

# Learning to manage a complex resource: a case of NTFP assessment in Nepal

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## SUMMARY

Due to increasing recognition of the importance of Non-Timber Forest Products (NTFPs) to local livelihoods and biodiversity conservation, the need for accurate assessment of NTFPs growing stock and yields as well as identification of sustainable harvesting options has become more critical than ever before. This paper seeks to explore how learning is taking place in Nepal in order to develop NTFP resource assessment and sustainable harvesting techniques based on an analysis of case studies from contrasting contexts. Using an adaptive management approach as a framework, the analysis focuses on developing an understanding of the strong and weak aspects of the current methodologies, leading to recommendations for ways forward.

Keywords: adaptive management approach, Forest User Groups, NTFPs, participation management, resource assessment, sustainable harvesting

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## INTRODUCTION

While the government of Nepal is committed, as part of the community forestry initiatives, to transferring the rights of forest management and use over to local communities there are still a number of policy and practical issues that need to address the potential of NTFPs as sources of livelihood, economic growth and biodiversity conservation (Chhetri and Pokhrel 2000; Ojha 2001). After the formation of 13,000 Community Forest User Groups (FUGs), with over 850,000 ha of forest under their control, NTFP management has emerged as a second generation issue in Nepal's community forestry, featuring prominently in contemporary debates of policies and practices (ANSAB 2003; Ojha 2001; JTRC 2000; Subedi 1997; Edwards 1996).

Government rules require FUGs to make assessments of NTFP stock and an estimation of yields, which is also a prerequisite for preparation of sustainable use plans (HMG/N 1995; HMG/N 2000). They are not allowed to harvest the products if sustainable use plans are not incorporated in their Operational Forest Management Plan (OP). Due to the limited history of scientific research into forest management before widespread implementation of community forestry, supporting institutions such as the Department of Forest (DOF), donor-funded projects and NGOs are also facing similar challenges in developing approaches, methods and tools for sustainable harvesting.

In order to cater for increasing levels of subsistence as well as the commercial needs of a broad range of people involved in the NTFPs sector, there is a growing need to promote more intensive management and extraction of NTFPs (Ojha *et al.* 2001; Subedi *et al.* 2001). A crucial

step to this end is to develop methods and techniques for resource assessment, and sustainable harvesting that are both compatible with local institutions and knowledge systems and biometrically adequate. The criterion of biometric adequacy is a particular challenge when dealing with a wide range of species, product types, varied ecological zones and diverse socio-economic contexts. A crucial issue in this regard is how key individuals involved in NTFP management can effectively learn to develop site-specific solutions.

This paper seeks to explore lessons with regard to how NTFP stakeholders are learning to develop NTFP resource assessment and sustainable harvesting techniques, based on selected case studies. The focus is on the analysis of the efforts to address the dimensions of complexities and management uncertainties, which characterise NTFPs management. Attempts are made to understand the learning approaches, which drive NTFP management initiatives, and assess their strengths and weaknesses. In particular, analysis focuses on determining how conscious and adaptive the learning strategies are. Finally the paper draws a policy perspective, building upon key lessons relating to developing sustainable harvesting system and practices in Nepal.

## NTFP MANAGEMENT ISSUES

The fundamental questions that foresters and FUGs should be able to answer while planning sustainable management of NTFPs at operational level are listed below (Wong *et al.* 2001, Ojha *et al.* 2001).

- Abundance/growing stock – knowing where and how much of a resource is present in the area being managed.
- Reproductive biology – determining the growth or replenishment rate of the present levels.
- Productivity per unit of time and area.
- Calculating sustainable harvest levels, based on an analysis of abundance and productivity.
- Designing a monitoring system to determine if harvesting is indeed meeting its objectives.
- Harvesting techniques – what specific sustainable harvesting techniques in terms of seasons, methods and tools are appropriate for each of the products in question?

Getting answers to these questions is a difficult job. One of the reasons is that NTFPs include diversity of plant forms (herbs, shrubs, trees and sometimes climbers) and diversity of parts used (whole plant, stem barks, root barks/fibres, roots, stems, flowers, leaves, fruits, seeds, cotton, exudates etc). Even a small patch of forest may contain several NTFPs needing specific consideration in resource assessment. Any process of NTFP resource assessment and management must be specific to the plant form and product type used.

NTFP resource assessment and harvesting should be seen in the local ecological and socio-economic context. Since most of the areas containing high value NTFPs in Nepal lie in the hills and mountains, where geographic and climatic constraints force local communities to resort to methods and arrangements through which they can collect maximum products in a limited time in the field (Luintel 2002), developing user friendly methods is a difficult challenge. In addition, as the focus of forest inventory has been on assessing the stock and increment of timber products (Branney 1994a; Branney 1994b; HMG/N 2000), another difficulty comes from the lack of documented knowledge to provide appropriate answers to resource assessment and sustainable harvesting questions for NTFPs.

