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Monitoring, indicators and community based forest management in the tropics: pretexts or red herrings?

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Abstract Over the last 20 years, transfer of the management of natural resources to local populations has been a major trend in the tropics. Many of these initiatives today incorporate the development of monitoring systems based on Criteria and Indicators (C&I), used to gauge environmental, socio-economic, and institutional consequences over a long period of time. The design of C&I at a local level involves combining scientific expertise with traditional ecological knowledge. There are numerous methods of merging these two branches of knowledge and developing a local monitoring system. The difficulty lies in setting up these local monitoring systems. A review of the literature available demonstrates that the handing over of monitoring systems to local communities has rarely been successful. In almost every case study, when the donor agency initiating the process withdrew, monitoring was either much less intensive or came to a complete stop. Despite this blatant deficiency local monitoring systems constitute an almost compulsory component of any donor-funded program/project dealing with sustainable management of natural resources. In our views, the real implementation of C&I by and for communities can only be achieved if there is a genuine devolution of management power, including responsibilities and benefits, to local stakeholders. Unless they link environmental changes to the communities' own management decisions, formal participative monitoring systems will continue to fail.

Keywords Community based forest management · Criteria and indicators · Local monitoring · Participation · Tropical forests

Abbreviations

C&I	Criteria and indicators
TEK	Traditional ecological knowledge
CBFM	Community based forest management

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PRM Participatory resource management
PA Protected area
JFM Joint forest management

Introduction

The international discussions on the sustainable use of natural resources have been oscillating between two poles, strict conservation and community participation. Since the Johannesburg Conference of 2002, the scientific community seems to be in favor of involving local communities in the management of natural resources (Barbault et al. 2002; Sheil and Lawrence 2004). Many tropical countries have thus developed mechanisms integrating the participation of rural populations, making the transfer of power from the State to the local people feasible. This is in conformity with the global agendas of the donor agencies (Agrawal 2001; Bratton and Walle 1997; Ribot 2004).

Decentralization of natural resources management is typified by a power shift from a central state structure to a local body (Ribot 2004). It can assume different forms, depending on the type of power being transferred, the nature of the recipient structure and what the mechanisms of accountability are (Edmunds and Wollenberg 2003; Ribot and Larson 2005). But whatever be the form, decentralized resource management is expected to generate three major benefits: (i) increase the well-being of rural populations; (ii) better preserve the forest resources and the biodiversity which depend on the knowledge and the know-how of native communities; and (iii) improve local governance by empowering communities and enabling them to democratically control resource management. Decentralized management is therefore seen today as a crucial element of public policies.

A large panoply of approaches and tools has been used over the last 15 years to constitute and implement participatory management of local resources (Borrini-Feyerabend 1996; Nguinguiri 1999; Wollenberg et al. 2005). Amongst these tools, special attention is being given to monitoring systems for tropical forest management. They are based on the model of environmental management projects that include monitoring as part of their customary specifications. The objective is to further involve locals in the sustainable management of resources, by giving due importance to their knowledge and facilitating communication between them and other stakeholders especially administrations and state agencies.

Much has been written on the process of designing participatory C&I, trying to combine scientific information with traditional knowledge (Fraser et al. 2006; Mendoza and Prabhu 2003; Prabhu et al. 2000; Prabhu et al. 2001). But studies on how to implement the C&I are much less exhaustive even though this area remains problematic. In most case studies, participatory C&I toolsets are to a great extent driven by external operators and have minimal impact at the local level. When the funds from the donor agencies cease, they quickly become dysfunctional (Topp-Jorgensen et al. 2005). Making these C&I sustainable is therefore the real problem and this can only be achieved if the C&I are actually useful in enhancing resource management, and are perceived as such.

This article looks into the obstacles hindering the successful implementation of participatory C&I since more and more researchers and developers are including them in their projects. This article has been organized in three parts. The first presents an overview of the theory and practices of local monitoring systems. The second part, based on a review of the literature available and our personal experiences in Cameroon and India, highlights a

few successful endeavors and numerous failures of this approach. The third part stresses the necessity of integrating the local monitoring system into a comprehensive environment management strategy, whereby the local population is truly in a position to take or at least influence management decisions.

