Iringa District Lands, Natural Resources and Environment Office (DLNRO, hereafter referred to as the District Forest Office). This cooperation was named the MEMA Projects and was vested in two separate projects that corresponded to the Tanzanian administrative set-up in relation to the protection status of the land. Thus, one part focused on implementation of JFM in montane evergreen forests in government reserves while the other focused mainly on CBFM in miombo woodlands on village and general land (Danida 2001; Kobbers and Vignon 2004).

#### *Study area*

The MEMA Projects supported the implementation of PFM in the following five areas, covering a total of 23 target villages:

- (1) The Kitapilimwa area, where five villages implemented CBFM in 12,000 ha of woodland on village land and JFM was implemented in another 3685 ha of Kitapilimwa Forest Reserve (DLNRO 2001a);
- (2) North Nyang'oro Forest Range, where four villages implemented CBFM on approximately 60,000 ha of woodland<sup>1</sup> (DLNRO 2001b);
- (3) South Nyang'oro Forest Range, where six villages implemented CBFM on approximately 60,000 ha of woodland (DLNRO 2001c);
- (4) New Dabaga/Ulongambi Forest Reserve, where JFM was implemented in 3728 ha of montane forest in six villages (DLNRO 2001d);
- (5) West Kilombero Scarp Forest Reserve, where JFM was implemented in approximately 5000 ha montane forest in two villages (DLNRO 2001e).

The montane forest areas are important sources of water for the country's hydroelectric power supply and for the neighbouring communities. The forests also support many endemic and threatened species and are part of an internationally recognised biodiversity hotspot known as the Eastern Arc (Lovett

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<sup>1</sup>The size of Nyang'oro forest range does not include village forests. The area managed by Nyang'oro woodland villages is therefore larger than the stated figures.

1985; Olson and Dinerstein 1998; Myers et al. 2000). The two forest reserves supply a number of forest resources to the local communities, including wild game (illegal), medicinal plants, honey and plant fibers for ropes and baskets. Wood extraction is limited as alternative wood sources are available outside the forest reserves in natural woodlands or planted woodlots. The wood resource base in the montane forests is good, although New Dabaga/Ulongambi FR until 1990s was subjected to large scale timber extraction that has affected the tree species composition of the forest (Frontier Tanzania 2001a). The most immediate threats to the biodiversity of the forests are hunting and wild fires (Frontier Tanzania 2001a, b).

The woodlands in the project areas are dry miombo woodlands receiving less than 1000 mm of rain per year (Frost 1996). This vegetation type holds only modest value in relation to biodiversity and species conservation, but supplies the surrounding communities with numerous forest products, including firewood, charcoal, construction materials and a large number of non-wood forest products. The wood resource base in the woodland areas vary, but is generally considered good. The most immediate threat in relation to the woodlands are degradation and clearing as a consequence of wood extraction (COWI/Danish Forestry Extension 2000; Boiesen and Lund 2003).

Roughly 54,000 people live in the 23 target villages. The dominant ethnic group is the Hehe, while there are Gogo, Masai and Sagara minorities. The primary economic activity is smallholder agriculture, although the majority of the Masai are pastoralists or semi-pastoralists. Subsistence crops are maize, cowpea, beans and groundnuts, while plantation timber, tomatoes, sunflower and tobacco are the most important cash crops. Animal husbandry and freshwater fishing constitute the main livelihoods of some of the rural dwellers in the woodland areas, while in montane forest areas this is on a small scale and mostly a secondary source of income. There is considerable variation between the villages in terms of market access to Iringa town or other local markets for agricultural and forest products, although most villages have access at least during the dry season.

In 1999, the MEMA Projects facilitated the election of Village Natural Resource Committees (VNRCs) as natural resource management bodies. The VNRCs are answerable to the village government and consist of 7–11 members, including leaders responsible for administration and accounting, plus four patrol guards linked to the committee (DLNRO 2001a, b, c, d and e).

The devolution of management rights and responsibilities is vested in management plans and village by-laws that provide for natural resource management on village lands, including rights to issue permits as well as to collect and retain revenue from natural resource use. Wildlife are not included in the management plans and exploitation still requires a permit from District Wildlife Authorities. All other natural resource extraction requires a permit from the VNRC, including resources that are not subjected to payment (i.e. most non-timber forest products extracted for household consumption). While villages in montane areas retain all revenues collected due to limitations

imposed on resource extraction, it was agreed that 5% of collected revenue in the woodland areas should go to the District.

The VNRCs had been operating in all villages for almost 2 years before the implementation of the monitoring system. The monitoring process was initiated through discussions with stakeholders from 7 of the 23 villages, NGOs, District authorities and by gathering information on biodiversity and forest resource uses from various reports (COWI 2000; Frontier Tanzania 2001a, b, c, d, e, f; Ngomello et al. 2001). Existing systems for managing the forest and monitoring natural resource use were discussed in relation to participatory monitoring methods developed elsewhere (Danielsen et al. 2000; Ling 2000; see also Poulsen and Luanglath 2005 (this issue)). Two villages, representing miombo woodlands and montane forest areas, were selected to develop and test the monitoring system. Once tested and modified, the system was presented to all villages during 3 day seminars at the end of November 2002, at which two representatives from each village were introduced to the system and encouraged to pass on the information to the rest of the VNRC members from their village. VNRCs have since been carrying out monitoring activities, with minor adjustments in methods from March 2003 following meetings in all project villages.

### **Monitoring system**

The objective was to develop a long-lived monitoring scheme that enables managers to implement sustainable management of natural forests. Local communities are today managing the natural forest with advisory support from the District Forest Office. This has implications for the design of the scheme. Originally a close collaboration between VNRCs and District authorities was sought, but limited resources and lack of incentives at District level led to a high degree of village level autonomy in the scheme. Emphasis was therefore placed on developing a monitoring scheme that was simple, cost effective and cheap, transparent, requiring a minimum of training and education, and with the ability to stimulate discussions on natural resource trends and threats at village level (Danielsen et al. 2000). In addition, a special requirement was that the system should be applicable in both woodland and montane forest areas.

Monitoring ecological sustainability is a key issue in relation to forest management. Recognising the limited interest, resources and skills at village level in relation to monitoring the status of a large diversity of plant and animal species, focus was placed on monitoring resource uses and forms of disturbance. Priority was given to the resources and species perceived as important by local communities, and were selected by the villagers based on the criteria from Danielsen et al. (2000), which were adapted to the local institutional setting and resource bases. Some simple indicators of biodiversity trends (mammal and bird species selected by villagers) were, however, included in the monitoring system in order to convey awareness of ecological sustainability issues to the village level managers.

It is essential that the monitoring is sustained in the long term. The scheme was therefore developed to; (1) comply with local interest, (2) ensure incentives for managers, (3) ensure transparency in decision-making processes and financial transactions at village level, and (4) provide ward, divisional and District levels with information on the forest management that enable these institutions to provide relevant support and advice to village level managers (VNRCs).