Unlike timber, there is no accumulation of products such as flowers, seeds and leaves of plants through the years. This means resource assessment should aim at calculating periodic yield (periodic production) rather than the increment (continuous accumulation of wood in the case of timber) for NTFPs. These differences have implications for approaches to assessment, management and monitoring of these resources.

These aspects require stakeholders to adopt a learning-based approach to developing NTFP assessment methodologies, in which each action or initiative is considered as an experiment to answer a specific sets of learning questions.

#### ADAPTIVE MANAGEMENT APPROACHES IN NTFP MANAGEMENT

Among the range of approaches to learning, adaptive management has been considered effective in complex and uncertain situations that characterise natural resource

management (Lee 1993; Lee 1999; Holing 1978; Salafsky *et al.* 1999; Ruitenbeek and Cartier 2001; MCDougall 2001; Ojha *et al.* 2002). Key elements of adaptive management are outlined in Box 1.

Adaptive management can be understood as a process of improving management outcomes by incorporating explicit learning plans into management actions. In managing natural resources institutions can imagine possibilities, challenge assumptions and consider their actions as experiments so that the rate of learning and improvement is maximised. The adaptive management approach considers systems thinking, recognises uncertainty as an opportunity to test and learn, systematically tests different options at the actual operational setting, and recognises failure as a source of learning. This approach combines an experimental element with on-going management actions.

#### BOX 1 *Key elements of adaptive management*

##### **1. Learning by planning (using learning questions)**

By appreciating the complexity of the system in which they are working, actors recognise that they are not certain to achieve desired results by their actions; so they pinpoint and prioritise areas of uncertainty and identify learning questions to be used as a basis for learning through the experience. This means that learning is one of the planned outcomes, not just a by-product of experience.

##### **2. Incorporation of experimental strategies**

To seek answers to identified learning questions, or to test specific assumptions and hypotheses, actors structure their actions to allow experimental comparisons of various actions in various conditions. Experimental comparison (not necessarily using controlled and structured designs, and quantitative data) is necessary to infer causal connections, which forms the basis of learning.

##### **3. Systemic consideration.**

Actors go beyond linear models of connections and change, and keep an eye on all elements of systems that significantly affect, or are affected by, the planned actions. This helps to create system-wide knowledge as opposed to the traditional scientific reductionist worldview.

##### **4. Monitoring**

Data, evidence and insights are collected along with implementation of actions that are designed, experimentally, to develop answers to identified learning questions. Analysis of this information is then fed into the next cycle of planning and action.

##### **5. Building negotiated knowledge**

Since diverse sets of actors, often with different perspectives, knowledge and interests, are related to a problem situation, the adaptive management approach seeks to build knowledge that is shared and respected by all by allowing and facilitating debates across various knowledge traditions with the actors involved (such as local and scientific knowledge). Through this, various perspectives speak to each other and they share knowledge and make collective decisions.

The elements of adaptive management illustrated in Box 1 were used as a basis to judge the strengths of NTFP resource assessment cases in Nepal. Although the study was constrained by a scarcity of data specifically related to adaptive management in the NTFP sector, there was still value in using this framework to indicate gaps and opportunities for future.

## PARTICIPATORY NTFP MANAGEMENT IN NEPAL

Because NTFP management is a second generation agenda in community forest management in Nepal the institutional, technical and policy arrangements are still evolving. Before 1990 management of each community forest was guided by a single document signed by FUGs and DFOs, and this did not explicitly recognise the need for forest resource assessment, or NTFPs. As the problem of resource information and planning was encountered in the field, provisions to assess forests and prepare a separate operational plan were then included in Forest Rules in 1995 (HMG/N 1995). The subsequent Directives issued by Ministry of Forest and Soil Conservation in 2000 have made it mandatory to assess the growing stock of all types of forest resources, and limit harvesting of forest products within the mean annual increment (HMG/N 2000).

However, most community forestry operations are in the mid-hills rather than the Terai or the High Mountains, where most NTFPs occur. Most Operational Plans (OP) for managing community forests (CF) contain management provisions for timber, fuelwood and fodder only and NTFPs are generally ignored except where support is received from an NGO or project interested in them. According to the prevailing forest regulations FUGs are not authorised to use and manage NTFPs if a provision is not included in the OP. Recently, however, with increasing awareness of the value of NTFPs, the need to better assess the status of NTFP resources is being realised. Several institutions have started to conduct training and participatory research, facilitate enterprise development and species-specific management techniques, prepare growth and yield databases, and promote resource-monitoring practices (NSCFP 2001; ANSAB 1999; Dangal 2002; Subedi *et al.* 2000; Luintel and Basundhara 2002).