The why and how of participatory monitoring systems

The emergence of monitoring systems and C&I

Basic monitoring has been used for over 40 years in the process of environmental impact assessment (Glasson et al. 1994; Munn 1975). It developed further in the 1990s (Lammerts van Bueren and Blom 1997) and today is an essential element in all environmental management projects.

Monitoring systems are based on a comprehensive set of C&I with which it is possible to observe the changes in the physical and social environment of a project. They are used by managers in order to take stock of the direct and indirect consequences of their projects and to be able to thwart any unwanted changes. Hence it is not limited to only assessing post project results but can help chart out a course of action. An indicator becomes meaningful if it is action oriented, enabling its users to influence their surroundings. Indicators are also a powerful communication tool to the extent they clarify the perceptions and expectations of parties involved in the environmental and social dynamics that are being monitored (Bouni 1998; Lescuyer et al. 2004; Raison et al. 2001; Reed et al. 2005).

Considerable literature is available on the designing, implementation, and functioning of regular monitoring systems based on C&I (Garcia et al. 2004; Lindenmayer et al. 2000; Prabhu et al. 2000; Ruitenbeek and Cartier 1998). Most of these systems have defects that have been readily identified (Dale and Beyeler 2001; Kelly and Harwell 1990; Landres et al. 1988; Noss 1990, 1999). The greatest difficulty undoubtedly lies in turning a scientifically sound C&I based system into a tool destined for daily use by managers (Failing and Gregory 2003; Sheil 2001). This can only be achieved if the final user has been closely associated with the development of the toolset. Although this requirement is not sufficient, failure to meet it means the monitoring system will probably remain outside the decision-making process and runs the risk of being finally abandoned.

Their application to participatory management

The difficult compatibility between the scientific construction of C&I and their practical implementation is made even more precarious when there is an attempt to integrate these expert monitoring systems into participatory programs of resource management (PRM). These systems are usually first developed by external organizations in keeping with their global priorities and later have local practices grafted on them, so they are often inappropriate and stand little chances of being consequently put to use (Bell and Morse 2005; Karsenty et al. 2004; Sheil and Lawrence 2004).

Monitoring systems based on C&I for participatory management should therefore be developed in a spirit of co-construction. They should draw as much as possible on local knowledge and on the pre-existing informal systems of data gathering—which we will refer to as pre-indicators, (Garcia et al. 2004)—used by the stakeholders to make their decisions prior to the implementation of the more formal PRM schemes (Danielsen et al. 2000;

Moller et al. 2004). Many different approaches have been developed to build the C&I through a process of dialogue between scientists and practitioners (Mendoza and Prabhu 2005). Most authors recognize that feasibility and social legitimacy of the monitoring system should prevail over scientific pertinence (Bell and Morse 2001, 2005; Campbell et al. 2003; Mendoza and Prabhu 2003; Prabhu et al. 2000; Reed et al. 2005).

Implementation of these co-constructed environmental monitoring systems will vary with the kind of manager bound to use them. Most of these participatory systems are today used by "official" environmental agencies and administrative bodies, normally backed up by external projects. They have enlarged their scope of action and management methods to include local practices, knowledge, and priorities, either through their own initiative or upon demand by external agencies. The monitoring system thus continues to be an expert system which incorporates some C&I that are either built upon local practices and/or monitored by locals.

If decentralized management of natural resources is to become prevalent, it will require the design of monitoring systems which can be entirely developed and put into practice by local structures (Topp-Jorgensen et al. 2005). This implies making use of "low-tech, low cost" solutions and rugged tools which can be easily adopted. The role of the expert would thus lie in confirming whether the pre-indicators are valid or not—by drawing on his/her understanding of how the ecosystem works for example—and identifying gaps in the informal system of data gathering.

Operational participatory monitoring systems respect five important principles (Danielsen et al. 2005a):

- They address goods and services which the community derives from the ecosystem being monitored.
- The benefits to local people involved in monitoring exceed the costs.
- Conflicts and politics between government managers and communities do not limit the involvement of local stakeholders in the monitoring process.
- Data are archived, analyzed, and accessible locally.
- Monitoring builds on existing traditional institutions and other management structures as much as possible. However the system may malfunction when the necessity of better governance clashes with traditional, undemocratic practices (Garcia et al. 2004).