The monitoring scheme builds on the existing village government system, and comply with regulations in the Local Government (Local Authority) Act (URT 1982) and the Forest Act (2002) on frequency of village assemblies and dissemination of VNRC information. The scheme consists of: (1) four information gathering components that allow evaluation of VNRC performance and provide information on which management decisions can be based, and, (2) four components for information use and dissemination that should facilitate good and transparent forest management. The scheme is outlined in Table 1.

To ensure that the scheme comply with local interests, and to maximise incentives to participate, the scheme was developed together with the villagers. Transparency in decision-making processes and financial transactions within the village was sought in three ways; (1) by making Village Council approve the monthly monitoring reports, (2) by making monitoring information in the village archives available for all villagers to see, and (3) making VNRCs present a summary of monitoring activities (including economic transactions and management issues) at quarterly Village General Assemblies enabling villagers to influence management.

The entire monitoring scheme is nested within several levels of the Tanzanian public administration. At Ward level, the Forest Coordination Committee coordinates VNRC decisions and intervenes if management decisions do not comply with the overall aims of the management agreements. Secondly, at District level the District Forest Office is responsible for responding to incoming monthly monitoring reports and for annual monitoring evaluation meetings in all villages. Lastly, the Cooperation Department, which works with auditing and tax collection under the District administration, will visit all villages annually to ensure accountability and transparency of VNRC accounts.

## **Methods**

### *Monthly monitoring activities*

The number of monitoring forms and activities were taken as a proxy for local manager commitment. Records were obtained from monthly monitoring reports and village monitoring forms (patrol and perception interview forms) verified by the authors. The data included number of VNRC meetings, number of patrols, number of perception interviews, and number of produced monthly

Table 1. Outline of the community-based monitoring system in Iringa District (Tanzania) at village level.

Purpose	System component	Activity	Justification
Information gathering	Records of VNRC activities	Records of meetings, training sessions, management suggestions and other VNRC activities in the secretary's book.	To assess whether monitoring activities and information dissemination takes place as agreed, and hence provide information on manager commitment.
	Records of transactions	Records of the issuing of user permits, fees, fines and expenditures on VNRC activities and village benefits on standardised vouchers and receipts.	Provide information to assess forest uses, user behaviour, manager behaviour and improve transparency and accountability by limiting the risks of corruption and embezzlement. Regular dissemination of these transactions should encourage VNRCs to adhere to agreed management practices and ensure a fair and transparent handling of natural resource revenues.
	Patrols (4/month/village)	Two to four patrol guards record resource uses, disturbances and selected indicator species on standardised forms. Separate forms for woodland and montane areas.	Provide information on user behaviour (illegal extractions), disturbances and wildlife trends that allow VNRCs to initiate relevant responses to observed threats.
	Perception interviews (5/month/village)	Two VNRC members meet individual households to discuss forest management issues.	Provide VNRCs with information on resource status and trends, stimulate discussions on natural resource management and provide individuals normally not taking part in village discussions with a chance to express their opinion. Additionally, the method serves as a tool to inform villagers of the contents of the management agreements, and the rights and responsibilities of villagers and VNRCs.

Information use and dissemination	VNRC Meeting (1/month/village)	VNRC meetings are forums for analysing monitoring information, discussing management issues, and deciding upon management actions. All VNRC members and patrol guards take part and a monthly summary report on monitoring is compiled. At Village Assemblies held quarterly (URT 1982), the VNRC presents all information to the villagers as outlined in the Forest Act (URT 2002). The monthly monitoring report synthesises all information regarding meeting activities, revenue collection and spending, patrols, perception interviews, requests (i.e. for more forms or training) and management decisions. Copies of the monthly monitoring reports are distributed to the District Forest Office, Divisional Secretary and Ward Executive Officer. These reports are also presented and discussed at Forest Coordination Committee meetings. All records of transactions and activities are available in the village archives for all villagers to see.	To ensure that management decisions are based on the information and opinions of all VNRC members and to enhance transparency within the VNRC.
	Village Assembly (4/year/village)		To ensure transparency within the village and provide villagers with a chance of influencing forest management.
	Reports to higher administrative levels (1/month/village)		Together with the records of activities and economic transactions (receipt books), this report serves to disseminate information to the village and higher administrative levels, thus providing the higher-level authorities with an opportunity to intervene if deemed necessary. To increase transparency, reports to the District Forest Office include vouchers of all economic transactions made by the VNRC.
	VNRC records available in the village		To improve transparency and accountability in forest management.

reports. Data were collected in July 2003, nine months after implementation. Additional data on report production were obtained from the District Forest Office in August 2004, eight months after end of project support.

#### *Management interventions*

The appropriateness of the system in improving forest management was assessed by reviewing management interventions proposed by VNRCs. A management suggestion is here defined as 'any initiative suggested by VNRCs to improve forest management', i.e. protect the forest by restricting resource extractions, limit illegal activities or protect forest from other human inflicted disturbances; achieve more sustainable use through changes in harvest volumes or adjustment of permit prices; optimise revenue collection by reducing or increasing permit prices according to demand, or; improve functioning of VNRC. Suggestions can be both new or correctional interventions.

Suggested management interventions were obtained from monthly reports and meetings held with all 23 VNRCs in September 2003. Suggestions were recorded on standardised data sheets, including the following information; village, date, observed problem, monitoring method providing the information, description of the management intervention, approving authority/person, whether the intervention was implemented or not and why, and the degree of success of the intervention.

Within each village, all suggestions for increased resource prices were counted as one intervention and likewise for price reduction suggestions. Where more than one monitoring method provided VNRCs with information leading to intervention suggestions, the method providing the earliest information was used in the analysis. The success of implemented interventions was assessed through discussions and random walks in the area. Interventions were categorised as successful if: (i) they resulted in a more than 50% reduction in disturbance level (number of traps, cut poles, cut trees recorded during patrols), (ii) more than 25 new households were engaging in the implemented activity (e.g. tree planting, small livestock keeping, new forest protection procedures abided by, (iii) more than 100 trees were planted and alive at time of assessment, (iv) more than 50 trees were planted and alive around wells, or (v) fire lines established. 'Limited success' was ascribed to interventions that showed some degree of success, but lower than the criteria for successful interventions. Interventions were unsuccessful if they did not have any forest conservation effect. Some interventions could not be assessed or verified and thus were categorised as such.

#### *Natural resource revenue collected by VNRCs*

Assessment of economic data was based on copies of vouchers and monthly reports submitted to the District Forest Office as of October 2003 and included



information on: village, date, name of permit holder, type of resource or service (tourism/research), permitted harvest and payment. In addition, information on the production and trade in charcoal and firewood was collected through 112 semi-structured interviews with producers, traders, and village and District level authorities.

## Results

All VNRCs implemented monitoring activities and generally expressed that they benefited from the more systematic information obtained through the use of forms compared to previous notebook records. Many stated problems with filling in the monthly monitoring report form, although most villages have submitted reports with no or only minor mistakes (primarily in columns summarising patrol and perception interview information). The accuracy of the monitoring information was, however, sufficient to fulfil the purpose of stimulating management discussions and it is unlikely that increased accuracy would have resulted in improved management decisions. Of concern for the ecological sustainability of current management practises was, however, that few villages monitored wood resource extraction levels in relation to assigned quotas.

