PROJECT DOCUMENT

Title Monitoring Matters: Comparative Analysis of Innovative Approaches (MOMA)

Countries Tanzania, Nicaragua, Bhutan, Ghana, Namibia, Philippines

Sector Community-based natural resource management, locally-based monitoring

Duration 1 January 2006 – 31 December 2008

Overall objective
Sustainable use of natural resources

Immediate objective
Local communities and national agencies have access to the most reliable methods for monitoring resource use trends

Output
Improved understanding of the reliability of locally-based monitoring *vis-a-vis* conventional monitoring

Responsible institution
The Royal Veterinary and Agricultural University (KVL), Denmark

Collaborating institutions
Nordic Agency for Development and Ecology, Copenhagen, Denmark (NORDECO)
Zoological Museum, University of Copenhagen, Denmark (ZMUC)
Forest and Beekeeping Division, Ministry of Natural Resources and Tourism, Tanzania (MNRT)
Iringa Districts Lands, Natural Resources and Environment Office, MNRT, Tanzania
Sokoine University of Agriculture, Fac. of Forestry and Nature Conservation, Morogoro, Tanzania
Centro Humboldt, Nicaragua
Danida Env. Sector Progr./MARENA, Ministry of Natural Resources and Environment, Nicaragua
Durrell Wildlife Institute Madagascar Programme, Madagascar
Wildlife Division, Forestry Commission of Ghana, Ghana
Ministry of Environment and WWF Namibia under the LIFE Programme, Namibia
Dep. of Env. and Nat. Res. (DENR), Protected Area and Wildlife Bureau (PAWB), Philippines
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List of Acronyms

CU	Cambridge University
DANIDA	Danish International Development Agency
DENR	Department of Environment and Natural Resources, Philippines
DKK	Danske Kroner
GIS	Geographical Information System
KVL	The Royal Veterinary and Agricultural University, Denmark
LIFE	Living In a Finite Environment Programme, Namibia
MARENA	Ministerio del Medio Ambiente y Recursos Naturales
MNRT	Ministry of Natural Resources and Tourism, Nicaragua
MEMA	'Better life' (in Kiswahili), Danida-funded project in Tanzania
MOMA	Monitoring Matters: Comparative Analysis of Innovative Approaches
NGO	Non-governmental organization
NORDECO	Nordic Agency for Development and Ecology, Denmark
PAWB	Protected Area and Wildlife Bureau, Philippines
RUF	Rådet for Udviklingsforskning, Danida, Denmark
UCB	University of California, Berkeley
UF	University of Florida
UM	Udenrigsministeriet, Denmark
WWF	World Wildlife Fund

Definitions

Monitoring: data sampling that is repeated at certain intervals of time. We distinguish this from surveys by emphasising repeated and replicable measurements over an extended time frame and by focusing on rates and magnitudes of change.

Locally-based monitoring: monitoring carried out at a local scale, and by individuals with no or only limited formal training (see section on Theoretical Basis).

Conventional monitoring: monitoring by professional scientists working primarily for government agencies or NGOs.

Project Summary

Recent decades have seen substantial efforts by national governments and the donor community to develop and initiate approaches that sustain natural resource use- and management at local levels. Ideally, these efforts support local livelihoods and national economies by promoting effective management of renewable resources. Although important results have been achieved, such efforts have frequently been constrained by a lack of cost-effective means of monitoring natural resource use. This has meant that (i) local communities often lack a means of assessing their resource off-take for planning and management purposes, and that (ii) no data is available to document the environmental sustainability of such community-based approaches. The obvious answer would appear to be implementation of standard natural resource monitoring systems. However, conventional monitoring can be costly and hard to sustain. On this background, a generation of new and alternative natural resource monitoring methods is emerging, carried out locally by community members or other individuals with little formal training.

This project examines whether these new approaches can detect true local or larger-scale natural resource trends and address the shortfalls of conventional monitoring. The project will conduct quantitative comparisons of the findings of locally-based vis-à-vis conventional natural resource monitoring in selected sites in six priority developing countries over a three year period. The findings will not only be of relevance for natural resource management communities, agencies and donors in their efforts to establish and sustain effective monitoring, but also for guiding realistic indicator development and policy-making of national line ministries.

CONTENTS

1. CONTEXT

Natural resources are crucial to rural livelihoods across the developing world, and furthermore provide vital, indirect ecosystem services to urban populations in many areas. Natural resources contribute substantially to national economies more generally, through activities such as sustainable forest harvesting and nature tourism.

In extension of this, monitoring of natural resources is becoming increasingly important. Firstly, at the international scale several macro-policy initiatives such as the United Nations' Millenium Development Goals (United Nations 2000), the 2002 Johannesburg World Summit on Sustainable Development (UNEP 2002), and related commitments by European Union member states (European Council 2001) have committed governments to achieving quantitative targets in reducing poverty and using natural resources in a sustainable manner. At the national scale, Poverty Reduction Strategies (and national development plans in countries without a Poverty Reduction Strategy) and Strategic Sector Plans are committing line ministries to similar and other quantitative targets. Yet, important though these high-level goals are, policy-makers simply will not know whether the goals are being met without robust and representative systems for monitoring the changing state of natural resources (Jenkins et al. 2003; Balmford et al. 2005).