Linked to some of these initiatives, three case studies related to NTFPs resource assessment were selected for analysis and discussion. The three cases together represent various ecological contexts (Case 1 – middle hills, Case 2 – high hills, Case 3 – Terai). While the socio-economic contexts also differ among the three ecological regions, a key institutional factor common to all was that they were facilitated by NGOs. Furthermore, all initiatives emerged from a concern about the sustainability of commercially traded species. Species used for subsistence medicinal purposes were also considered during assessment in Case 3. In terms of plant habit, Case 1 focused on a shrub, Case 2 on a herb, and Case 3 related to a number of herbs. One of the authors had direct experience with the two cases (1

and 3) in terms of designing the methods and guiding the fieldwork, and information on Case 3 was obtained from documented information and interaction with those directly involved in the process.

### Case Study 1: Developing methods for resource assessment, Dolakha [Adapted from Ojha *et al.* 2001]

Bhitteri Pakha FUG of Dolakha district in central Nepal is located at an elevation of between 1,800 and 2,600 m.a.s.l., with a total of 378 ha of forest area, managed by 243 households (Acharya 2002). Although the forest was handed over to the FUG in 1995 the stock assessment and management prescriptions for Argeli (*Edgeworthia gardenieri*) were not included in the OP. Argeli is a fast growing shrub with a unique triangular branching pattern. Whiteskin is extracted from steamed stem barks and exported to Japan, where it is converted to a high quality paper, which amongst other things is used for making currency.

The FUG wanted to initiate commercial activities based on this plant, and looking at the market prospects, establish a processing enterprise with support from the Asia Network for Sustainable Bioresources (ANSAB), an NGO supporting the group. The FUG needed to identify annual sustainable harvest levels for running the enterprise. So in early 2000 the NGO technical staff and the FUG representatives conducted detailed assessment of this plant resource to estimate the stock and yield. Since there were no previously tested methods the ANSAB technical team devised a methodology based on plant characteristics.

The field process of resource assessment was as follows:

#### 1. Preliminary mapping

A participatory map of the forest was prepared jointly by local village leaders and the NGO technical staff showing different forest types and conditions, indicating the distribution of Argeli, along with forest types and stocking levels. This allowed both the staff and the villagers to locate ecological details (such as forest types), geographic features (slopes etc.) and the management history of various blocks of community forests.

#### 2. Habitat mapping and area calculation

In the participatory map prepared, habitats of Argeli were delineated by ANSAB foresters and villagers. This allowed them to target Argeli areas, rather than the whole forest. The species is found only in *threemanagement* blocks out of 10 (21.5 ha out of 378.5 ha).

#### 3. Transect walk

NGO staff and villagers made a transect walk through the forest, recorded distribution and validated previous assumptions about forest conditions. Qualitative data on the condition of Argeli were collected, which was used later to show three density classes in the habitat map. At this

stage, density classes were designed based on the subjective judgment, not on objectively defined quantitative criteria.

#### 4. Determining diameter and clump size distribution

Since a key question of resource assessment was to estimate the number of stems by size classes, proportions of stems of different diameter classes (applicable though the whole forest) were estimated through a sample of 1,000 stems in 27 clumps of different sizes. The clumps were selected to include all clump size classes with the objective of getting clumps of various size classes rather than locating clumps in particular geographical points. The girth classes used for this purpose were: <2 cm, 2–4 cm, 4–6 cm, 6–8 cm and >8 cm. The number of classes was limited to four in order to minimise the cost in collecting data and efforts in data analysis, and to allow local users to understand as much as possible. These data were used to determine the diameter distribution curve (size and frequency were X-axis and Y-axis variables respectively). The clump size distribution was also assessed in order to determine a suitable clump size classification for the sample inventory. Four classes of clump size were determined keeping the method simple as well as fairly accurate: small (<15), medium (15–30), large (30–45) and very large (>45).

#### 5. Sampling and measurement of clumps

Taking a sampling intensity of 1%, the sampled plots (plot size: 400m<sup>2</sup>) were allocated proportionately (in terms of Argeli habitat area) to the three strata delineated on the stocking density map. The plots were located systematically using compass and tape across a fixed direction and interval. In the plots, only the number of clumps (and not the number of stems) in each size class was recorded, keeping the method short and simple so that local users with low educational levels could also follow and apply it.