### *Level of monitoring activities*

A total of 166 monthly reports were produced during the first nine months of monitoring, corresponding to 80% of the potential number (see Table 2). Nine of the 23 VNRCs produced reports for all months, while the lowest number of reports produced was two out of nine (22%). Eighteen of the 23 target villages produced more than 75% of potential reports. The remaining five VNRCs stated the following reasons for their low rate of reporting: conflict with Village Council (one village), problems with individual VNRC members (illness, travel, transparency and accountability, three villages) and unclear delivery procedures for reports to the District Forest Office (one village). The number of monthly reports produced by VNRCs did not differ between woodland (CBFM areas) and forest villages (JFM areas) ( $t$ -test:  $df = 21$ ,  $p = 0.732$ ), and there was no correlation between amount of revenue generated and the number of reports produced (Pearson:  $df = 21$ ,  $r = 0.094$ ,  $p > 0.05$ ).

Data on monthly report production from August 2003 to June 2004 provided by the District Forest Office, show a low report production rate for two woodland areas after end of project support, while the montane areas produced more than 80% of potential reports (see Table 2).

The frequency of patrols, perception interviews and meetings were lower than the level envisaged by villages in the monitoring manual: 2.25 patrols/village/month, 3.20 perception interviews/village/month and 0.84 meetings/village/month.

Table 2. Monthly monitoring reports verified by the authors nine months after implementation, and report production up to and after end of technical support based on data provided by Iringa DLNRO.

Area	Number of reports		Average per Village/year		% of potential number of reports		
	Nov.'02-July'03	Nov.'02-July'03	Nov.'02-July'03	Nov.'02-July'03	Nov.'02-July'03	Aug.'03-Dec.'03 <sup>a</sup>	After end of project Jan.'04-June'04 <sup>a</sup>
<i>CBFM areas</i>							
Kitapilimwa zone	40	10.7	89	72	97		
North Nyang'oro	20	6.7	56	65	8		
South Nyang'oro	50	11.1	93	60	33		
<i>JFM areas</i>							
New Dabaga/Ulongambi	44	9.8	81	90	94		
West Kilombero	12	8.0	67	100	83		
TOTAL	166	9.6	80	75	63		

<sup>a</sup>Data provided by Iringa DLNRO.

### Management interventions

In total, 181 management interventions had been suggested by the VNRCs 10 months after implementation of the monitoring scheme. Detailed information was obtained for 131 of these as they were discussed during meetings with the VNRCs. The remaining 50 were mentioned in the monthly reports but were not elaborated on.

According to the VNRCs, the most important information sources forming the basis for the 131 intervention suggestions were VNRC discussions (40%), patrols (29%), accounts (14%), perception interviews (9%), and informal information from villagers (8%). At the time of assessment, 50% of these 131 intervention suggestions had been implemented. As shown on Figure 1, the main obstacle for implementation was the procedure of management intervention approval by the District Forest Office. Only accounts did not lead to any implemented interventions because these suggestions all relate to regulations in the management agreement that have to be approved by District authorities. The revision of these agreements was initiated in August–September 2003 and was still ongoing by September 2004.

Management intervention suggestions were analysed to evaluate whether the scheme addresses scientifically identified threats (Woodlands: wood extraction; Montane forests: hunting and fire). Of the 23 villages, 21 had suggested

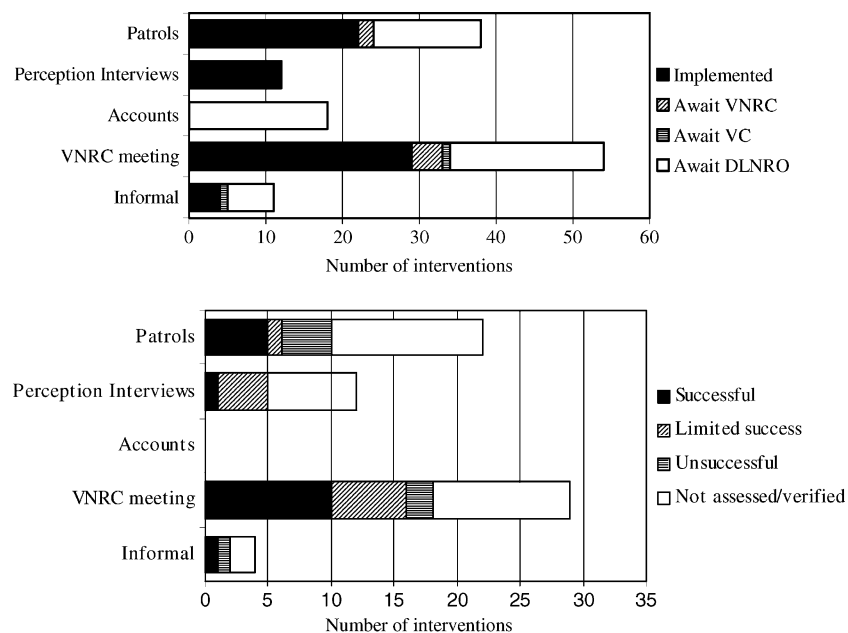


Figure 1. Degree of implementation and success of *all* intervention suggestions in relation to monitoring method. Abbreviations are: VNRC, Village Natural Resource Committee; VC, Village Council; DLNRO, District Lands, Natural Resources and Environment Office.

Table 3. Number of management intervention suggestions 10 months after implementation, including percentage of management interventions implemented and percentage targeting most important threat to the forest.

Area	Number	Average per village/year	Interventions implemented	Interventions targeting most immediate threat
<i>CBFM areas</i>				
Kitapilimwa zone	37	8.5	19 (51%)	22 (59%)
North Nyang'oro	26	7.4	5 (19%)	6 (23%)
South Nyang'oro	46	8.8	23 (50%)	19 (41%)
<i>JFM areas</i>				
New Dabaga/Ulongambi	16	3.0	15 (94%)	6 (38%)
West Kilombero	6	3.4	5 (83%)	3 (50%)
TOTAL	131	6.8	67 (50%)	56 (43%)

management interventions targeting the most important threats to the forests, and 43% of all suggestions were targeting these threats (see Table 3). Seventy-five per cent of interventions targeting the most immediate threat had been implemented, while the majority of remaining suggestions await District Forest Office approval (see Figure 2).