Secondly, monitoring is crucial at all scales for natural resource managers to assess the impact of their interventions. Natural resource management interventions vary widely in their success, but identifying the circumstances under which different kinds of interventions succeed (or indeed fail) requires effective monitoring.

Thirdly, the past two decades have seen a progressive shift towards encouraging local communities formally and more effectively to manage their own lands in ways that are compatible with agreed development goals (Brandon and Wells 1992; Caldecott 1998; Hulme and Murphree 1999; Dubios and Lowore 2000; Roe and Jack 2001; Jeanrenaud 2002a,b). These newly recognised partners in natural resource management also require monitoring data to inform their decisions – in a form that is accessible and credible to them, and which measures those aspects of natural resource management that are of greatest local relevance.

Previously, national and international institutions working with natural resource management have paid most attention to monitoring by professional scientists working primarily for government agencies or NGOs ("conventional monitoring"). Conventional monitoring however faces a number of important challenges, particularly in developing countries, where financial and human resources are especially limited:

1. Conventional monitoring is often costly, at least relative to the budgets of most government agencies. Employing scientists with appropriate field and analytical skills, buying and maintaining field equipment, and running data analysis facilities, can together take up a significant fraction of an organisation's resources, without directly delivering management on the ground.
2. High cost in turn means that many monitoring programmes are not sustained over time. The resulting work may still be valuable as a series of one-off assessments, but it does not constitute monitoring, and it cannot provide the information on trends over time essential to management decisions.
3. Conventional monitoring can often be difficult, both logistically, technically, and analytically. To some extent these problems can be addressed through explicit advance consideration of the importance of systematic, unbiased and sufficiently replicated data collection. However, some aspects of natural resources remain technically difficult to monitor – such as the extent or condition of certain habitat types which cannot be readily measured via remote sensing, and the rate of delivery of certain ecosystem services. As a consequence, only a minority of the world's

major biomes, and very few key ecosystem services, are currently being monitored at a regional or global scale (Balmford et al. 2003; Jenkins et al. 2003).

4. Monitoring is frequently perceived to be insufficiently relevant to the needs of managers (e.g. Sheil 2001), and as a consequence, may have limited bearing on management decisions. The solution to this is to involve managers, right from the outset, in identifying the objectives of the monitoring programme, and in checking, at an early stage, that these objectives are being met (Yoccoz et al. 2001; Royal Society 2003; Green et al. 2004). However, this is an increasingly difficult challenge for conventional monitoring in a world where formal responsibilities for resource management are becoming devolved away from high-level government employees.
5. A related issue is that conventional monitoring is often seen as paying inadequate attention to the objectives of other key stakeholders, besides professional resource managers – especially local communities whose livelihoods are often closely impacted by the resources concerned (Steinmetz 2000; Lawrence and Elphick 2002). Again, in principle, conventional monitoring can and should address this, through extensive dialogue with all stakeholders at the onset and throughout the course of monitoring but in reality, shortages of money, time, and trained personnel can make this a tall order.

In the light of these challenges, alternative approaches are emerging, carried out at a local scale and by community members or other individuals with little formal training ("locally-based monitoring"). To test the potential of locally-based monitoring to complement conventional monitoring and translate into tangible results on the ground in developing countries, an international symposium was held in Denmark in April 2004. The participants were scientists from 15 countries, incl. the project partners from Tanzania, Bhutan, Ghana and the Philippines as well as representatives from the World Bank/Global Environment Facility. Sixteen papers from the symposium have been published as a special thematic issue of Biodiversity and Conservation (vol. 14, pg. 2507-2820, available at www.monitoringmatters.org). The symposium was followed by a ½-day seminar hosted by Danida/BFT Miljø to discuss the findings of the symposium with the Danish resource base.

The symposium concluded that, if properly designed, locally-based monitoring can address several of the shortfalls of conventional monitoring. Most importantly, local monitoring has the potential to be low cost, rapid, locally relevant, and capable of building capacity among the local constituents. The symposium however recommended that rigorous validation studies need to be undertaken across a range of local contexts.

Locally-based monitoring has the potential to shed valuable light on changes in natural resources and ecosystem services at national and even global scales. To the extent that such systems can be implemented and replicated, important national and global monitoring gaps can be plugged, at relatively low cost, while at the same time increasing local people's input to higher-level decision-making.

For locally-based information to be useful at larger scales, monitoring schemes will need to be established in more sites and countries, and the resulting data must be as unbiased and precise as possible. Results can also only be synthesized where many programmes have monitored the same attributes (such as the rate of offtake of medicinal plants, or changes in condition of rangelands). They need not all use a single standardized technique – this would be difficult given the importance of the monitoring schemes being autonomous, and would preclude schemes from being responsive to local circumstances and needs. However, it is important that only a relatively small number of methods, each well replicated, is used across the set of studies to be analysed. Provided this is the case, then new meta-analytical techniques (Côté et al. 2005) can be used to check (and if necessary adjust) for differences in results being due to differences in field methods.