#### 6. Estimation of total clumps (by size class) and stems (by diameter class)

The data from the sample inventory were used to estimate total number of clumps by clump-size class for the entire habitat area. First, the number of clumps in each of the four size classes were calculated by adding up entries in the data collection sheets. Then the total number of stems were calculated by multiplying the number of clumps and frequencies. And finally, the total number of stems were divided into the four girth classes using the 'proportion' or 'percentage' calculated in Step 4. The final output of this analytical step was a table presenting number of stems by girth classes.

#### 7. Projection of population

Using the knowledge of local villagers and after a discussion with the company wishing to buy whiteskins, two assumptions were made about harvesting criteria: an acceptance of 30% mortality of stems and 8 cm girth as the minimum size for the harvest. These two assumptions were used to project the stems distribution for ten years using spreadsheet analysis (see Table 1).

TABLE 1 Number of harvestable size stems estimated for the 10 years

Year	No of stems (> 8 cm)
2000	1,859
2001	1,735
1002	2,962
2003	6,664
2004	3,945
2005	3,945
2006	3,945
2007	3,945
2008	3,945
2009	3,945

Source: OP of Bhitleri Pakha 2001 quoted in Acharya 2002.

#### 8. Estimation of sustainable yield

The number of stems greater than 8 cm in girth were estimated using the projected population. The output table gives number of stems that can be harvested and the quantity of whiteskin produced annually. It was recommended that cutting would be controlled by size and not by rotational area – resulting in all stems above 8 cm girth throughout the forest being harvested annually (rather than using rotation period to move through blocks). This was partly dictated by the market requirement of 8 cm or higher girth classes of acceptable stem whiteskins. It was estimated that between 41 and 187 kg of dry finished bark per year could be harvested (average dry weight per stem is 22.05 gm) (Operational Plan of Bhitleri FUG 2001)

#### 9. Prescribed harvesting techniques

It was recommended that stems less than 1.5 m in length, even if greater than 8 cm in girth, should not be used for processing but may be used for preparing new plants through cuttings.

#### Case Study 2. Developing Sustainable Harvesting System for Jatamasi, Humla [Adapted from ANSAB (1999); Ojha *et al.* (2001)].

ANSAB (1999) documents a case of biological monitoring linked to a community-based ecosystem management project in the western Himalayan district of Humla, Nepal. The project aimed to promote sustainable use of medicinal and aromatic plants through creating economic incentives for local people. Although people in the region had a long experience of collecting plant products for local as well as commercial use, the project did not have any convincing basis that indigenous harvesting practices were optimal in terms of productivity and conservation impact. The project undertook participatory action research to identify the best harvest intervals and collection methods for four commercially harvested medicinal plants, including a well-known rhizomatous herb called *Jatamansi* (*Nardostachys grandiflora*), by incorporating a five-year biological monitoring plan.

While the five-year monitoring plan was prepared to assess the outcomes of various harvest intervals, the project team also developed a rapid method to find an optimal harvest interval using indigenous knowledge of the local people engaged in resource management. Under the rapid assessment, three patches (I, II and III in Table 1) harvested previously in three different years were located with the help of collectors, and two more were identified for subsequent harvest treatments, which the project could monitor directly. The results were analysed to assess the effect of harvest intervals across the two habitat types – bushy cover and open ground. Applying the same harvest levels as villagers had used before, in two newly selected sites, the five patches were harvested according to rotation periods of five, four, three, two and one year in a period of two years (see Table 2 below). This allowed the project team to record the annual yields of fresh *Jatamasi* roots and rhizomes for up to five years of a rotational cycle within a period of just two years.

TABLE 2 Times of annual harvests by observation years

Observation year	Number of times of annual harvest by observation years for different patches				
	Patch I	Patch II	Patch III	Patch IV	Patch V
1995/96	2	1	0	0	0
1996/97	3	2	1	0	0
1997/98	4	3	2	1	0
1998/99	5	4	3	2	1

Source: ANSAB (1999)

The analysis revealed that the yield increased significantly until four years of age. In the fifth year, the yield increased but not significantly. A harvest interval of five years was therefore recommended.

### Case Study 3. Participatory Biodiversity assessment, Nawalparasi [Adapted from Neupane and Ojha (2002)]

In 2002 participatory action research was conducted by the NGO called ForestAction with Sishwar FUG in Nepal's central Terai district of Nawalparasi. Its purpose was to develop a methodology for integrating biodiversity and livelihood concerns in the context of community forestry, and to facilitate community actions on conservation and management of a diverse number of NTFPs including medicinal plants, which was not addressed adequately in the FUG operational plans.