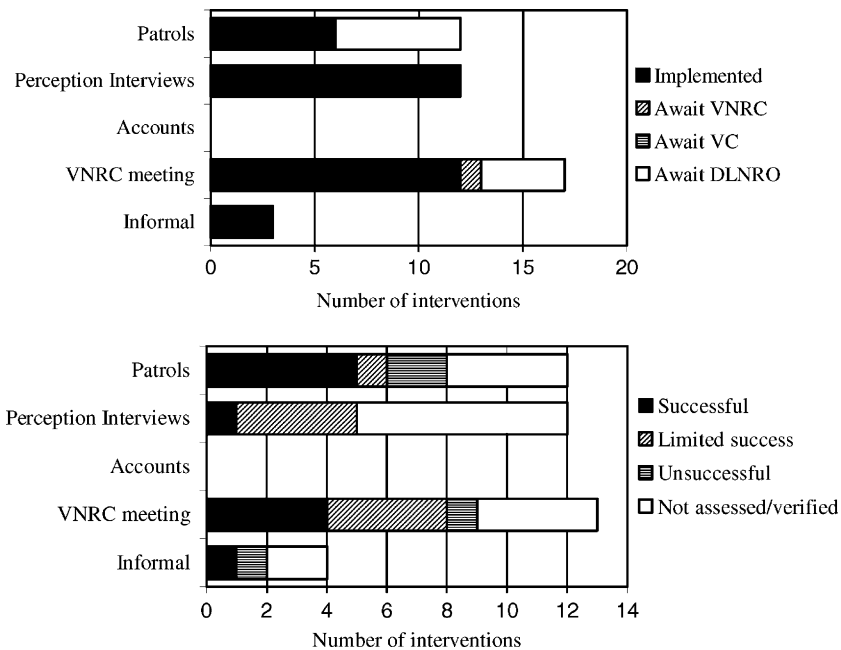


Figure 2. Degree of implementation and successfulness of intervention suggestions targeting most immediate threat to the forest in relation to monitoring method. Abbreviations are: VNRC, Village Natural Resource Committee; VC, Village Council; DLNRO, District Lands, Natural Resources and Environment Office.

Implementation of forest conservation activities does not guarantee improvements in the forest condition and, due to the time lag between intervention and visible effects, it is too early to make any final conclusions on success. However, at the time of assessment, 25% of implemented interventions were regarded as being successful according to defined criteria. Some degree of success was achieved by 16% of implemented interventions, 10% were unsuccessful, while 47% could not be assessed or verified. Twenty-four implemented interventions targeting the most immediate threat could be assessed in terms of degree of success and of these, 46% were categorised as being successful, 37% had some degree of success and only 17% were unsuccessful (see Figure 2).

Woodland villages suggested more management interventions than forest villages (*t*-test:  $df = 21$ ,  $p < 0.001$ ), while forest villages implemented a higher proportion of interventions than woodland villages (see Table 3). This is a result of the difference in resource use pattern, which required woodland villages to focus on changes related to regulations in the management agreements that have to be approved by the District Forest Office (63% of suggestions), while forest villages focused on awareness raising activities (68% suggestion) that could be implemented by the VNRCs. The number of management intervention suggestions did not correlate with the number of monthly reports produced (Pearson:  $df = 21$ ,  $r = 0.235$ ,  $p > 0.05$ ). A modest positive correlation was, however, found between the amount of revenue generated and the number of management interventions (Pearson:  $df = 21$ ,  $r = 0.420$ ,  $p < 0.05$ ) indicating that VNRCs have realised a necessity of increasing management decisions in areas with higher levels of resource extraction.

#### *Natural resource revenue collected by VNRCs*

At the current efficiency of the revenue collection scheme and using a conversion factor of 997.1 Tshs per USD (1 February 2003), the 15 woodland villages collect USD 9000 annually (USD 604 per village) while the eight forest villages collect USD 850 (USD 107 per village) (see Table 4). It should here be noted that several non-timber forest products are only paid for when extracted for commercial purposes.

A considerable inter-village variation exists in the amounts registered, ranging from USD zero to USD 2321 per year. In the montane forest villages, around 80% of the total revenue originates from research fees and tourism licenses paid in one village. Tourist activities consist primarily of birdwatchers coming to observe endemic species such as the Udzungwa partridge (*Xenoperdix udzungwensis*) and orange-winged sunbird (*Nectarinia rufipennis*). The remainder consists of fees for collecting milulu grass to make mats and baskets, as no wood extraction is allowed from these catchment forests. The opportunities for securing economic benefits to local forest managers through revenue

Table 4. Status of revenue collection per village by the 23 MEMA villages as of October 2003.

Area	Total registered revenue collection (USD) <sup>a</sup>	Estimated annual revenue collection per village (USD) <sup>b</sup>	Main revenue sources
<i>CBFM areas</i>			
Kitapilimwa zone	511	586	Firewood, charcoal
North Nyang'oro	849	1003	Fishing licenses, firewood, timber, grazing
South Nyang'oro	285	353	Charcoal, pasture, firewood, poles
<i>JFM areas</i>			
New Dabaga/Ulongambi	14	26	Visiting researchers
West Kilombero	293	352	Tourism, visiting researchers, milulu grass

<sup>a</sup>The sum of monthly figures for all the months for which accounts are available. The figures are from either receipts or monthly reports or, where both are available, the average. In the woodlands, the average village has submitted receipts from 6.3 months. Receipts from the montane forest villages were not analysed.

<sup>b</sup>Estimated annual income has been calculated as 12\*Total income/number of months with accounts.

collection are thus very limited under the current restrictions in JFM agreements in montane forest areas.

In woodland villages, the main revenue sources are fees for commercial charcoal production, firewood collection and fishing licences. The woodland villages exhibiting large revenue bases are generally situated within market distance of Iringa town, or near Mtera Dam. Thus benefits from revenue collection are dependent on either access to urban markets, status of resource base or local production using wood, i.e. fish curing or tobacco drying. The woodland villages within market distance of Iringa town particularly benefit from revenue collection, as they experience a positive inflow of cash from urban traders paying the fees without demanding a lower producer price.

#### *Running costs of the monitoring*

The Patrol Guards and VNRC members spend approximately 300 man-days annually on managing and monitoring the forests. Allowances for attending VNRC activities are in the range of USD 0–1.75 per day, the average being below USD 1.00. This is also the approximate payment for unskilled labour per day and is perceived as a fair compensation by most Patrol Guards and VNRC members. Using USD 1.00 for simplicity, the total annual expenditure on monitoring and management activities is USD 300 per village. At the current levels of revenue collection, these cash expenditures can be covered by two montane forest villages and 13 woodland villages. It should however be noted here that not all VNRCs compensate managers economically.

Generally, compensation levels correspond to revenue collection level. VNRCs have focused expenditure on manager compensation, and 4% of expenditures have been used to finance public goods. Examples of public goods that have been financed by VNRCs are: improvement of primary school buildings, school desks, a contribution to a secondary school, a water pipe between two villages and allowances for seminars. Although the share of 4% is rather low, it should be noted that some villages have deposited some of their collected revenue in bank accounts. The amounts deposited are, however, presently unknown.

District expenditure in relation to the monitoring involves printing of forms and receipt books, staff attendance of yearly monitoring evaluation meetings, collection of the District's 5% share of VNRC revenue in the villages, and administrative costs related to the system. For the target villages, the estimated system running costs at District level are approximately USD 30 per village per year, which should be compared to an estimated 30.2 USD collected per village in woodland areas. The District receives no revenue from montane forest areas due to limited resources allowed for extraction and therefore limited revenue potential for villages.