2. JUSTIFICATION

A. Theoretical Basis

"Locally-based monitoring" embraces a broad range of approaches, from self-monitoring of harvests by local resource users themselves, to censuses by local government staff, and inventories by amateur naturalists; it includes techniques labelled as "participatory monitoring", "community-based monitoring", "hunter self-monitoring" and "ranger-based monitoring". Many of these approaches are directly linked to resource management, but the entities being monitored vary widely, from individual species of plants and animals, through habitats, to ecosystem goods and services. However, all of the approaches have in common that the monitoring is carried out at a local scale, and by individuals with no or only limited formal training.

There are indications that locally-based approaches have considerable potential to complement conventional monitoring by addressing some of the shortfalls of conventional approaches (see Context section). Specifically, it is possible to carry out locally-based monitoring at much less cost than conventional monitoring, and hence for it to be more sustainable. Through careful training and sampling design, it should also be possible for locally-based monitoring to yield results which are as reliable as those of conventional techniques (Yoccoz et al. 2003), and which can shed light on aspects of natural resources which are hard to monitor conventionally. Perhaps most importantly, locally-based monitoring will by its nature tend to focus on management issues of greatest concern to stakeholders, and is thereby likely to have considerable advantage over conventional approaches in its potential to influence on-the-ground management activities, and to empower and enhance capacity among local stakeholders.

While locally-based monitoring has the potential to generate data sustainably and at low cost, many scientists however remain concerned about its ability – compared with conventional methods – to detect changes in populations, habitats, or patterns of resource use (e.g. Penrose and Call 1995; Brandon et al. 2003; Rodríguez 2003). Unfortunately, studies to date have been too few, and their results too inconsistent, for strong conclusions to be drawn.

Only 16 published tests compare the performance of locally-based and conventional methods: twelve from temperate regions (four terrestrial, six freshwater, and two marine), and only four (two terrestrial, two marine) from developing countries. Between them, these tests provide cautious support for the idea that locally-based methods can identify underlying temporal or spatial variation in natural resources, but a number of important concerns emerge repeatedly. Compared with conventionally-derived data, results from locally-based monitoring often have higher variance (Barrett et al. 2002; Genet and Sargent 2003), with the size or abundance of organisms sometimes being consistently under- or over-estimated (McLaren and Cadman 1999; Bray and Schramm 2001), and with mis-identification of more difficult taxa quite common (Brandon et al. 2003; Genet and Sargent 2003). Likewise, several studies caution that analysis of locally-derived data can sometimes be overly simplistic (Ericsson and Wallin 1999; Engel and Voshell 2002). However, most authors consider that these difficulties can in principle be addressed, through improved training of data collectors (Mumby et al. 1995; Darwall and Dulvy 1996; Bailenson et al. 2002; Barrett et al. 2002; Brandon et al. 2003; Janzen 2004), continued support from professional scientists (Barrett et al. 2002; Greenwood 2003), and more careful data analysis (Ericsson and Wallin 1999; Engel and Voshell 2002; Greenwood 2003).

Taken together, the literature and the presentations and discussions on the international symposium in Denmark in 2004 (Brashares and Sam 2005; Danielsen et al. 2005; Hockley et al. 2005; Roberts et al. 2005; and Uychiaoco et al. 2005) support the following general conclusions about the relative ability of locally-based monitoring to detect changes in natural resources:

1. Locally-based methods are in general more vulnerable than conventional techniques to various sources of bias, which decrease their accuracy (defined as the closeness of the resulting measures to their true values). Key potential problems include a lack of measurement experience on the part of observers (which often leads to over-estimates of abundance and size); potential conflicts of

interest (with recorders perhaps inadvertently providing data which are biased towards managers' preconceptions); a tendency, in the absence of careful documentation, for methods to drift over time, or for results to reflect long-term ("fossilized") perceptions more than current trends; and the potential for the spatial or temporal coverage of monitoring to be unrepresentative of the entire system of interest.

2. Besides accuracy, the utility of monitoring is limited by the precision of the results (the closeness of repeated measures of the same quantity to each other). Sources of low precision (leading to high variance around the estimated true value of the attribute of interest) include small sample sizes; overly thin or patchy temporal or spatial deployment of sampling effort; the physical loss of data; and the inconsistent application of methods, either through time or across observers. These problems can affect all sample-based monitoring, but are likely to be a particular problem where financial or professional (human) resources are tightly limited.

Further quantitative comparisons of the findings of locally-based and conventional monitoring are therefore badly needed, especially in developing countries, and in circumstances where data-gatherers have received little or no formal scientific education. The most frequently used locally-based monitoring methods (village group discussions, patrol records, transects/species lists, and photography), individually and combined, need careful and well-documented checking against broadly accepted techniques, across a range of local contexts. Unless this task is done, there will always be the concern that, however well intentioned, management interventions derived from local monitoring might in some cases be directed towards inappropriate targets.

