INTERNATIONAL WORKSHOP ON ECOLOGICAL MONITORING

PROCESSES, PROCEEDINGS & PROTOCOLS

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All photos by Keystone Foundation

A. 1. WHY ECOLOGICAL MONITORING?

While working on Resource Assessment issues of Non Timber Forest Produce (NTFP), **the translation of the findings or the handing over of the process of monitoring to the stakeholders is always a challenge.** This pack is a condensation of many processes. There has been for a while now, a loud call by eco-enterprises and harvester groups for clear guidelines in ecological monitoring.

History & Context

The Beginnings of the Knowledge Network: A South-South field Workshop on monitoring of NTFPs used by people

This is a proposal for a field workshop of applied scientists and local resource users from South Asia and southern Africa as part of a "knowledge network" focused on ecological monitoring, that combines formal scientific monitoring with participatory monitoring by local resource users. In South Asia and Southern Africa, people are facing similar problems: how to deal with policy bans on harvest by State conservation or forestry authorities? The solutions they are coming up with are similar in some cases, and creative and very different in others. Exchanging experience in a field situation will provide long-lasting links for a "knowledge network" sharing experience on these questions. With support from well established mentors working in this field, it can also provide encouragement to young scientists and a "critical mass" of interest in participatory work with local people. Part funding for a workshop has been secured from IDRC, with a focus on medicinal plants. Given the importance of medicinal plants such as Phyllanthus emblica and Cycas species in the Western Ghats and Nilgiri Hills, there is an opportunity to maintain the focus on what Keystone and ATREE have been doing.
- Excerpts from a Concept note by Tony Cunningham

The idea for a workshop of this nature was also discussed at the same time by participants of International Development Research Center's (IDRC) Medplant Network. Through an e-discussion that spanned several months, we discussed the major issues relating to use and conservation of medicinal plants, and concluded with plans for a south-south cross-regional workshop exchange on issues relating to the conservation of medicinal plant resources. A discussion between three organizations (People & Plants International (PPi), Ashoka Trust for Research in Ecology and Environment (ATREE) & Keystone Foundation (KF) took place to discuss how to approach a workshop and exchange. Given many of the similarities in wild plant harvest between south India and southern Africa, it was decided that an exchange between these two areas would be particularly fruitful, and IDRC agreed to fund this initiative. In one of the villages Samaigudal, that KF works in, some questions were raised which lead the way to this process.

View from Ground - Basic Questions & Observations

- *Keystone is providing key baseline and management data for the Forest Department and community. They are now building community monitoring capacity which could improve terms of trade.*
- *Monitoring will facilitate an improved relationship between the community and the forest department, and thereby reduce the "fear" element.*
- *Locals had no idea that there was a Nilgiri Biosphere Reserve. This, coupled with an apparent lack of any sense of scarcity, suggests that they might well not understand, or share, the need for monitoring. How does one engage communities in monitoring unless they have some questions?*
- *Are there young people in the community who might be directly involved in monitoring, after raising awareness of why and how – and ideally, local processing of results? This can raise questions re: scarcity in the future which people may not be aware of at present.*
- *The importance of resource maps and inventory data was made clear in two instances (1) the land struggle, (2) negotiations with the Forest Department. By generating these maps and implementing a monitoring plan, the villagers can show the FD that sustainable use of the forest is possible, and that they have the knowledge to manage it. We heard about a plan to compare their, indigenous, zonation with the FD's. With the monitoring results, they will be able to make a case if the FD sets the NTFP harvesting quota too low, or too high. (It's not clear if the villagers are aware of or understand these potentials).*
- *Can monitoring be built onto existing traditional leadership roles?*

These questions raised early set the thoughts about a rationale for monitoring that took all role players together.

Goals

Our plan is to approach Ecological Monitoring (EM) through three different stages, thereby achieving the objective of demystifying the science of Ecological Monitoring and establishing linkages with other stakeholders to formulate practical, beneficial, and robust guidelines that are executable by the community, traders, NGOs and researchers. The aim of this project is to make EM viable. Challenges and potential benefits within the project as Outcomes will be:

1. EM is beneficial to harvesters as a tool for better prospecting and conservation of species / populations for sustainable long-term use.
2. Products resulting from an EM regime might attract a better price in the market due to its value as a fair-traded ecological product. An EM brand gets a better price.
3. EM might be beneficial to traders as these products are from "safe areas" –harvesting does not harm other species – both animal and plant. Trader gets access to a Green label through EM.
4. EM is useful to the consumer who buys the product from the shelf – as he/she is part of a network promoting conservation through purchase of the right – value produce.