Expected benefits

The intention behind developing local monitoring systems is to promote and facilitate participatory/decentralized management of resources. In developing countries these systems complement the monitoring mechanisms operated by professional managers. They have many specific advantages (Danielsen et al. 2000; Danielsen et al. 2005a; Fraser et al. 2006; Karsenty et al. 2004):

- The development and implementation of local monitoring systems opens up a forum where the community can discuss options and objectives on how to sustainably use natural resources. This can raise environmental awareness and induce the local population to modify their practices and make them more sustainable.
- Participatory monitoring offers the local population the opportunity to interact and collaborate with government bodies and administrative officials in charge of natural resources management. Mutual awareness and a deeper knowledge of the different

points of view can reduce misunderstandings and frictions. Moreover, by turning traditional knowledge into data which can be assimilated by an administration, the monitoring system can contribute to legitimizing traditional management systems and thus enhance the group's self-identity.

- When local management is coupled to the monitoring system, bureaucratic processes do not hinder it. In fact its response to environmental changes is much faster since the community is continuously present in the area and can rapidly take note of any unexpected development.
- In spite of the high initial setting up cost, participatory monitoring systems are systemically less expensive—rudimentary equipment, minimum salary expenses, available manpower—than expert systems handled by professional managers.

For the system to work, it is crucial to involve local communities in a virtuous management cycle. In areas newly entrusted to them, monitoring can provide a steady feedback allowing for a critical self-analysis of the management decision and facilitating the adoption of suitable strategies (Hartanto et al. 2002; Westley et al. 2002).

In developing countries, this approach has been promoted in the 1970–1980s, for instance by the UNESCO Man and Biosphere program or during the "Forests for People" World Forestry Congress held in 1978. However it has really been put in use since 2000, mainly through participatory management of protected areas (PA) with funds from external agencies (Andrianandrasana et al. 2005; Danielsen et al. 2000; Danielsen et al. 2005b; Gray and Kalpers 2005; Yuan et al. 2003). It is increasingly being used in decentralized environmental management (Hartanto et al. 2002; Reed and Dougill 2002; Stuart-Hill et al. 2005; Topp-Jorgensen et al. 2005; Vernooy et al. 2006).

In spite of the practical difficulties underlined in this endeavor, the authors are generally enthusiastic about the applicability and utility of community based monitoring systems. However, after a literature review and taking into account our personal experiences in India (Garcia et al. 2004; Kushalappa and Garcia 2007) and Cameroon (Bonis-Charancle et al. 2007; Tiani and Bonis-Charancle 2007), we have identified a gap between what the systems set out to do and what they really achieve.

Hopes and disillusionment

Environmental awareness

Thinking together with the community about the variables likely to lead to sustainable management almost always entails a preliminary discussion on the ways to connect their daily use and understanding of natural resources and processes to formal concepts like "management," "sustainability," and "biodiversity" (Lawrence et al. 2006; Purnomo et al. 2005). These discussions give rise to opportunities to take stock of the different threats to the environment and propose coping strategies and possible solutions, reinforcing environmental awareness in the community (Andrianandrasana et al. 2005; Poulsen and Luanglath 2005; Tiani and Bonis-Charancle 2007).

Nevertheless, even if this may be considered to be beneficial by external promoters of local monitoring systems, it could also be regarded as an extraneous imposition of concepts, criteria, and objectives on the local population. This sensitization can thus serve to subjugate local practices to new ecological constraints.

If it is essential to increase environmental awareness, other more suitable and efficient methods can be used to reach this goal. Participatory Rural Appraisal Tools (Chambers

1992, 2007), Environmental Education (Palmer 1998) or Sustainable Livelihoods Analysis (Campbell et al. 2003; Scoones 1998), for example, are well described, widely implemented and relatively efficient in identifying natural resources and the different pressures they are subject to.

Improved interaction with external actors

The need to set up a local monitoring system is generally felt by external actors who consequently motivate local stakeholders to launch the process. The venture is thus participatory by nature, associating at least one outsider, usually international, one or a few communities and one decentralized administrative body (Gaidet et al. 2003; Garcia et al. 2004).