B. Relevance of Project to Danish Development Cooperation and Partner Countries

Natural resources are crucial to rural livelihoods across the developing world, and furthermore provide vital, indirect ecosystem services to urban populations in many areas. Natural resources contribute substantially to national economies more generally, through activities such as sustainable forest harvesting and nature tourism.

Most programmes and projects of Danida (and indeed most bi- and multilateral donors) have struggled with monitoring systems which are expensive and hard to sustain, logistically and technically difficult to implement and sometimes perceived to be irrelevant by resource managers and the local communities. The efforts of this research project contribute to the objectives of Danish-supported environmental sector programmes in three countries (Tanzania, Nicaragua and Bhutan). The environment programmes and the line ministries they support have had difficulties in establishing effective systems for monitoring, and the findings from this research initiative will be of considerable value. In Tanzania, the government, KVL and NORDECO (Copenhagen) as part of the Danida-funded MEMA project developed an innovative community-based monitoring system (Topp-Jørgensen et al. 2005). This scheme is now being institutionalized country-wide in the Forestry sector. In Namibia, Danida/Danced formerly provided project support for natural resource management. The present research will contribute to the long-term objectives of these initiatives.

In Ghana, Danida focuses on human health and conflict prevention. The present research is also relevant in this context. Reliable, long-term access to natural resources for food, medicine and economic livelihoods is a critical determinate of health, governance, and social/political peace, particularly in rural areas. Sustainable use of natural resources contributes to conflict prevention. Assistance to establish and validate community-based monitoring of resources serves to empower otherwise disenfranchised rural people. Such empowerment is a central goal of Danida's efforts in Ghana.

Philippines is not a main collaborating country of Denmark. Danida has however funded technical assistance to design and institutionalize community-based resource monitoring (administrated by the World Bank and implemented by NORDECO 1996-2002; Danielsen et al. 2000). Community-

based monitoring now guides resource management in c. 25 Philippine protected areas. The present research consolidates this work and contributes to extend the lessons to other areas and institutions.

An important multilateral partner of Danida, the Global Environment Facility (GEF), also assigns considerable value to participatory resource monitoring. The majority of the more than 200 large biodiversity conservation initiatives of GEF are currently planning or establishing participatory monitoring schemes. The findings from the present research initiative will be of substantial importance to GEF.

C. Project Areas

The project will include research in selected areas of six countries:

1. Tanzania, Iringa District
2. Nicaragua, Bosawas
3. Bhutan, Trashi Yangtse and/or Gasa/Punakha
4. Ghana, Northern and Volta Region
5. Namibia, Caprivi Region, Kunene Region
6. Philippines, Bukidnon, Isabela and/or Visayas

The project areas have been selected so as (i) to be representative of developing countries in a wide range of biomes, continents and socio-economic conditions (Africa East, West and South; Himalaya; Tropical Asia; Latin America), and (ii) to include those four developing countries where innovative monitoring of natural resources are most advanced (Tanzania, Ghana, Namibia, Philippines), where fieldwork will be cost-effective and new experiences are most likely to be generated.

D. Expected Results

A number of publications are expected, mainly in international journals focusing on natural resources and resource management. Some of these papers will provide a broad-scale analysis across the different countries and other papers will be specific to the individual study areas. Results, including generalized guidelines for participatory monitoring, will also be presented and discussed with other scientists in the field on international conferences as well as with governments, NGOs and smaller agencies. We expect that the publications will be the most detailed study of locally based monitoring, dealing with a range of questions of interest outside monitoring *per se*. The locally based monitoring schemes in Ghana, Namibia and the Philippines are now well known as the most institutionalized and long-term monitoring schemes of their kind in developing countries, and the project therefore provides material for a wide range of studies.

E. Innovative Elements

The project builds on the experiences from a long engagement in international studies of natural resource monitoring by the Zoological Museum of Copenhagen University, NORDECO, the Zoology Department of Cambridge University, Ghana Wildlife Division, University of California Berkeley and The University of Florida, including participation in the development of locally-based monitoring schemes in Tanzania, Ghana, Namibia and the Philippines. These are the only locally-based monitoring schemes which have been (or are being) adopted nationally in developing countries (all others are specific to local areas). The project will develop further the experiences from these initiatives to fill in gaps in knowledge on the ability of locally-derived data to detect true trends and extend the research to other biomes and continents.

Current international research on resource monitoring has focused on (i) outlining the fundamental assumptions for quantitative recording of natural resources and (ii) developing a sound theoretical basis for designing rigorous programmes for sampling and analysing natural resource data under ideal

(laboratory) conditions. This information has proven useful for developing large databases and monitoring schemes in North America, Europe and Australia. In the less financially wealthy countries, most current monitoring programmes are incapable of contributing to natural resource management, because they suffer from (i) an unrealistically large size and complicated design that are impossible to sustain with the locally available funds, institutions and human resources, and (ii) ineffectiveness in integrating information into decision-making.