5. EM works for the scientific community – through a validation of what the community does, the market needs and the consumer demands. The protocols then will be well-calibrated and internalized within the community. Empirical data will show the trend of convergence (if any) between community perceptions and scientific studies.
6. EM, depending on its robustness and ease of use, might be incorporated in Forest Department working plans – for the forest guards, Village Forest Council members and others to implement and coordinate in the field. The village Forest Council / Village Protection Committee / Vana Samrakshana Samitis are local bodies organized by the Forest Departments of the State to facilitate the implementation of the Joint Forest Management or Participatory Forest Management Policy of the State. These councils have a lot of privileges and powers but lack the tools to make effective use of the P&P.
7. EM incorporates aspects of biological conservation and thus allows for the dual objectives of conservation and income generation.

Pre-Workshop Brainstorm

A meeting was held in early May 2005 at the Keystone office with representatives of ATREE, PPI and KF. We started by sharing our experiences on monitoring asking the question 'why was it important at all for communities to be involved in EM '.

- Tenural security,
- Open access to forest areas,
- Linking conservation values to enterprise

Value of EM

Communities are also interested when their product gets a higher value, productivity rises because of sustainable harvests and lessons learnt on better methods are shared. Monitoring also gives an idea of how soon we need to make an intervention.

Present day forest managers have constituted village forest councils; this broadens the term 'communities'. Many are grouped into these councils not because of any traditional linkages but mostly owing to their proximity to the forests. Therefore it can only be through some structured EM that informed decisions on productivity take place. In many cases forest products are undervalued as against agricultural produce.

Instead of asking traditional communities to monitor like Biologists we should be giving them an incentive to monitor in their way but sharing that information within themselves and with other role players. They may not be monitoring species but the whole system around that particular species. We still haven't understood why in so many cases the NTFP species prefer disturbed habitats and seem to do better when harvested.

When we monitor we leave out monitoring of the Markets. Markets very much control the harvests and an appropriate intervention can contribute to sustainable harvests. Markets also tend to scuttle the customary rights that a certain community may have.

The EM workshop needed to touch upon 3 aspects:

- Science of monitoring
- Markets
- Traditional monitoring mechanisms

The workshop would bring together harvesters, traders, biologists, Forest Department, field and policy level decision-makers and Voluntary agencies working with these issues. Invitees would be from South India, Southern Africa, and two from East Africa. The focus would be on participatory ecological monitoring of non-timber resources, with a special focus on medicinal species.

The idea was that during this workshop the outputs from the protocols would be shared and improved. Linkages between community monitoring and scientific monitoring would be discussed and analyzed through working groups. The workshop would also bring Village Forest Councils (VFCs) to discuss how they perceived the role of EM and how best to dove-tail EM into their present activities and strategies. These would culminate into the framework for a Field Course, its contents, level of practice and teaching, possible field sites, and the hypotheses that needed to be tested.

A. 2. WHAT ARE WE LOOKING FOR?

- How best to develop adaptive management plans for non-timber resources?
- What scientific tools can be used to gain insights for sustainable harvest?
- How does ecological monitoring aid the gatherer community?

- How can conservation concerns link to local livelihoods and enterprise development?
- How can monitoring be placed to have cross linkages to assessment, productivity, value addition of resources, trade, markets and lead to a better policy that ensures the three principles of Biodiversity Conservation, Sustainable Use and Benefit Sharing

Expected Outcomes

1. *A "resource pack" would be prepared as a reader for all participants before the course by People and Plants International This reader would provide up to date and relevant materials related to ecological monitoring, participatory approaches;*
2. *Greater recognition amongst policy makers that sustainable use is possible and that links between local livelihoods and conservation can be an important conflict resolution exercise;*
3. *Awareness of the health issues related to Cycas seed consumption (negative effects on the nervous system due to cytotoxicity) and therefore the need to avoid seed harvest for food – leading to better conservation outcomes.*
4. *Shared ideas and understanding of applied methods used in adaptive management.*
5. *Development of a strong "knowledge network" alliance which can share information of "what works when, where and how" and of new technologies that can be used to raise the profile of research results for policy reform*