## **Discussion**

Biologically based methods for assessing conservation impact are often impractical and costly in a developing world context (Danielsen et al. 2003), especially when used by integrated conservation and development projects where the ability to track changes in biodiversity are limited (Kremen et al. 1994; Salafsky 1994; Margoluis and Salafsky 1998; Salafsky and Margoluis 1999). Salafsky and Margoluis (1999) argue that monitoring threats (resources extractions and disturbances) through Threat Reduction Assessment (TRA) provides an indication of the status of an areas biodiversity, assuming that: (i) all threats to biodiversity are caused by humans; (ii) all threats to biodiversity can be identified; (iii) changes in these threats can be measured. There are some problems with this approach in relation to PFM. While the TRA approach allows managers to minimise illegal extractions for the benefit of biodiversity in general, the impacts of extractions allowed under PFM will not be monitored. Hence, the impact on species affected by the resource use may not be detected through the TRA approach. Threat Reduction Assessment does, however, have some significant advantages in that results are easy to analyse by villagers, results are directly related to management interventions and it does not necessarily require a baseline to measure monitoring results against (Salafsky and Margoluis 1999). The present scheme has been inspired by the ideas outlined in the TRA approach.

The decentralisation process and implementation of PFM within the forest sector has changed the role of the forester in many developing countries (Springate-Baginski et al. 2003a, b). In areas under PFM the foresters role has

changed from protecting and policing to support and advice local forest managers. In Iringa District a lack of incentives for District forest staff meant that VNRCs received limited support following the implementation of the monitoring system. As experienced in Nepal, this may limit the chances of some VNRCs to become self-supportive as it takes time to develop capacities within the village level management (Springate-Baginski et al. 2003b).

Villages engaged in the monitoring of natural resource use and forest quality in Iringa District, generally have displayed high production rates of monthly monitoring reports during the first 9 months after implementation. This may indicate that VNRCs have recognised the potential to benefit from the devolution of rights and responsibilities over forest resource management and acknowledged that monitoring is a necessity in this process, although we cannot rule out the effect of District support. It should however be noted that VNRCs have not received any support relating to monthly report production and that District support to VNRCs at best has been sporadic after project-facilitated establishment of the monitoring scheme. The reason for the decrease in report production observed in two woodland areas following the end of technical assistance is uncertain, but could be a result of produced reports not reaching the District Forest Office or failure of the Forest Extension Officer in providing the necessary support to local communities.

Initial experiences with the scheme also showed that at the time of assessment, the VNRCs were able to use the monitoring methods, although activity levels were somewhat lower than they had envisaged. The lower activity level for patrolling and perception interviews was most often caused by lack of collaboration within the VNRC, where other VNRC members failed to encourage or support responsible members. As experienced under the implementation of PFM in Nepal, lack of collaboration within the VNRC also created situations of asymmetrical information, which resulted in problems of embezzlement and capture of benefits by elites (Yadav et al. 2003). However, in response to this, some villages in Iringa District displayed indications of a demand for higher levels of transparency and accountability thus forcing village leaders to adhere to democratic practices.

Involving villagers in monitoring may compromise data accuracy (Brandon et al. 2003; Rodríguez 2003). The gathering and processing of monitoring information, however, provided local managers with sufficient information and understanding to allow proposition of relevant management interventions targeting key threats to the forest and functioning of the VNRCs. It is unlikely that increased accuracy would do much to improve the villages' management decision making. Management intervention suggestions are, however, no guarantee for sustainable management, but the documented 50% success rate of interventions shows that VNRCs were able to initiate measures to improve forest management despite only sporadic assistance from the District Forest Office. As interventions were based on information from all monitoring methods, it seems that all the methods of the scheme are relevant to VNRCs.



Discussions with local stakeholders identified incentives, transparency, accountability and autonomy as key areas for the success of the scheme and are discussed in detail below, together with cost effectiveness, conservation impact and potential for application in other areas.

### *Incentives*

It is widely agreed that devolving rights over the management and use of forest resources offers local communities important incentives to engage in forest management and monitoring activities (Hobley 1996; Davies and Richards 1999; Petersen and Sandhövel 2001). The high degree of commitment observed at village level is closely linked to economic, social and personal incentives for the villagers involved. In the target villages, stated incentives have been financial compensation, appreciation of the water catchment value of the montane forest, exemption from village labour days, and increased prestige associated with being a member of the VNRC.

In the miombo woodlands, the revenue collected has provided an opportunity for managers to be compensated for time spent on management and monitoring activities. In the montane forest areas, a national and global interest to preserve catchment values and biodiversity means that the government has banned wood resource extraction. Montane forest villages therefore manage a forest where national (i.e. electricity production, agriculture, fishing and livelihoods) and global (biodiversity) interests significantly reduces their potential for revenue generation and the possibility of economic compensation for forest managers. At present, the observed commitment level in montane forest villages does not differ from woodland areas, indicating that incentives other than economic at present suffice for the villagers to engage in the monitoring activities. Such local appreciation of non-economic incentives should be recognised, but whether they are sufficient for sustaining long-term commitment is unclear – as indicated by experiences elsewhere in Africa (Polansky 2003). This example stresses the importance of bringing the issue of who is benefiting from the services provided by the natural habitats into consideration in the design of PFM schemes to ensure that local managers receive fair benefits for their work (see also Danielsen et al. 2005a (this issue)).

### *Transparency and accountability*

Transparency and accountability are recognised as being core issues in decentralisation processes the world over (Blair 2000; Petersen and Sandhövel 2001; Ellis and Mdoe 2003). The high levels of cooperation necessary for any community-based monitoring system can only be achieved and sustained in a fair and transparent system, as cases of corruption among managers destroy

the incentive for users to assist in achieving the common goal (Hobley 1996; Ostrom 1999).

A problem that was recognised by the MEMA Projects was a tendency for elites to capture benefits (e.g., rent seeking behaviour) and to develop systems of informal payment at village level. This problem must be resolved if the cooperation of users is to be maintained. Although the MEMA Projects have encouraged the representation of all sub-villages in the VNRCs, this does not automatically solve the problem of monitoring user behaviour in distant areas, as some monitors are experiencing split loyalties between the VNRC and their fellow villagers, many of whom are family and close friends. In the MEMA Projects, this may have been aggravated by the fact that, in the early days of the projects, patrol guards were not part of the VNRCs.

The five VNRCs that produced less than half of expected monthly reports, explained this with conflicts related to economical issues either within the VNRC or between the VNRC and the Village Council. Prior to the establishment of the VNRCs, village leaders may have received bribes for permitting illegal resource extraction. The introduction of the VNRCs thus reduces the possibilities for village leaders to receive informal payments and may therefore result in a power struggle between the Village Council and the VNRC. Some conflicts also originated from accusations (in some cases rightful) by the Village Council of VNRC members receiving informal payments or Patrol Guards taking bribes instead of bringing offenders to the Village Council. Internal conflicts within the VNRC related to accusations of acceptance of informal payments and VNRC members refusing to take over accounts after VNRC treasurer failed to carry out his or her duties due to illness or leaving the village. Some of these conflicts could not be resolved locally without the assistance of the District authorities, thus underlining the importance of enabling VNRCs to request immediate assistance before the situation deteriorates further (Springate-Baginski et al. 2003a).