This project aims at improving our understanding of monitoring approaches which can be sustained in developing countries and which can be effective in guiding decision-making. The focus is on a newly developed approach to natural resources monitoring which, together with recently developed meta-analytical techniques (Côté et al. 2005), has very substantial potential for plugging important national and global monitoring gaps. The project comprises the first assessment of locally-based monitoring across a range of local contexts in developing countries. Attempts at community-based conservation are undertaken in a 'piece by piece' approach because we lack communication among managers and a larger synthesis of past successes and failures (i.e., to date we can provide no comprehensive framework for establishing effective locally-based monitoring). This work will provide just such a synthesis for locally-based monitoring.

The project will approach methods development and knowledge production through direct collaboration between academic staff and practitioners from relevant Government and civil society institutions. By bringing together the different knowledge systems and perspectives held by these different actors, the project thereby seeks to overcome conventional professional dividing lines in favour of a more interactive approach. Experience increasingly shows that such direct collaboration provides for dynamic and informed research processes, and greatly enhances the prospects for subsequent application of research results in everyday policies and practices.

3. AIMS

The aim of the project is to quantitatively assess the ability of locally-based monitoring methods to detect changes in natural resource populations, habitats, and the provision of ecosystem goods and services.

4. METHODS

The project will quantitatively compare findings of locally-based and conventional natural resource monitoring. It will carry out conventional monitoring alongside locally based monitoring, by comparing sites with different levels of disturbance, and by hiring strong local researchers to carry out the field work. The involvement of local researchers also contributes to building local capacity in appraisal and implementation of natural resource monitoring schemes.

In four of the countries, there are already well-established locally-based monitoring schemes and the project only needs to carry out conventional monitoring (Tanzania, Ghana, Namibia, Philippines). In the remaining two countries, the project will need to establish locally-based monitoring as well as conventional methods (Nicaragua, Bhutan). The most frequently used locally-based monitoring methods will be assessed. These are:

1. Patrol records: filling-out routine patrol sheets on key species, habitats, or extent of resource exploitation (including ranger event books);
2. Transects: simple dedicated transects of wildlife and human resource use;
3. Simple photography: on-the-ground fixed point photography;
4. Village group discussions.

The findings from these methods used at a local scale by individuals with little formal training will be compared with findings from conventional monitoring methods carried out by professional scientists in the same areas.

An international project workshop will be convened in year 2 to review progress and preliminary results, fill-in gaps in the fieldwork as necessary and discuss the findings and conclusions.

The development of locally-based monitoring in Nicaragua and Bhutan comprises the following activities:

1. Identifying information on existing resource use/biodiversity monitoring activities in the areas. Analysing this information and making preliminary suggestions as to how to build on such initiatives
2. Discussing and agreeing on the objectives for the locally-based monitoring system, the institutional framework, and the strategy with government staff, and other national and local stakeholders
3. Proposing a design for a locally-based monitoring system that is suited to the local context. This activity will use existing information on resource use and biodiversity from other previous and ongoing government/university/project initiatives
4. Discussing the proposed monitoring with local stakeholders and staff of the government, university and projects; and revising the monitoring system accordingly
5. Developing an effective mechanism to integrate information into management decisions
6. Establishing the monitoring system by beginning to facilitate initial on-the-ground implementation with community monitoring groups and other local people on a small number of sites. Discussing the results with local and national stakeholders, and revising the monitoring accordingly
7. Training government staff and representatives of local people in locally-based monitoring, including in field work techniques, how to integrate the information generated into management decisions, how to facilitate community participation in monitoring, etc.

To discuss the findings of the project with persons and institutions that are not directly involved with the research and disseminate the results more broadly, two national workshops will be convened in each of the case study countries.

Preliminary Outline of Monitoring Framework

At a kick-off meeting, the participants will finalise a detailed monitoring approach that can be employed consistently by all project partners. This detailed approach will be developed from an existing methodological framework built on considerations of statistical rigour, sampling constraints, and means of sustaining the findings and achievements of the project. The following text and Table 1 provide an outline of our preliminary general framework to monitoring.

Sampling Unit. The research project will use specific areas of discernible habitat or land-use (e.g. a specific catchment forest, an area of lowland forest, a river, an area of tidal flats, etc.) as the primary sampling unit. These areas will be of a size and value that make them significant both in terms of natural resources and in terms of importance for utilization by local communities. Sampling will be stratified across a range of habitat and land-use types. For each sampled area, habitat and land-use data and geographical coordinates will be obtained and recorded in a Geographic Information System (GIS). An alternative would be to use villages/communities as sampling units, around which a series of random and repeated data sampling efforts would be conducted. However, this would add a high degree of sampling 'noise' from lumping data together from different land-types. Each sampled area will be spatially independent of others. Where necessary this assumption of independence will be tested

and accounted for by controlling for spatial autocorrelation in our analyses (e.g., by evaluating 'nested' subsets).