A. 3. PLANTS, HONEY, LICHEN & ROOTS, ETC – HOW DO WE MONITOR IN THE WILD?

- Cover scientific and indigenous methods of estimating production, extraction and regeneration of the product. This would be helpful to understand the sustainability of the product.
- Focus on the relevant species in Western Ghats and Southern Africa and use the same format.
- How to make the protocols more "cross-cutting". While we know that protocols for species harvested for the same part will need to vary according to each species due to their differences in life history, environment, harvesting patterns and socio economic factors etc , it would still be really useful to have a 'base set' of protocols that make sense for each category of part harvested. These can then be specifically adapted to each species.
- Come up with a 'base set' of protocols for each plant part harvest, in the drafts, then in the workshops and in the drafts we would work on adapting these to the specific Western Ghats and South African species with the help of all the participants.
- Approach of "generic" (or "base") protocols, followed by case specific examples relevant to the WG or Southern Africa would be good - this avoids a "one size fits all approach" which can lead to problems in the complex world we live in.

Therefore what we would have, would be:

1. A base set of protocols based on literature, other studies and experiences for each plant part (including a list and .pdf files, if possible, of articles written on harvest of specific parts)
2. A set of examples of how these can be specifically adapted to fit specific species (these being WG and SA species)

The advantage is that these could be applied:

1) The protocols adapted for the specific species could then be used for the field training courses with the VFCs and forest managers

2) Generalized protocols that we can later apply to other species, or importantly, that others elsewhere can use as bases to apply to other species.

(Both incorporating technologies, local perceptions, markets etc)

B. 1. Applications and Approaches to Ecological Monitoring

- One of the **reasons to do monitoring** is to be warned early – that something might need to be done, e.g. with slow growing species that reproduce only with seed, if the seed is being harvested. On monitoring methods – some of the suggested methods (e.g. Wong 2001) were too expensive to be practical. Better to find other ways, e.g. cards with photos for easy identification by villagers, palm pilots using only icons and local knowledge and skills – Tony Cunningham, Ppi

- IDRC's medicinal plant network was keenly interested in developing some **generic protocols** for key species that could be used after some fine tuning from site specific examples – Tamara Ticktin, Ppi

- **Community Based Ecological Monitoring in India** There are no efforts at ecological monitoring of the NTFP harvest even by the so-called managers even though some NTFPs (the nationalized ones) are very high revenue earners. **Traders** have small margins too, have storage problems and suffer losses due to perishability, which leads to a lot of **wastage of NTFP**. **The time** incongruity of **manufacturers vs. harvest** is that production is regulated whereas collection is **seasonal – creates price fluctuation**. Collection is also all by organized by tender – so control on the collection process and quality thereof is minimal. Produce from the forest, we always want to have it at the **lowest price**, that's still the perception of it - if its wild, its free and abundant, and these **perceptions create problems** (or at any rate determine) what happens – Snehlata Nath, KF.

B. 2. Sharing of Experiences

Experiences from India and South Africa: On important commercial species and the procedures that were in place for monitoring through NGOs like KF, Research organizations like ATREE and Government agencies like the National Biodiversity Institute of South Africa.

Monitoring Honey Bees - Pratim Roy (KF, India)

- 4 indigenous honey bees: *Apis dorsata*, *Apis florea*, *Apis cerana*; Dammer bees. Himalayan bee does not occur in this part of the country, and *Apis mellifera* (introduced).
- The maturity of the honey or the right season for collection is indicated by the change in shape of the comb.
- Indigenous knowledge on the bees exists - there are names for the cliffs, e.g. a cliff where the bees sting a lot, near a water source. It is possible to get a lot of information about the habitat of the bees from the name.

Has there actually been a trend seen as a result of the work of Keystone? There have been some trends seen – in some places moisture content which is the thumb rule we use to keep a tab on quality varies in some places number of colonies, and they are able to trace the trends to areas and thence to practices of harvest also.
Are there changes in the use of honey? A lot of honey is used in community, historically and now. Also they now value add the beeswax and sell it; earlier they would just use it for barter. Traditional food utilization of honey continues. Some honey is kept for the village's own customary uses.
What percentage of harvesters in your area do you end up working with? Keystone is one of the top 5 people taking honey from the harvesters in the Nilgiris.
A certain amount of training for moisture content, time of collection, farming co-ops/societies, etc has been going on in Madurai, Dharmapuri, etc.

Cycads – Domitilla Raimondo (South Africa National Biodiversity Institute- SANBI)

- Cycads: one of oldest plants that exist; one of the most threatened also. They are very long lived. Much traded and much used for medicinal use. Conservation of long-lived plants is a challenge.
- Did the study to see if one could generalize a method to assess sustainability across the array of life histories– 30 years adulthood with a single cone to 400-500 years with multiple stems.
- With the faster growing species- 10% adult harvest still gives growth, but more than that leads to rapid decrease. With the slower growing species – even 10% adults harvested brings the populations crashing down. Harvesting seeds makes little difference.