The problems of elite capture and embezzlement have mainly been confined to the villages in the woodland areas. The reason for the higher frequency in this area could be a higher natural resource extraction level and larger amounts of cash being handled by the VNRC that increases the potential gains (Ostrom 1998). Observed problems include VNRC members refusing to pay for resource extraction permits, and users giving informal payments to VNRC leaders to avoid paying for resource permits. The fact that these problems were solved either by the villagers themselves or after their request for assistance, however, indicates a growing demand for accountability and fairness among the villagers. Thus, there are indications that the implementation of PFM may have furthered or supported the general development of democratic processes and social sustainability at village level (see also Becker et al. 2005; van Rijsoort and Jinfeng 2005 (this issue)). Beyond doubt, this process is facilitated by and depends on the extension service provided by District authorities during PFM implementation. Continued extension services are therefore essential to sustain and enhance current levels of transparency.

Differences in livelihood strategies between ethnic groups and lack of social integration have led to conflicts between agriculturalists and the primarily pastoral Masai. An attempt to include all ethnic groups in the VNRC has not had the desired effect on integration of minority rights and some VNRCs have imposed further restrictions on pastoral activities in the woodland (increase in permit price or restriction on the number of fences that can be made per year). There are, however, also examples of positive collaborations. In one village, pastoral Masai argued that they functioned as patrol guards while grazing their livestock in the woodland and the VNRC subsequently lowered the permit price for grazing.

#### *Autonomy*

Whilst this monitoring scheme was being developed, motivation and commitment among the District forest staff was low and the support to VNRCs limited. Combined with low levels of autonomy for making changes to the management plan, this limited the possibilities for villagers to initiate immediate actions to counter forest disturbances, which subsequently may lead to decreasing village level commitment. The success of the scheme therefore demands a high degree of autonomy to ensure that responsibilities remain closely linked to incentives. In support of experiences from Nepal (Springate-Baginski et al. 2003b), results show that VNRCs proposed management interventions relevant to the local context but refrained from implementing 44% of these interventions because they were not allowed to implement changes related to management agreement regulations without approval from the District Forest Office.

To preserve local manager commitment and allow rapid responses to observed problems, the MEMA Projects decided to include all use-related issues (i.e. resources allowed for extraction, permit fees, fines and permitted extraction level) in an appendix that can be revised annually, while general aims, area descriptions, institutional set-up and responsibilities would be kept as by-laws in the management agreements, which can be changed at five year intervals. Whether this one year interval is short enough to enable quick responses and preserve local manager commitment remains to be seen. However, in the opinion of the authors, autonomy comprises a strong incentive for local forest managers, and should be utilised to as high a degree as possible.

#### *Conservation impact*

As the management interventions have only been in function for a short period, it is as yet difficult to draw any firm conclusions regarding conservation impact. VNRCs, however, initiate more management interventions in areas subjected to higher levels of resource use. In addition, there are examples of

interventions that have been successful in reducing threats to the forest. In New Dabaga/Ulongambi Forest Reserve, the monitoring scheme has documented a reduction in the frequency of traps by more than 50%. This was achieved by different means in the villages surrounding this forest. One village chose to present the traps found to a Village General Assembly and to educate villagers about the content and purpose of the management agreements, while other VNRCs trained villagers in small livestock keeping in an attempt to substitute this wildlife resource. Villagers in the montane forest areas generally felt that the forest quality had improved. They particularly noticed that wildlife encounters had become more frequent. It is unlikely that populations have increased much over such a short period, but it may indicate a behavioural change of the wildlife following a reduction in hunting levels.

Few interventions focused on conserving specific species but like in a similar scheme in the Philippines (Danielsen et al. 2005b (this issue)), several forest protection interventions indirectly conserve species through a general protection of the forest. Examples of VNRCs responding to a resource decrease are: one woodland village stopped selling a specific timber species due to low availability, while another closed a felling coup, as trees of production diameter were becoming scarce. Nevertheless, as villagers do not possess the interest, resources and skills to monitor a large number of plant and animal species, there is a risk that national and international interests in protecting biodiversity may not be met by the community-based monitoring alone. In areas considered important for the protection of biodiversity, the community-based monitoring may therefore have to be accompanied by conventional monitoring of the areas' flora and fauna, especially of species affected by resource extractions and human inflicted disturbances (i.e. hunting and fire). As villagers should not carry the burden of protecting national and international interests (see also Stuart-Hill et al. 2005 (this issue)), funding for the additional monitoring will probably have to come from the international community interested in protecting the biodiversity rich areas.

In general, the choice of the village as administrative unit for PFM implementation implies that large and geographically dispersed forest areas will be managed by geographically dispersed communities. This may cause problems in relation to monitoring, as monitors may have difficulties in effectively monitoring the resource status and development of large forest tracts. A study in a village experiencing such area-related monitoring problems indicated that only 20% of wood extractions were taxed and that the annual total wood extraction was slightly higher than the annual allowable cut (Boiesen and Lund 2003). This suggests that spatial issues may create problems in relation to monitoring the behaviour of users living in sub-villages situated far from the main village but right next to the resource.

Lack of monitoring wood resource use in relation to assigned quotas resulted in harvest levels exceeding permitted quotas for some woodland villages (Kobbers and Vignon 2004). While timber tree quotas are given in number of trees, all other wood extraction quotas (i.e. charcoal, firewood, building

materials) are given in cubic metres. This involves calculations using various conversion factors and may pose a problem given the limited capacities of many VNRCs. To improve sustainability, quotas should be simple and meaningful to villagers, and the District Forest Office should provide assistance to VNRCs when needed.

### *Cost-effectiveness*

The limited economic resources of governments in developing countries make cost-effectiveness an essential aspect in relation to the long-term sustainability of monitoring systems (Danielsen et al. 2003). Set-up costs of the MEMA Projects have been significant, about USD 3,000,000, while technical assistance for development of the scheme was about USD 100,000. Once developed, the scheme can be introduced in other areas at a much lower cost. The District Forest Office in Iringa has continued to implement the scheme in other villages so that by July 2004 more than 60 villages were engaged in monitoring (Kobbers and Vignon 2004).

A strong feature of this scheme is that only limited government funding is necessary to sustain it over time. Natural resource revenue provides many villages with an opportunity to financially compensate VNRC members, while other non-economic incentives have been sufficient in ensuring commitment in villages with low levels of revenue collection. The devolution of management responsibilities to local communities along with their right to retain income from natural resources implies that the forests are managed more closely today than when under District jurisdiction and management. An indication of the better control over forest resources is that the amount of forest revenue collected annually by the 23 target villages is higher than the average annual amount collected by the District from all 188 villages during the past 10 years (Boiesen and Lund 2003). This further implies that under the current engagement level of the District Forest Office, the District expenditures related to the monitoring scheme may be covered by the District's 5% share of the natural resource revenue collected in the villages. This situation is, of course, particular to the context, as areas with poor resource bases cannot expect to contribute revenue.