Locally-based Methods. The locally-based methods will be undertaken by local community members and natural resource users with little or no formal training in science. At the kick-off workshop we will determine which of the locally-based methods to include. Based on existing data and current standards for monitoring, the most obvious focus would be on village patrol records (incl. ranger event books) and two types of data from village group discussions: (a) community assessments of presence/absence of species and other resources, and (b) community assessments of trends for populations/abundances of different focal species or ecosystem services, such as change in the availability of clean water or firewood, or in the abundance of wild pigs.

Other options for locally based monitoring include but are not limited to simple transects, point counts, fixed-point photography and species lists. Currently, patrol records are used in all four countries with existing locally-based monitoring schemes, village group discussions are used in Ghana, Philippines and Tanzania, simple transects and photography are used in the Philippines. To our knowledge, point counts and species lists are not used in any of the countries. The selected locally-based methods will be implemented consistently across all sites. This means that in some sites new methods will be introduced at the start of the research project.

Conventional Methods. Data sampling with conventional methods will be carried out by professional researchers. The methods defined by the group during the kick-off workshop in 2006 must be easily replicated across all sites and countries. These methods will be a combination of an abundance estimator (such as distance sampling transects; Buckland et al. 1993; Laake et al. 1993) and simple presence-absence sampling. However because sample sizes of many species may be low we will also use encounter rates (e.g. Brugiere et al. 2005) as a comparative index of species presence.

A proportion of transects will be re-sampled 2-5 times to estimate seasonal detection probabilities, so that site occupancy can be estimated as an alternative index of use by a given species (e.g. MacKenzie et al. 2002, 2005). In addition, local people's species identification ability for spoor marks (e.g. dung) will be evaluated through spoor mark identification tests for selected species included in the monitoring schemes. Species identification by locals will be compared to the results of tests of species identification administered to professional researchers. The tests will be conducted in the field to reflect realistic monitoring situations.

Types of Data. We will collect data on (a) species, ecosystem services, resource uses and threats, (b) presence/absence, and (c) a measure of quantity (e.g. increase/decrease/no change/no info).

Frequency of Sampling. Sampling is estimated to be feasible in each area four times per year. The relevant literature suggests this frequency should be sufficient for rigorous monitoring of most species and ecosystem services/goods (e.g., Brashares and Sam 2005; Brugiere et al. 2005). This sampling frequency also suits at least three of the four already existing locally-based monitoring schemes (Danielsen et al. 2005). Exact sampling frequency to be used at all sites will be decided upon at the kick-off meeting.

Number of Sampling Sites. The number of sampling sites in each country will be defined according to (a) the final selection of conventional and locally-based methods, and (b) the number of sampling sites available in the vicinity of each focal village. For instance, in the Philippines and Tanzania, there are generally only one or two areas of discernible habitat sampled by locally-based monitoring per village,

whereas in Ghana there can be 6 or more distinct habitats or land-uses around villages/posts. The final sampling strategy will incorporate this heterogeneity.

Approach to be taken in the New Countries. In the two countries, Nicaragua and Bhutan, where locally-based monitoring does not exist today, we will work with interested local villages and establish both locally-based monitoring and conventional monitoring.

Analysis. The study will compare across space rather than time – i.e., our comparisons will be made across a scale of habitat alteration and assume that differences between habitats reflect past losses and gains. The alternative option - to observe population responses over time within a given site - would in most cases not be practically feasible given this study's limited duration. Nevertheless, we expect some species and processes will show sharp and detectible changes over the short course of the project. Possible examples include, dry-wet season shifts due to migration of wildlife in Tanzania and Ghana, and changes in species abundance or distribution driven by dramatic habitat alteration.

Comparing the two data sets (locally-based and conventional data) using Wilcoxon's non-parametric test for matched pairs will provide a measure of the discrepancy between the methods. Assuming that the conventional methods reflect 'true' trends and applying the test value as a measure of local monitoring accuracy, correlation can be sought with a number of parameters such as income from natural resources, distance from the forest etc. (see below) using Pearson's Correlation, multiple regression, and Principal Component Analysis.

In each country, data from the sites will be entered into a simple Excel-spreadsheet to allow for national-level analysis. In Denmark, the national data will be compiled on a GIS-database for comparison with other parameters. The data set will be made available to all participating institutions. Parameters which could be useful as co-variates in our analysis include, dominant type of land and resource use by the local communities, importance of natural resources to local livelihoods, existence of different services (school, health post, etc.), local human population density, history of settlement, basic environmental characteristics (rainfall, temperature and soils) and land cover type, distance to water, distance from village to forest, distance to urban market, and level of deforestation.

Interdisciplinary Approach. Locally-based monitoring is based on a combination of natural and social science techniques. The aim of this research program - "to quantitatively assess the ability of locally-based monitoring methods to detect changes in natural resource populations, habitats, and the provision of ecosystem goods and services"- however mainly entails natural science work. Nevertheless, there are a number of activities in this programme, where input from social science will be essential, see Table 1 below.

The comparison of logistical and contextual requirements (Activity no. 5 in Table 1) was not envisaged in the original programme document. Inclusion of this activity, however, does not require much extra effort and will enable the programme to identify under which conditions locally-based monitoring is an efficient resource management tool compared to conventional monitoring. We think this would be of very considerable interest to practitioners, governments and donors.