The learning process supported the FUG to identify issues/problems, make an action plan and initiate action to address the problems, monitor the actions, and then reflect/share results and improve future actions. It was carried out through an iterative series of meetings, using a range of participatory techniques, which analysed resource system in relation to the broader socio-economic reality. Researchers from ForestAction took the role of facilitator, while local communities defined the method and scope of actions.

The community forest is a small patch (about 25 ha) of riverine forest along the bank of Narayani river, one of the biggest of Nepal's rivers originating in the high Himalayas. Although the forest was handed over in 1995, the Operational Plan did not contain adequate details of biological resources available in the forest. The FUG consists of six ethnic groups, some indigenous to the riverine locality and some who had migrated from the hills, thereby combining different perspectives, values and interests in different components of biodiversity.

Since the project was mainly related to developing a methodology to integrate a broader spectrum of biodiversity values in the FUG planning and management process, the focus was on helping users to identify, assess and prioritise NTFPs on the basis of resource abundance, subsistence (medicinal, food etc.) in addition to market values and the potential of domestication.

The actual steps in resource assessment were as follows:

#### 1. Discussion with FUG leaders

Researchers discussed the existing resource management practices with FUG leaders and representatives of various hamlets, and identified resource information gaps. Through this, the users realised that there was too little information about the forest in their records and plans, which motivated them to take detailed account of the biological resources available in the forest.

#### 2. Participatory mapping

With the help of community representatives, FUG committee members and other interested persons, the overall distribution and abundance of various biological resources were located in a sketch map. These data indicated the type and stock of biodiversity resources in the area.

#### 3. Stratification

Based on the information recorded on the map, the community forest of 25 ha was divided into three strata of different sizes, mainly using the criteria of forest cover.

#### 4. Sampling and plot lay out

Ten circular plots were laid in the three strata, allocating at least two plots in each stratum. The size of the circular plot was 5 m radius. This plot size was considered adequate for herbs, climbers and shrubs, to which the resource assessment was targeted. The total number of plots (sampling intensity) was kept relatively small, as the purpose was mainly to identify and list the available species, rather than quantify them.

#### 5. Measurement

The local representatives and the research team completed the intensive assessment of resources in the community forest jointly. Recording was carried out by research staff, whereas local users identified plants, local names and uses with assistance from a local herbalist.

Data was collected on species names and plant numbers, to calculate density and abundance.

### 6. Analysis and feedback

Qualitative analysis of information was carried out jointly by the researchers and local users, including listing the herbs, climbers, shrubs, and trees by species and their uses. Users were surprised to see the diversity of plant species in such a small and seemingly low density forest, as most of them were used to paying attention to only the big trees. Quantitative analysis led by researchers included calculation of stocking levels (number of plants per ha). The analysed information was useful to FUGs when prioritising species (depending on abundance and potential of expansion), and led to proposals for revision of the Operational Plan.

## ANALYSIS AND DISCUSSIONS

This section presents the strengths and weaknesses of the three cases, and then analyses the learning aspects of these initiatives.

**Case 1** The methodology was strong in various aspects: a combination of ecological knowledge relating to the plants in question with quantitative techniques (such as estimating stem proportions in various girth classes); emphasis on measuring easier and economic (i.e. less costly) variables (i.e. clump size, instead of individual stems); development of estimating models linking measured and difficult-to-measure variables (number of stems estimated from number of clumps, and bark weights estimated from number of stems by size class above harvestable sizes); use of multiple sources of information and ideas – ecological theory, quantitative techniques, local knowledge and market requirements. Likewise, focusing measurements in effective areas only (i.e. habitats of Argeli) was also a strong element, because of which the inventory was carried out only in about 5% of the total forest area inhabited by Argeli.

The initiative could have further been improved in various aspects. First, despite recognizing uncertainty as regards the mortality rates of the plant, there was no clear plan developed to test the assumption of 30% mortality. Likewise, the prescription of cutting is not accompanied by a plan to assess the impact cutting has on regeneration and coppicing ability, rate of growth, optimal percentage of cutting in a clump, differences in population distribution patterns that affect the sustainability of Argeli management.

The documentation of the detailed process/methodology was weak which limited sharing with local forest authorities and other institutions. The design and implementation of protocol was led by an external technical team allowing only limited room for local users to articulate their perspectives. While the emphasis on quantitative data (such as number of stems) estimation of yields, allowed biometric analysis, there was no concurrent attention to collect qualitative ecological features – such as the relationship between site characteristics and growth characteristics, light conditions, and other plant associates, which are central to designing sustainable harvesting techniques.

In **Case 2** there were several innovative ideas. First, linking a monitoring plan with project activities provided an opportunity to understand the natural resource dynamics, including the impact of harvesting on plant populations. The approach to resource assessment combined both quantitative as well as qualitative data, relying on local knowledge of resource dynamics and harvesting practices.