### *Potential for application in other areas*

The present scheme has some features that could facilitate its successful application in other areas of Tanzania and in other countries with similar devolution of forest management rights and similar resource bases.

The scheme was developed by villagers, ensuring that local interests are covered by the monitoring. This has been raised as a crucial issue to achieve successful conservation (Gaidet et al. 2003; Danielsen et al. 2005a (this issue)),

also within Tanzania (Meshack 2004). Focusing on monitoring resource use and disturbances that are the prime concerns of the villagers implies that results are directly related to management interventions without requiring expensive baseline surveys to measure monitoring results against (Salafsky and Margolis 1999). Experiences under the MEMA Project also indicate that it is better getting started than waiting for extensive baseline surveys to be conducted (Korongo 2003). Rough guidelines for potential harvesting levels can be developed for areas with similar forest types and status of resource base and applied to relevant PFM areas (Polansky 2003). Monitoring of resource status and trends should then enable VNRCs to adjust this harvest level according to observed trends and thereby ensure harvest levels are adjusted to improve sustainability. While the scheme may have high development costs, it can be implemented in similar areas with only minor adjustments and to a much lower price.

A high level of autonomy for VNRCs and devolution of resource use rights is essential for the sustainability of the monitoring if there are periods when the authorities lack resources for continued engagement in the monitoring. Monitoring also acts to preserve local manager commitment and ownership by allowing villagers to adapt swiftly to observed problems, provided that the management plan contain provision for making such changes (Polansky 2003). Implementing agents should also address issues like incentives, transparency and accountability in order to ensure economic and social sustainability in local natural resource management. Addressing the issue of incentives is especially important in areas where restrictions on resource use have been imposed due to a deprived resource base or outside interests. In areas where villages manage forests of national and international importance, it would be fair to identify a way of compensating local communities for protecting these values as it often reduces their natural resource revenue potential.

The strong integration of monitoring of resource use and forest quality with monitoring of natural resource revenue in this scheme is important because it ensures that managers are reminded of the linkages between ecological and economic sustainability.

### **Acknowledgements**

This paper is an expanded version of a presentation we were invited to make at a symposium on locally-based monitoring held in Denmark in April 2004 ([www.monitoringmatters.org](http://www.monitoringmatters.org)). The symposium was organized by the Nordic Agency for Development and Ecology (NORDECO, Denmark), and the Zoology Department of Cambridge University (UK). We highly appreciate the assistance provided by the Government of Tanzania and the Government of Denmark (Danida). We are grateful to H. Lerdorf, M. Mhina, regional and District forest staff and local communities in Iringa for participating in discussions of progress and results of the monitoring. We also want to thank

S. W. Andersen and T. Skielboe for advice and N. Burgess, F. Danielsen, M. Enghoff, M. Funder and F. Helles for valuable comments on earlier drafts on this paper, together with those of three anonymous reviewers.

## References

- Becker C.D., Agreda A., Astudillo E., Constantino M. and Torres P. 2005. Community-based surveys of fog capture and biodiversity monitoring at Loma Alta, Ecuador enhance social capital and institutional cooperation. *Biodivers. Conserv.* 14: 2695–2707.
- Blair H. 2000. Participation and accountability at the periphery: democratic local governance in six countries. *World Dev.* 28: 2–39.
- Boiesen J.H. and Lund J.F. 2003. Participatory Forest Management in Tanzania – A Socio-Economic Study on the Implementation of PFM in Iringa District. MSc-thesis, Unit of Forestry, Department of Economics and Natural Resources, The Royal Veterinary and Agricultural University, Copenhagen, Denmark.
- Brandon A., Spyreas G., Molano-Flores B., Carroll C. and Ellis J. 2003. Can volunteers provide reliable data for forest vegetation surveys? *Nat. Areas J.* 23: 254–262.
- COWI 2000. Project Monitoring and Evaluation System. Technical Report for MEMA. COWI, Copenhagen, Denmark.
- COWI/Danish Forestry Extension 2000. MEMA NWMP Forest and Vegetation Baseline Survey. Iringa District Council, Forest and Beekeeping Division and MEMA/Danida.
- Danida 2001. Community Based Natural Woodlands Management: Project description, Revised version. Ministry of Foreign Affairs/ Danida, Copenhagen, Denmark.
- Danielsen F., Balete D.S., Poulsen M.K., Enghoff M., Nozawa C.M. and Jensen A.E. 2000. A simple system for monitoring biodiversity in protected areas of a developing country. *Biodivers. Conserv.* 9: 1671–1705.
- Danielsen F., Mendoza M.M., Alviola P., Balete D.S., Enghoff M., Poulsen M.K. and Jensen A.E. 2003. Biodiversity monitoring in developing countries: what are we trying to achieve? *Oryx* 37: 407–409.
- Danielsen F., Burgess N. and Balmford A. 2005a. Monitoring matters: examining the potential of locally-based approaches. *Biodivers. Conserv.* 14: 2507–2542.
- Danielsen F., Jensen A.E., Alviola P.A., Balete D.S., Mendoza M.M., Tagtag A., Custodio C. and Enghoff M. 2005b. Does monitoring matter? A quantitative assessment of management decisions from locally based monitoring of protected areas. *Biodivers. Conserv.* 14: 2633–2652.
- Davies J. and Richards M. 1999. The Use of Economics to Assess Stakeholder Incentives in Participatory Forest Management: A Review. European Union Tropical Forestry Paper 5, ODI, London, pp. i-10, pp. 23-45.
- DLNRO 2001a. Agreement, Bylaw and Management Plan: Kitapilimwa Forest Reserve. Iringa District Council, Iringa, Tanzania.
- DLNRO 2001b. Agreement, Bylaw and Management Plan: Nyang'oro Forest Range, north. Iringa District Council, Iringa, Tanzania.
- DLNRO 2001c. Agreement, Bylaw and Management Plan: Nyang'oro Forest Range, south. Iringa District Council, Iringa, Tanzania.
- DLNRO 2001d. Agreement, Bylaw and Management Plan: New Dabaga/Ulongambi Forest Reserve. Iringa District Council, Iringa, Tanzania.
- DLNRO 2001e. Agreement, Bylaw and Management Plan: West Kilombero Scarp Forest Reserve. Iringa District Council, Iringa, Tanzania.
- DLNRO NORDECO 2003. Community based monitoring of natural resource use and forest quality. District Lands, Natural Resources and Environment Office, Iringa, Tanzania.
- Ellis F. and Mdoe N. 2003. Livelihoods and rural poverty reduction in Tanzania. *World Dev.* 31: 1367–1384.