Table 1. Outline of MOMA activities.

	Activity	Natural science analysis and input	Social science analysis and input
1.	Establish and/or conduct locally-based monitoring	• Train/facilitate and supervise the locally-based monitoring methods	• Identify and describe socio aspects of the monitoring methods • Facilitate participatory approach • Help classify the different approaches in the different countries
2.	Undertake conventional monitoring	• Use existing knowledge and develop a conceptual model of the assessment so that limitations become explicit • Develop a sampling strategy that specifies who measures what, how, where and when • Conduct a pilot study to test the feasibility of the data collection protocols • Undertake conventional monitoring	• Support identification of team members
3.	Conduct comparative analysis of results from conventional and locally-based monitoring	• Provide analysis of species/ecosystem service/resource/threat issues • Feed results back to data gatherers • Check results are fit-for-purpose and improve sampling strategy accordingly	• Provide analysis of resource use issues
4.	Trace and analyse sources of error in the locally-based monitoring and in the conventional monitoring	• Examine types and extent of sources of error in the locally based and conventional monitoring	• Examine types and extent of social and cultural sources of error in the locally based monitoring
5.	Compare logistical and contextual requirements (management actions, costs, capacity, geographical features, ecological features, institutional context etc) for conventional and locally-based monitoring in the case-studies	• Provide analysis on management actions, cost, geographical and ecological features etc.	• Provide analysis on cost, capacity, public support etc.
6.	Provide recommendations for future approaches to monitoring in natural	• Provide recommendations on natural science and resource	• Provide recommendations on

	resource management	management aspects	social and institutional aspects

5. RISKS AND ASSUMPTIONS

An important assumption is that staff changes in the governments do not significantly negatively affect the locally based resource monitoring. The only major risk to the project is unforeseen climatic, infrastructural or political conditions which e.g. may prevent access to the field sites. The project activities are however distributed over a wide area so the overall impact on the project is likely to be minimal.

6. PROJECT ORGANIZATION

Overall Responsibility. Overall responsibility for the scientific contents of the project and the administration of the research grant rests with Associate Prof. Per Moestrup Jensen of The Royal Veterinary and Agricultural University (KVL).

Project Steering Committee. The Steering Committee for the project will be composed of Dr Per Moestrup Jensen of The Royal Veterinary and Agricultural University (Chair), one person from each participating developing country, one representative of Danida-BFT (proposed), Prof. Jon Fjeldså of the Zoological Museum, University of Copenhagen, and Mr Finn Danielsen of NORDECO, Copenhagen (see organogram in Appendix 1). The Committee will meet annually. In Year 2, the meeting of the Steering Committee will be held simultaneously with the international workshop, where the leading researchers will be present (funded from budget lines of their individual institution). In Year 3, the meeting is envisaged to be held in a developing country.

Project Kick-Off Meeting. A project Kick-Off Meeting will be held to elect members of the Steering Committee, and to discuss and agree on detailed field methods and practical organisation of the work. This meeting will involve all participating researchers and institutions, including two persons from each developing country (the researcher and a senior representative of the government counterpart since the case study coordinator and the Steering Committee member should be different persons). To save funds, the first Steering Committee meeting will be held immediately after the kick-off meeting.

Project Secretariat. The day-to-day administrative work of the project in Denmark will be undertaken by a Secretariat. The Secretariat at the Department for Ecology, The Royal Veterinary and Agricultural University will undertake the task as project secretariat. Supplement assistance to the secretariat will be hired in the beginning and end of the project. If a suitable candidate can be located, the supplement secretary will have both biological background at M.Sc. level and insight into the socio-cultural context in the cooperating countries. The permanent secretary to the institute and project assistant should enable a smooth and efficient communication between secretariat and project members. The permanent secretary is partly funded by overhead and thus indirectly financed by this project. The supplement assistant will be paid from overhead from this specific project. The budget for the supplement assistant totals DKK 125,000 equaling 3.5 months work or 7 months half time. A total of 3.5 months are allocated for 1 year and 3.5 for the 3 year.

International Workshop. The Secretariat will also organize Steering Committee meetings as well as an International Workshop with project staff to enhance the coordination and quality of the work and concrete activities (e.g. sessions with presentations and discussions led by developing country participants), which contribute to exchange of experiences between the developing country participants.

Case Study Coordinators and Technical Support Group. Daily technical and administrative operations of the project in the individual countries will be led by Case Study Coordinators (Appendix 1). Supervision and technical support will be provided by members of the Technical Support Group.

Activity Planning. Central coordination of the project will be anchored at KVL, with Dr Per Moestrup Jensen as overall responsible. Activity planning will be undertaken in full collaboration with collaborating partner institutions in the countries concerned. The detailed project activity planning will include:

(i) Designation of a government partner staff to be seconded to the project in each country, full-time or part-time.

(ii) National planning workshops in each country, and establishment of small natural resource management reference groups in each country to meet semi-annually and to be comprised of strategically selected or professionally relevant persons.