The first benefit of this participatory scheme is that it makes it possible for communities to share their perceptions, knowledge, priorities, and practices, make them explicit and potentially demonstrate their positive impacts on the human and natural environment. Making this information available, preferably by quantifying it, is a good way of getting decision makers to take notice and act accordingly. It will at least make it more difficult for them to ignore it (Danielsen et al. 2005a; Tiani and Bonis-Charancle 2007).

Another advantage is that it consolidates the community—administration relationship since it is necessary for both of them to collaborate in the implementation of the monitoring system (Danielsen et al. 2005b; Poulsen and Luanglath 2005).

Building a monitoring system that combines endogenous knowledge with scientific expertise is doubtlessly the best way to demonstrate that these two branches of knowledge are complementary. However giving more value to TEK and merging it with scientific methods does not necessarily entail a change in the relationship between stakeholders. Information alone cannot reduce the power asymmetry in the absence of good governance and counter-powers. The development of the monitoring system can on the contrary introduce a new form of interference by external stakeholders into traditional informal practices which had so far passed unnoticed yet may have been quite successful in managing the resources in a sustainable manner. Therefore, for local communities it is crucial not merely to generate information, but to produce information which can alter the position of other stakeholders involved in the process (Hezri and Dovers 2006).

Reinforcement of local institutions

The implementation of a local monitoring system should reinforce the role of local communities as managers or co-managers of natural resources by giving due importance to their TEK and at the same time involving them formally in sustainable resource management (Bonis-Charancle et al. 2007; Fraser et al. 2006; Lawrence et al. 2006). This empowerment of local institutions happens in two phases, at the time the monitoring system is created and then when it is implemented.

The work involved in developing the monitoring system must take into account the necessity of multi-stakeholder discussions through which the interests of the parties involved are highlighted and then combined (Karjala et al. 2004; Mendoza and Prabhu 2003). The expected outcome is a consensual C&I system which can be at least partially implemented by communities to guide their actions. The aim is to shorten the decision cycle, the data gatherers being the first managers of the environment. This enables them to

quickly take action when a trend detrimental to the sustainability of the management system is detected.

In fact even if the phase of data gathering at the local level is more or less straightforward—at least as long as external support is assured—most of these local institutions face difficulties using the data flow from the monitoring system for active adaptive management (Stuart-Hill et al. 2005). This difficulty is not only a feature of local monitoring systems (Lescuyer et al. 2004), but it is certainly more apparent in this context.

On the one hand, the hypothesis stating that better information leads to better management tends not to take into account the social dynamics underlying and restricting or enabling the use of natural resources. Since they are difficult to formalize and often impossible to set down openly (secrets, taboos, illegal practices, kinship…), these dynamics, however essential, cannot often be considered during the development of the monitoring system. Those control systems exist in most if not all rural societies and therefore such a critique clearly reduces the scope of any formal monitoring system unable to cope with them.

On the other hand, environmental changes often take place due to external factors (state level policies, global change, market dynamics…), on which the communities have little or no leverage. In the absence of an organized and functional relationship with higher level decision makers (administration, policy makers, national and international NGOs….), a part of the data gathered at the local level cannot be used for improving the management of the environment. Yet it may be difficult for an administration to take decisions based on the data gathered by communities if they feel the competence and seriousness of these communities have yet to be put to test.

Finally, in the absence of genuine transfer of power, communities not having a hand in the decision-making process may find monitoring systems of little interest. In some cases, local institutions may consider monitoring to be a luxury, diverting precious resources without the sure promise of returns (Sheil 2001).

Sustainability of the monitoring system

The development and implementation of a monitoring system does not come for free. The start up phase is the most expensive and always financed by an external donor agency, either state or foreign. The initial costs entail the development of the monitoring systems and the setting up of local structures (Danielsen et al. 2005a).

The operational phase is more difficult since it is supposed to function in the absence of external support. This implies that the benefits gained from monitoring should not be less than the costs (Topp-Jorgensen et al. 2005). The advantages to be gained from monitoring should be obvious to the communities involved (Hartanto et al. 2002; Stuart-Hill et al. 2005). This condition is rarely verified in case studies. Table 1 shows a sample of recent trials of local monitoring systems and their outcomes. Those experiments were done in various countries and under different administrative and social contexts: participatory management of protected areas (PA), joint forest management between Governments and communities (JFM) and community management. In all but three occasions, formal monitoring decreases significantly or stops altogether after the donor agency leaves the field. The three successful cases noted are certainly due to the long history of support extended by the external agencies that goes far beyond the standard longevity of development or environmental management projects.