The project team pinpointed uncertainty about the sustainability of existing harvesting practices from the outset, and decided to test through experiments. They also looked beyond the issue of immediate concern – the harvest intervals, and discovered other dimensions of sustainability such as the season and method of harvesting. The documentation and record keeping was also strong, which facilitated communication of the findings.

Despite these strengths, the process was mainly driven by an external project team, with the aim of developing more generic conclusions. In doing so, a number of variables (such as aspects, slope, soil type) were controlled. While this approach is likely to result in useful understanding and prediction models at larger geographic levels, it may not be specifically useful to local resource users and managers due to the highly generalised conclusions and limited articulation of local knowledge in the process. The overall process was not iterative, with limited opportunity to provide feedback backwards.

In **Case 3** the methodology had both strong and weak points in relation to the approach of adaptive management. The methodology explored local perceptions and values of biodiversity as it was understood that these guide peoples' attitudes and behaviour in relation to resource management. The first step towards more effective management of biodiversity was to explore these values, and facilitate negotiation of values held by different groups of people within the FUG.

The method was iterative and flexible, allowing users to move back and forth between the methodological steps. This meant that, for example, group and sub group meetings to explain perception and biodiversity values were combined with the process of resource assessment. However, it did not make experimental comparisons focusing on generating answers to identified questions. The qualitative data and insights did not allow rigorous quantitative analysis, which was also constrained by a low sampling intensity and subjective plot layout.

The extent of, and approaches to, the learning behind the initiatives was then assessed. This comprised focusing on the extent to which each case study conformed to the learning based approach of adaptive management (Table 3).

### Learning by planning

The three initiatives vary in recognizing the uncertainty that a planned methodological protocol leads to intended results, and identifying and using questions as a basis for learning. All cases used several assumptions and yet did

TABLE 3 Summary of learning approaches in each of the case studies

Key elements of the Adaptive Management Approach	Summary status		
	Case study 1	Case study 2	Case study 3
Extent of learning by planning (including identification of learning questions)	<b>Medium:</b> identification of learning gaps in some aspects before completing the project (such as making assumptions of 30% mortality of <i>Argeli</i> ), but the whole process was controlled by learning questions.	<b>Medium:</b> identification of learning gaps (such as assumption of equal intensity and method of harvest in previously harvested areas) but this was not considered a question of further learning which could increase the reliability of the method used.	<b>Medium:</b> emphasis on facilitating local groups to develop learning questions. Despite having a research question on developing a methodology, the project team did not question various tools and techniques to achieve this.
Extent of experimental strategies adopted	<b>Low:</b> no replication of the method or any specific elements of it planned or reported (focusing on <i>Argeli</i> ). There is a system of feedback between steps (iterative) but not experimental	<b>High:</b> adopted experimental framework to analyse yields (harvest intervals versus yields). Complemented by a more rigorous monitoring plan. Structured to allow statistical analysis.	<b>Low:</b> highly iterative but not experimentally structured to answer questions or test hypotheses.
Degree to which relevant system variables are considered in the analysis	<b>Medium:</b> consideration of cost factor and local capacity (to understand and use) in designing methods. Focus on single species.	<b>Low:</b> control of factors (aspects, slope, soil type etc.). Focus on generic model applicable to wide locations. Multiple species considered still within the commercial range	<b>High:</b> consideration of local perceptions, institutional capacity, political system affecting equity and resource access. Creation of various sub-groups to address various aspects of resource management – market, policy, resource, linkages.
Extent to which monitoring is designed and implemented (tailored to learning questions, if any)	<b>Low:</b> one time assessment, limited monitoring of consequences resulting from methodological actions, assumptions.	<b>High:</b> periodic monitoring but focused on certain variables, while controlling others. Monitoring less understandable to local users.	<b>High:</b> focus on self-monitoring by community.
Extent to which negotiations and compromises between various knowledge traditions takes place	<b>Medium:</b> use of biometric principles and local knowledge (but less than potential).	<b>Medium:</b> use of biometric principles and local knowledge (but less than potential).	<b>High:</b> application of ecological theory but not statistical analysis. Use and promotion of local knowledge.

not clearly spell out how they could have been tested through experience. In Case 1 several issues relating to sustainable harvesting of *Argeli* could have been used as learning questions, e.g. cutting impact on regeneration and coppicing ability, rate of growth, optimal percentage of cutting in a clump, differences in population distribution patterns and its causes. Some of these questions were recognised at the level of technical staff, but were not shared with the local users. The lower than ideal learning commitment in this case emerges from the project focus on enterprise based on the plant product being assessed, as both supporting staff and local users were anxious to start an enterprise. A possible connection that needs further testing is that when institutions are driven by outputs, rather than learning, the opportunities for learning may be reduced.