- Frontier Tanzania 2001a. New Dabaga/Ulongambi forest reserve – management and summary report. In: Doody K.Z., Howell K.M. and Fanning E. (eds), Report for the Udzungwa Mountains Forest Management and Biodiversity Conservation Project. MEMA, Iringa, Tanzania, 77 pp.
- Frontier Tanzania 2001b. West Kilombero scarp forest reserve – management and summary report. In: Doody K.Z., Howell K.M. and Fanning E. (eds), Report for the Udzungwa Mountains Forest Management and Biodiversity Conservation Project. MEMA, Iringa, Tanzania, 78 pp.
- Frontier Tanzania 2001c. New Dabaga/Ulongambi forest reserve – botanical and forest use report. In: Doody K.Z., Howell K.M. and Fanning E. (eds), Report for the Udzungwa Mountains Forest Management and Biodiversity Conservation Project. MEMA, Iringa, Tanzania, 117 pp.
- Frontier Tanzania 2001d. West Kilombero scarp forest reserve – botanical and forest use report. In: Doody K.Z., Howell K.M. and Fanning E. (eds), Report for the Udzungwa Mountains Forest Management and Biodiversity Conservation Project. MEMA, Iringa, Tanzania, 45 pp.
- Frontier Tanzania 2001e. New Dabaga/Ulongambi forest reserve – zoological report. In: Doody K.Z., Howell K.M. and Fanning E. (eds), Report for the Udzungwa Mountains Forest Management and Biodiversity Conservation Project. MEMA, Iringa, Tanzania, 160 pp.
- Frontier Tanzania 2001f. West Kilombero scarp forest reserve – zoological report. In: Doody K.Z., Howell K.M. and Fanning E. (eds), Report for the Udzungwa Mountains Forest Management and Biodiversity Conservation Project. MEMA, Iringa, Tanzania, 191 pp.
- Frost P. 1996. The ecology of miombo woodlands. In: Campbell B. (ed.), *Transition – Woodlands and Welfare in Africa*. Centre for International Forestry Research, Bogor, Indonesia, 266 pp.
- Gaidet N., Fritz H. and Nyahuma C. 2003. A participatory counting method to monitor populations of large mammals in non-protected areas; a case study of bicycle counts in the Zambezi Valley, Zimbabwe. *Biodivers. Conserv.* 12: 1571–1585.
- Hobley M. (ed) 1996. *Participatory Forestry: The Process of Change in India and Nepal*. Rural Development Forestry Study Guide 3, Rural Development Forestry Network, Overseas Development Institute, London, UK, 330pp.
- Kobbers B. and Vignon C. 2004. *Forest Policy Implementation Support: Development of Guidelines and Regulations regarding the sharing of Costs and Forest Revenues/Benefits in Participatory Forest Management in Tanzania*. Consultancy Report for the Forest and Beekeeping Division, Tanzania, 10pp.
- Korongu 2003. Technical report for MEMA: initial learning experiences. Iringa District Council, Forest and Beekeeping Division and MEMA/Danida, Tanzania.
- Kremen C., Merenlender A.M. and Murphy D.D. 1994. Ecological monitoring: a vital need for integrated conservation and development programs in the tropics. *Conserv. Biol.* 8: 388–397.
- Ling S. 2000. NBCA Biodiversity Monitoring. Vientiane WCS/FOMACOP, pp. 113.
- Lovett J.C. 1985. Moist forests of Tanzania. *Swara* 8: 8–9.
- Margoluis R. and Salafsky N. 1998. *Measures of Success: Designing, Managing, and Monitoring Conservation and Development Projects*. Island Press, Washington, DC, USA.
- Meshack C.K. 2004. Transaction costs of Community Based Forest Management: Empirical evidence from Tanzania. M.Sc. thesis, University of York, UK.
- Myers N., Mittermeier R.A., Mittermeier C.G., da Fonseca G.A.B. and Kent J. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403: 853–858.
- Ngomello K.A.S., Kitahiko M.G.G. and Kimaro I.J. 2001. Report on the second game survey in NWMP/MEMA project villages, November 2001. MEMA, Iringa Tanzania.
- Olson D.M. and Dinerstein E. 1998. The global 200: A representation approach to conserving the earth's most biologically valuable ecoregions. *Conserv. Biol.* 12: 502–515.
- Ostrom E. 1998. A behavioral approach to the rational choice theory of collective action. *Am. Polit. Sci. Rev.* 92: 1–22.
- Ostrom E. 1999. *Self-Governance and Forest Resources*. Occasional Paper no. 20, Centre for International Forestry Research, Bogor, Indonesia, pp. 1–15.
- Petersen L. and Sandhøvel A. 2001. Forestry policy reform and the role of incentives in Tanzania. *Forest Policy Econ.* 2: 39–55.



- Polansky C. 2003. Participatory forest management in Africa: lessons not learned. *Int. J. Sust. Dev.* 10: 109–118.
- Poulsen M.K. and Luanglath K. 2005. Monitoring for management of Xe Pian in Laos by protected area staff and local villagers. *Biodivers. Conserv.* 14: 2591–2610.
- van Rijsoort J. and Jinfeng Z. 2005. Participatory resource monitoring as a means for promoting social change in Yunnan, P.R. China. *Biodivers. Conserv.* 14: 2543–2573.
- Rodríguez J.P. 2003. Challenges and opportunities for surveying and monitoring tropical biodiversity – a response to Danielsen et al. *Oryx* 37: 411.
- Salafsky N. 1994. Ecological limits and opportunities for community-based conservation. In: Western D. and Wright R.M. (eds), *Community-based Conservation*. Island Press, Washington, DC, USA pp. 448–471.
- Salafsky N. and Margoluis R. 1999. Threat reduction assessment: a practical and cost-effective approach to evaluating conservation and development projects. *Conserv. Biol.* 13: 830–841.
- Springate-Baginski O., Yadav N. and Soussan J. 2003a. Institutional development of forest user groups in Nepal: processes and indicators. *J. Forest Livelihood* 3: 21–36.
- Springate-Baginski O., Dev O.P., Yadav N. and Soussan J. 2003b. Community forest management in the middle hills of Nepal: the changing context. *J. Forest Livelihood* 3: 5–20.
- Stuart-Hill G., Diggle R., Munali B., Tagg J. and Ward D. 2005. The event book system: a community based natural resource monitoring system from Namibia. *Biodivers. Conserv.* (this issue).
- URT 1982. The Local Government (District Authorities) Act, No. 7 of 1982, The United Republic of Tanzania. Government Printer, Dar es Salaam, Tanzania, pp. 43–115.
- URT 1998. National Forest Policy, The United Republic of Tanzania. Dar es Salaam, Tanzania 59pp.
- URT 2002. The New Forest Act, no. 7 of 7th June 2002, Ministry of Natural Resources and Tourism, The United Republic of Tanzania. Government Printer, Dar es Salaam, Tanzania, 174pp.
- Wily L.A. and Dewees P.A. 2001. From Users to Custodians – Changing Relations between People and the State in Forest Management in Tanzania. Policy Research Working Paper, WPS 2569, Environment and Social Development Unit, The World Bank, 31pp.
- Yadav N., Dev O.P., Springate-Baginski O. and Soussan J. 2003. Forest management and utilization under community forestry. *J. Forest Livelihood* 3: 37–50.