Table 1 Durability of participatory monitoring systems after the founder's departure

Location	Management type	Funding	Durability
Botswana (Fraser et al. 2006)	CBFM	UNDP	Not tested on the field
Cameroon (Tiani and Bonis-Charancle 2007)	CBFM	US NGO	Stop
China (van Rijsoort and Jinfeng 2005)	PA participatory management	Dutch cooperation	Significant decrease
India (Garcia et al. 2004)	JFM	French cooperation	Not tested on the field
Laos (Poulsen and Luanglath 2005)	PA participatory management	Danish cooperation	Stop
Madagascar (Andrianandrasana et al. 2005)	JFM	International sponsors	Durable but NGO-funded
Namibia (Stuart-Hill et al. 2005)	JFM	State and international NGO	Extended through (moderate) international support
Philippines (Danielsen et al. 2005b)	PA participatory management	Danish cooperation	Durable but State-funded
Nepal (Ojha et al. 2003)	CBFM	English cooperation	No answer
Philippines (Hartanto et al. 2002)	CBFM	State	Stop
Tanzania (Topp-Jorgensen et al. 2005)	JFM	District + Danish cooperation	Significant decrease

The short life span of those local monitoring systems has several causes that are not mutually exclusive:

(1) Low profit. The income resulting from better monitoring (with the unwritten assumption that it entails better management) may be less than the formal and informal costs borne by the community to implement the monitoring. It is especially the case when the communities are requested to take part in the production or protection of global goods and services—such as biodiversity—without ensuring an appropriate monetary return. The crux therein lies in the inadequate choice of the management level or in the complexity and cost involved in monitoring the environmental dynamics at different levels (Fraser et al. 2006; López-Ridaura et al. 2005; Riley 2001).

(2) Inadequate focus. In spite of being developed in a participatory manner, the monitoring system is not sufficient to establish guidelines for adaptive management of the resources at the local level. One of the reasons may be the importance attached to ecosystem variables by the donor agencies while the people are mainly interested in the socio-economic impact resulting from the management of this ecosystem (Balint 2006; Yuan et al. 2003).

(3) Changing institutional agreements. Participatory management rests on the willingness of the authorities to reduce power asymmetry and to listen to suggestions from local stakeholders. But this depends on the directives given from the hierarchy and on personal preferences. Thus any working arrangement is susceptible to being modified by political pressures or the transfer or promotion of an official. Monitoring systems developed by and for the community can become obsolete even before being

implemented, when the participatory schemes are broken or cancelled and management responsibilities revoked (Garcia et al. 2004).

Rethinking C&I

Lukewarm results

The lessons learnt over 5 years of trials have led to a consensus regarding the necessary conditions for the emergence of successful C&I for participatory management (Danielsen et al. 2000; Danielsen et al. 2005a). However, one has to admit that most of the attempts fail as and when the donor agencies leave. Triggered by external forces, the monitoring system collapses in their absence, for the above-mentioned reasons.

Despite these shortcomings, we acknowledge that the dynamics developed during the definition of C&Is may have indirect beneficial effects for communities, mainly in promoting their TEK and in facilitating relationships with external stakeholders and administrations.

However those results could have been obtained by using other participatory methods. So are these local indicators red herrings for experts and project managers deluding themselves or are they a pretext for communities to come one step closer to sustainable resource management? Should they be considered, as suggested by one of the reviewers of this article, as mere "displacement behavior",[1] activities that external experts undertake because they can do nothing to significantly improve the existing management system at the local level? In short, are they worth the trouble?

We doubt the local stakeholders feel the same need for self evaluation tools based on a formal, endogenous assessment of sustainability. After all, they have their own informal monitoring systems which have developed as the societies co-evolved with their environment. These light, informal systems are so embedded in everyday's life that they are difficult to elicit, even for the stakeholders themselves.