In Case 2 the project team hypothesised a linkage between existing harvesting practices and sustainability of the resource system, which prompted experimental analysis and monitoring. This drive to learn was actually a result of longer-term project commitment with an explicit focus on biological monitoring. This exemplifies a point that time and institutional factors are critical in order to have a more

learning oriented approach established.

Case 3 was different from the others in putting local people and their views of biodiversity first. This involved the community directly in the learning process and avoided extractive and biometrically rigorous procedures. The facilitators concentrated on the learning questions of local communities to know more about their resources, reflect upon their institutions, and explore market values.

In all three cases the projects were NGO-led, and were characterised by professional staff with a relatively higher commitment to learning when compared with staff working for government institutions. While this motive is partly a condition for the emergence of such initiatives, a project approach characterised by limited or finite time and resources, with definite results to be delivered, is often not conducive to learning (Biggs and Smith 2003).

#### Incorporation of experimental strategies

To improve learning outcomes, repeated experiences should be structured in an experimental mode allowing trends and causal connections between and among variables to be

established. Experimentation typically follows from the definition of a learning question, but in Cases 1 and 3, there is no evidence of experimental considerations made at any stage for any questions.

In the cases examine learning is not considered solely as a psychological and behavioural process, it has a dimension related to methodology of knowing; this means if one learns something, s/he should be able to demonstrate some connections between or among any variables in the system. Such variables may include one's own actions, that are undertaken anticipating some responses of the system. To demonstrate connections a valid comparative analysis of "with and without" or "with different levels" of variables is needed.

It was argued that iterative nature of a method alone, even with tremendous flexibility, may not help establish connections between variables, as the process of iteration may simply be a repetition of same thing or an unsystematic combination of different things (without experimental comparison). For example, the value of carrying out habitat mapping could have been better seen if outcomes were compared in different scenarios: such as with and without habitat mapping, or with habitat mapping and some of its close substitutes or competitor steps.

All the three methods tend to leave assumptions untested, although there are some opportunities to test. For example, in Case 1 the questions of harvestable size and mortality rates could have been tested in a participatory way by designing and laying out small plots for observation under different situations.

### Systemic consideration

The idea of experimentation is sometimes considered to run counter to systemic analysis, because to some, experimentation means to control certain variables and to see the linear relationships between targeted variables. Adaptive management considers system wide experimentation. In other words, application of a resource assessment method affects components of various subsystems – such as costs of adopting it, quantitative knowledge base required to handle it, the extent to which it draws on the knowledge of various actors, and serves their interests. If assessment methods are designed purely on ecological considerations, they can have disastrous but unconsidered connections with other variables, including the disempowerment of poor and disadvantaged groups.

The three cases of resource assessment initiatives implicitly or explicitly assumed external staff were the users of the process, with consequently higher costs, and handling capacity than local community users typically have. If the purpose is to assist local users then there is a question regarding the extent to which such methods would be useful to the community groups. In this respect, the seemingly simple approach used in Case 3 may seem more practical in terms of local relevance. Formation of specific sub-groups within communities to define the scope and process of resource assessment process in this case was a strong

point in bringing many socio-economic variables into the process, while at the same time following through the results and making necessary adjustments.

Market consideration has been a driving factor in the development of resource assessment. Argeli (Case 1), *Jatamasi* (Case 2) and *Pipla* (Case 3) that were the focus of resource assessment are all among the frequently traded species in Nepal. Given that the distributions of business opportunities are not uniform across the classes, castes and gender, external support in the management and expansion of commercial products, without serious concurrent political efforts to promote redistribution, may further raise inequity within communities (Ojha 2001a). Equally important is the possibility of ecological catastrophe that may result from over emphasis of one or more commercially important species, at the cost of many other associates, which form the part of larger ecological system.

However, an innovative aspect of the cases was the deliberate attempt to use prediction models (such as in the case of Argeli, where clumps were used to estimate stems and bark weights).

### Monitoring – information collection and analysis

The idea of monitoring stems from the need to test assumptions for learning (Ojha *et al.* 2002a). As such, this depends partly on the personal commitment to learn among the actors involved, and partly the institutional structure dictating the individual behaviours. The two initiatives (Case 1 and 3) are actually a one-time assessment, as they were conducted in a short time frame (less than a year). Case 2 is stronger in having monitoring element over a longer time, primarily because of a five-year project in place.

Documentation provides an important monitoring tool. In all three cases, there was both a documentation requirement, and relatively strong documentation skills among the staff involved. In addition, in Case 3, an explicit emphasis was on facilitating self-monitoring by FUGs themselves, apart from information gathering carried out by outside researchers.