Devil's Claw – Domitilla Raimondo (SANBI)

- A plant harvested in the Kalahari, grows only in very dry areas.
- The plant is harvested, medicinal value brought to light by Germans in the 40's and there is now an international trade in the species.
- The tuber is the part used, the secondary part can be used and the primary/mother tuber if put back the plant can re grow. Unsustainable harvest involves not replanting the mother tuber. The sliced dried tuber is exported as is, but in the West used as a good medicine for rheumatism and arthritis.
- A study to find out resource status, found that Namibia, Botswana and S. Africa didn't even know how much of the plant they had, how much was being harvested.
- Huge fluctuations in the demand because of regulation and other things such as whether *Medicaid* would pay for devil's claw have meant lot of uncertainty for sustainable livelihoods.
- Useful characteristic- grows well where grazing is very high – doesn't compete with grass very well. But the price per unit time spent to collect is very little.
- Over 80% of harvesters are women, over age of 40. About 3000-3500 harvesters.
- The agency does some training, managing and monitoring of harvest. Also suggest that people collect in groups so they can monitor each other for replanting the primary tubers.
- In Namibia the trade is much more difficult to manage because it's very remote and no roads. The traders just drive out with harvesters, and there is no attempt at sustainability. There has been an attempt at training where they are even more strict, allowed to harvest only half the plant and during the dormant season.
- Got organic certification, but doesn't make much difference to the demand – people seem to bother about organics for food but not so much for medicine, and there isn't a sustainable harvest, biodiversity friendly label that can be used instead.
- The plant is sold at local village medicinal markets at **10** times the price it commands in the export market!! The traditional use is that strong! But it's not a large enough market, so attempts need to be made to develop the local markets.

Collection of Amla fruit from BRT Wildlife Sanctuary – Siddappa Setty (ATREE-India)

- Collectors give visual estimations of what is available in terms of bags; we have to convert to kilos values. Lately they have said that they don't need to specifically go to the forest to do estimation, they go to the forest regularly anyhow for fuel wood and other needs and have regular estimates generated that way.

How do you handle the problem of when traders bring in outsider labourers who clean out the forest in 2 days flat? In RF areas where it approaches a free for all, it can pose a problem; in this situation training for sustainable harvest, etc. might not mean much. In some places where local institutions are strong, having rules such as no harvest allowed before onset of season can work. It's not foolproof, but there are some arrangements possible.
Are there traditional systems governing times of collection? e.g. in Orissa, before 15th April no one can pluck a mango. In shifting cultivation areas, before a certain festival crop can't be harvested even though the crop may be ripe in the field? In BRT, it's decided by LAMPS calling the tender also, but there are restrictions around festivals in the month of March as well.

Alternative Approaches Opening A Wider Arena for Monitoring - Vivienne Williams -University of the Witwatersrand, School of Animal, Plant & Environmental Sciences, South Africa

Instead of monitoring from the source/ origin of the plant or animal product, looking in markets at the sizes of barks that were harvested for medicinal plant trade in Namibia can also provide an idea of sustainability

Able to classify and assess the impact of harvest on the populations from where the harvests could have taken place.

Monitoring – inside out

Traders being from KZN province meant that the home location of the sellers was different from the province where the sale was taking place, up to a quantum of 97%!! But not so many went back home to harvest, so the area where they were selling can be surmised to be hard hit by the collection. Bark study – appears that in Malawi, Zambia and Mozambique sell much more root than bark, which is a problem. Also Faraday and Durban seem to be wholesale markets.

Monitoring of the age of tree whence the bark was taken done on basis of thickness of bark. But thickness of bark diminishes considerably (and not in a regular or proportionate fashion) with the time since it was taken, so can't do a straightforward calculation of how old the tree was based on the bark thickness. A predictive table was done, and with that it was estimatedf what the size class was which was being taken from most for supply to the market.

The forest types are mixed or distinct areas where you find specific species? The trees would mostly be wild, not plantation. A lot would be coming from PAs too.

The estimation of diameter based on bark thickness is complicated because people will collect from small branches and roots too as price go up.

Traditional healer institutions may not be the route to go for managing the resource. Diviners, who are more influential, and mostly women and go through a rigorous training process, may be the place to start. But then doesn't always work, the diviners will refer you back to the traditional healers associations – medicinal plant trade and everything associated with it has become highly politicized in South Africa.