(iii) Country project progress reporting also to the relevant national government institutions not only for distributing information but also to obtain feed-back and encourage creation of local ownership (annual progress, one completion, and 2 technical reports),

(iv) Dissemination of findings will take place to other government and NGO partners in each country.

Management of Project Funds. In order to ensure sound management of the project funds, financial administration will be coordinated from Denmark by KVL, and allocated to the participating institutions according to pre-arranged schedules. Funds will be managed according to the guidelines from RUF.

Internet Forum. To ensure that all members have equal online access to all information in the project, an internet forum will be created on the KVL-Campus-Net. KVL-Campus-Net has a wide range of services ranging from messages, file-sharing, conference room, calendar etc. for a given course or project. It has WWW access by secure ID and Passswords created by the KVL IT-service unit. Thus files and messages can be uploaded/downloaded or send from any location in the world allowing for service on demand. As the main bulk of the documents prepared under the project will be avalable in Campus-net e.g., minutes from meetings, this provides full transparency in the project. Finally the KVL-Campus-Net data security is handled by the KVL IT-service unit, and hence the Campus-Net-project site will deliver free backup and data safety to all project members.

Study Tours. The project will include experience exchange visits by staff from those two countries (Nicaragua and Bhutan) who have not yet established locally-based monitoring schemes. Participants from these countries (researcher and government counterpart) will visit two of the countries where locally-based monitoring schemes are already well established (2-week visit, one week in each country, funded by the budgets of the Nicaraguan and Bhutanese institutions).

7. DISSEMINATING AND APPLYING RESEARCH RESULTS

The main users of the research findings will be natural resource management agencies and donors. The project builds on the already established long-lasting cooperation on resource monitoring and/or management between the scientific institutions and the government agencies from the countries involved.

To ensure involvement of a broad resource, two national workshops will be held in each country over the lifetime of the project to discuss the research and its implications for policy-making and management with other agencies, NGOs and embassies etc.

Dissemination of the research findings to the donors will mainly take place (i) directly by the participation of donor programmes in the research (Tanzania, Nicaragua), (ii) by participation of embassy staff in discussions of the research findings on national workshops, (iii) through the regular exchange of experiences which are taking place between staff of the Danish and British institutions involved in the project and staff of key donors such as the World Bank and the Global Environment Facility.

8. COOPERATION WITH RELATED RESEARCH INITIATIVES

The project builds on the experiences from a long engagement in international studies of natural resource management and monitoring schemes, including participation in the development and evaluation of locally-based monitoring schemes in Tanzania, Ghana, Namibia and the Philippines. An effort has been made to establish a broad collaboration. A symposium was held in Denmark in 2004, which established a network of researchers on locally based monitoring in 15 countries. An active collaboration takes place with all the major research groups working with participatory monitoring in developing countries, including Bill Sutherlands group on evidence-based conservation at University of Sheffield, Anna Lawrence's group at the Environmental Change Institute of Oxford University, the Conservation Measures Partnership, and the Cambridge Conservation Forum's Harmonising Measures of Success project.

9. NEEDS FOR PERMITS

On the project location, the following situation applies re permit requirements:
Tanzania, Namibia and Philippines: the permission process is well known by the Case Study Coordinators, authorizations take time, but the time schedule of the project has been developed accordingly. Nicaragua: permissions are required from the General Direction of Protected Areas (Ministry of Environment and Natural Resources) and are underway. Bhutan: Permissions are required for research (issued by the project partner, the Nature Conservation Division) as well as for travel within the country and in the border regions; if this application is approved for funding, the Case Study Coordinator will work on obtaining the permissions; they have previous experience with this process, and it will not be a problem. Ghana: Only a research permit is required (issued by the project partner, Wildlife Division).

10. MILESTONES

Milestones (needs adjustment/approval UM)
The project has the following milestones:

1. Locally-based monitoring established and in operation in Nicaragua and Bhutan (< Month 6)
2. Conventional monitoring started alongside the locally based monitoring in all six countries (< Month 10)
3. First national workshop held in each country (< Month 16)
4. International workshop convened (< Month 20)
5. Second national workshop held in each country (< Month 28)
6. Project fieldwork finalized (< Month 33)
7. Draft report (< Month 34)
8. Final report (By the End of the Project)

11. BUDGET

Table 2. A summary of the budget is provided in the table below.

Institution	**Budget (DKK)**
Royal Veterinary and Agricultural University, KVL (incl. work in Tanzania)	2.042.832
Nordeco (incl. work in four countries)	3.028.184
University Centro America, Nicaragua	536.540
Nature Conservation Division, Bhutan	453.453
Wildlife Division, Ghana	357.783
Namibia LIFE Programme, Namibia	455.215
Protected Area and Wildlife Bureau, Philippines	422.861
University Berkeley (Prof. J. Brashares)	388.299
University Florida (Assoc. Prof. B. Child)	303.626
Total costs	7.988.793

12. SELECTED REFERENCES

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References not mentioned here are listed in Danielsen et al. 2005 (www.monitoringmatters.org).

Appendix 1. Organogram of the Project