### Negotiation between various knowledge traditions

The issue of managing knowledge while developing NTFPs management innovations is critical, as there are at least two different strands of knowledge involved: local knowledge, and scientific knowledge. While to some extent they may complement each other, there is definitely an area of conflict between the two. For example, for a resource method to be more biometrically reliable, a more rigorous protocol of sampling and analysis is needed, which is not likely to be understood by local forest users, and may also be costlier than local users are willing to pay. Since local communities need the outputs of resource assessment for use, usability of the methods should be prime criteria for methodological innovation.

All the three initiatives used local knowledge as a basis but the extent of external support provided during resource

assessment and planning was high in all cases. This seems to be mainly because outsiders wanted to conduct more rigorous analysis of data using sophisticated techniques (which was the case in three initiatives). But no method fully considered the biometric rigour, as the method of determining sampling intensities was only arbitrary without using any random techniques.

The cases described suggest that local knowledge has contributed more on qualitative aspects, while external researchers collected and analysed quantitative data. This was partly because of the regulatory emphasis on quantitative information, and the better quantitative skills of outsiders.

## CONCLUSIONS AND FUTURE DIRECTIONS

This paper has presented and analysed three case studies on the development of NTFP resource assessment methods in Nepal, in the broader institutional and ecological contexts. The analysis focused not on contents or outcomes of such methods, but on how 'conscious' they are in terms of learning. This is because the learning dimension is critical in the face of the diversity of products and limited prior documented knowledge with regard to NTFPs management in Nepal.

Due to increasing subsistence as well as commercial expectations from NTFPs, the need for assessment and identification of sustainable harvesting options has increased. Sustainable NTFP harvesting requires analysis of multiple dimensions, both social and ecological and balancing participation of local communities with biometric rigor in sampling and analysis. Indigenous NTFP knowledge is often extensive and may provide a basis of scientific inquiry as well as a provisional harvesting plan, but indigenous knowledge may not be enough in a situation where commercial harvesting is a recent phenomenon.

The analysis of cases indicates that they have significantly innovative characters in understanding the complexities of NTFPs resource management in Nepal. These include: use of indigenous knowledge and wisdom, experimental monitoring of resource dynamics, integrated analysis of ecological and social factors (recognition that sustainable harvesting has multiple dimensions to be considered, particularly the use of quantitative as well as qualitative information), identification of learning questions to guide observation/monitoring during action, use of simple prediction models, and creation of specific institutional arrangement to look after the issue of resource assessment and sustainable harvesting.

However, several aspects still need improvement. The methods are based on assumptions, which are not systematically tested. Having a monitoring plan for this is the exception rather than a rule. Local knowledge still seems to be treated as being of peripheral importance, and used mainly to develop an understanding of the site features at the beginning of the resource assessment process.

While the recent shift to participatory resource management is undoubtedly an innovation in approach to promoting conservation and livelihood, methodologies for NTFPs resource assessment and techniques of sustainable harvesting are usually either based on local perceptions alone or scientific ideologies imposed from outside. Biometric adequacy in one time measurement is not enough; it has to be approached through adaptive management in a dynamic context. There is still a paucity of innovations that combine participatory methods with scientific techniques. Efforts to combine biometric rigor with local knowledge should seek to maintain biometric accuracy as well as empowerment of the local resource managers. A strategy of enhancing the use of local knowledge is to promote context-specific innovations rather than generic protocols targeted to wide range of locations.

Methods of assessment and sustainable harvesting of NTFPs have to be site and product specific to address both ecological and social considerations. Institutional and policy frameworks should encourage testing of new ideas and close scrutiny of commonly held assumptions. These cases demonstrate the need for a diversity of resource assessment approaches to respond to specific plant form and product types, as well as a holistic consideration of social and ecological factors to address often ignored dimensions of sustainable harvesting such as season and techniques of harvesting.

## ACKNOWLEDGEMENTS

We would like to thank Ram P. Acharya and Hari Neupane for their inputs in the methodological design and sharing of field experiences on Case 1 and Case 3 respectively. The first author also thanks Himlal Shrestha for sharing his experiences in Case 3. He is indebted to the critical but very useful comments of Anna Lawrence and two anonymous reviewers. Likewise, the first author thanks ANSAB for providing him with an opportunity to test and develop the method in Case 1. He is also thankful to Whiteley Awards foundation, UK for providing financial support to test and develop methodology in Case 3. Cynthia McDougall and Krishna Paudel deserve thanks for their comments on adaptive management. Finally, we both feel indebted to ForestAction, who provided us with the opportunity to undertake the analysis and write-up.

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