In fact, unless the objective is to obtain socio-economical acknowledgment, especially through a "market", whether it be a payment for environmental services scheme or the capture of development funds, local communities primarily need mechanisms to prevent and solve conflicts over access, use and control of common pool resources. This does not preclude communities to seek sustainability adapted to the local context and conceptions. But in this quest, many different tools can be brought to bear (patrimonial negotiation techniques, codes of conducts, social fencing, etc.) of which C&I become but one of the potential elements.

The need for more formal assessment of sustainability usually comes through external stakeholders. Today, only true community-based natural resources management provides an adequate context for a sustainable implementation of local C&I. The challenge is thus,

[1] "Although no binding rules exist by which displacement behavior can be recognized, the term is applied to behavior patterns which appear to be out of context with the behavior which closely precedes or follows them, either in the sense that they do not seem functionally integrated with the preceding or following behavior or that they occur in situations in which causal factors usually responsible for them appear to be absent or at least weak […]. Displacement activities occur in three situations: motivational conflict, frustration of consummatory acts and physical thwarting of performance" *in* (Delius 1967).

whenever there is need for them, to include and dilute formal C&I into the complex and informal traditional monitoring systems anchoring them on local knowledge and practices.

Devolution and effectiveness

There are sufficient existing experiments to list the basic conditions for creating and implementing a sustainable local monitoring system (Danielsen et al. 2005a). As of now it is complex and costly to meet these conditions and only in (very) few cases has it been done successfully. But we know now the necessary ingredients and more or less how to accommodate them.

The essential difficulty in implementing these monitoring systems in a durable and effective manner lies in the dysfunctional link between monitoring and management. Even when the local stakeholders have the means to collect all the necessary information to get a precise idea about the dynamics taking place in their environment, it is generally difficult if not impossible for them to modify the crucial parameters driving them. The critical link between monitoring and the decision-making process is periodically challenged and that sooner or later leads to the monitoring system being put aside.

Most instances of monitoring of protected areas or joint management initiatives illustrate such a process. The local stakeholders keep track of dynamics on which they have little or no control. In any case the protected area cannot be questioned or fundamentally amended and the same goes for "joint management" schemes where the State fixes once and for all—by law for instance—the core intervention modalities. In such cases, which are by far the most frequent in the literature, one can hardly equate the local monitoring system to a tool for participatory management. "Local" in this case only conveys a sense of geographical space and does not relate to any kind of decentralized decision-making process.

This does not mean that such local monitoring systems are useless: at a low cost, managers obtain crucial information on the use/protection of the environment and this will eventually benefit the local population. But they should not be regarded as tools for establishing sustainable resource management at the local level. Such systems would gain from being the subject of a clear contractual agreement between the decision makers and the local population, instead of being passed off as participatory management of natural resources.

The pattern is different when it comes down to truly develop PRM. Here a significant share of authority, duties, responsibilities, benefits, and management capacities are handed over to local stakeholders. Under this condition, the monitoring system actually is a tool that can help orient local management decisions. Depending on the history shared between the communities and the resources to be managed, the informal monitoring systems (pre-indicators) are more or less evolved. The need of formalized C&I is thus proportionate to the duration the population has been managing the resources; the longer the common history, the less the need.

For the communities to formalize participatory C&I, they have to seriously sit down and outline the general and specific management objectives as well as the necessary means and strategies to attain them. This is the first step to shift from effective management—the simple addition of all the stakeholders' activities—to intentional management based on clearly spelled out and shared objectives (Mermet et al. 2005). Intentional management can be divided into five components: (i) resource assessment; (ii) needs analysis; (iii) monitoring of dynamics; (iv) negotiation over access and use; and (v) control (Fig. 1).

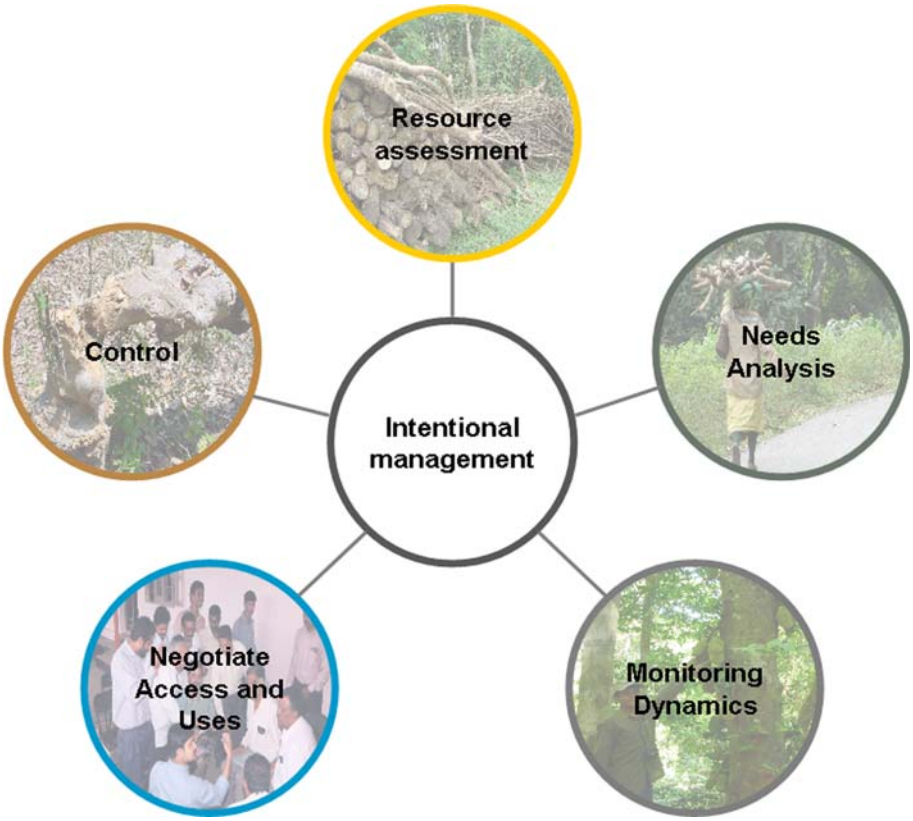

Fig. 1 Components of intentional management of local resources. Unless the communities are directly involved in all those five components (i) resource assessment, (ii) needs analysis, (iii) monitoring of dynamics, (iv) negotiation over access and use, and (v) control, chances are that participatory monitoring will fail in the short term

Not having mastery over one of these components tells on the effectiveness of the management and on the usefulness of a monitoring system. Unfortunately, this is the most common situation for PRM where, for example, control is usually in the hands of stakeholders outside the community (Ribot 2004).

Partial delegation of management powers to communities represents the major obstacle to the proper functioning of local, participatory monitoring systems. A genuine devolution of management to the communities would enable them to master the results of their management and also be accountable for them. It is in this context of truly decentralized management that the local monitoring systems become legitimate, effective, and sustainable.

Conclusion

Most of the information systems based on criteria and indicators recommended for initiating participatory management initiatives usually fulfill expectations which are external to the

local management system and thus collapse when the funding agency leaves. This usually reflects either the inadequacy of the data collected to solve problems faced by local management structures or the fact that monitoring costs exceed the benefits expected from it.

However the creation of participatory monitoring systems often triggers a process of collective action, by virtue of which it can be included in any strategic action aimed at managing natural resources. The thought that goes into the development of C&I can be instrumental in building capacity and giving legitimacy to local stakeholders and communities.

Implementing these local monitoring systems in the field is much more difficult. The hypothesis stating that the information generated by the system is inserted into the decision-making process so as to approach sustainability is generally not supported. When management decisions are based on power conflicts and alliances and not in the interest of intentional management, the indicators are of little use. This is equally the case when the stakeholders who do the monitoring on the field have limited power to make management decisions.

The ideal situation for implementing local monitoring systems is when resource management is completely decentralized and when a direct link is established between the monitoring results and the management decisions taken. But let us not forget that there should be a balance between social and ecological pertinence. The expert's role consists in integrating these two elements (social pertinence and ecological pertinence) into the information system. Accurate scientific information devoid of meaning at the local level will gather dust on the shelves while information which is understood and used for decision making but fails to mirror environmental changes will lead the managers down a false path.

The best conditions to marry these two different types of knowledge are when national authorities and local communities come to an agreement regarding the principles on which decentralized resource management should be founded. Decentralization does not mean *carte blanche*, since external actors also may have a say in the management of the natural resources, especially when global goods and services are at stake. The monitoring system then offers the possibility to assess whether the terms of the contract are being respected on both sides, the state and the local stakeholders.

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