Peris Kuruiki, Kenya Resource Centre for Indigenous Knowledge (KENRIK), National Museums of Kenya, Nairobi, Kenya, East Africa

The projects arose out of awareness of different attempts by research group, policy group and communities. Communities and research groups had made a lot of progress, but without any influence on policy. The Network project was launched in 2003. There has been progress, but the **bringing together of stakeholders can be painful and protracted process**.

Documentation was done on testing the toxicology of potions in *Luo-suba and Kamba* communities in western Kenya. There was also a focus on conservation and prioritization of medicinal plants.

Do you have a system of traditional medicine documented and systematized the way we have Ayurveda? No system comparable to the Chinese or Indian traditions. Most of Africa, with the exception of Ethiopia, there hasn't been a tradition of writing down these diverse traditions. Doesn't detract from the diversity of the traditions though.

There seems to have been a diversity of methods used, and there must have been a huge amount of information generated just by use of e.g the ethno botanical surveys and the ground-truthing. We are hoping to **develop a national ethno botanical**

database, into which this information will feed, it is currently being stored at the KEFRI and Museum. Conservation surveys are being developed into manuals and guidelines for prioritization and management decisions.

How many people interviewed? 721 TBAS and 80 odd healers. This many TBAS because this was a particular focus of the project, and also because in Kenya it has been discovered that mothers prefer to be attended by TBAs.

What were the results of the toxicity testing? The real traditional healers (i.e., not quacks) use toxic plants but at concentrations that are not toxic. There is a possibility of their being harmful if the concentrations were not carefully monitored. In India, there are a lot of herbal and medicinal products sold, and it is often advertised that compared to allopathic products there are no side effects. Is this true? This is most probably a myth. It's usually the quantity of something that decides whether it's a poison or a medicine.

Harvesting impacts of selected medicinal species in the Lowveld, South Africa + socioeconomics of trade: implications for ecological monitoring - Jenny Botha - University of the Witwatersrand, South Africa

- To gain an improved understanding of market dynamics , biological status across different land regimes and look at harvest impacts.

Resource users were TMPs, patients, gatherers, vendors, traders, general public who were cash and time strapped, vendors: cooperative/competitive relationships. TMPs often not paid; ambivalent position in society.

Market dynamics: High demand, High volumes traded, Extensive linkages, Pricing.

Availability and demand:
No relationship between species availability and price.Non-significant increase in price with increased demand in Limpopo. No relationship in Mpumalanga. In both, species used to treat children more expensive; those used for anti-social purposes sometimes considerably more expensive.

Consumer behaviour: Consumer resistance to higher prices. 'Free, good? but people often could not afford to pay more for products, apart from special products. As an alternative to higher prices, harvest from wild (local species) or do without.

Summary of key findings:

- Harvesting pressures relatively low however, increasing to meet demand from metropolitan markets as their original sources become depleted.
- Vendors collected illegally from private forestry land, legally from land under Traditional Authorities.
- Harvesting methods varied – often unsustainable
- Habitat loss more of a threat to certain species e.g. *Catha edulis* and *Rapanea melanophloeos* than current levels of harvesting.

- Some populations of fast regenerating species tolerating current levels of harvesting for medicinal products, but those harvested for additional products often pressurised (e.g. poles).
- Harvesting patterns – extent and degree usually related to accessibility - distance from villages, communal land.
- Species in protected areas not necessarily doing better than those on privately owned land e.g. forestry and game farmers.

What does this mean for NRM initiatives in the subsistence sector, particularly ecological monitoring

- High price/kg in markets cannot necessarily be translated into profits : price/unit.
- Higher prices for 'ecologically approved' medicinals in this sector could well place products out of reach of those who most need them.
- Could possibly use the concept that plants that are harvested sustainably are more powerful medicinally as an incentive.

Ecological Monitoring

- Sheer numbers and socioeconomic circumstances would make it challenging to develop ecological monitoring programmes with vendors and gatherers without financial benefits (cash and time strapped; tenure issues; competition).
- Access to plants on private land could provide an incentive.
- Might also be possible to develop E.M. initiatives with some private land owners and TA's, employing local, unemployed plant specialists to monitor plant populations.
- But : how to pay for it in communal areas?
  - Income from harvesting fees +
  - Contribution from corporate social responsibility funds in private sector +
  - Additional income generating initiatives (e.g. mass cultivation of fast growing, popular species for markets)

(However, TAs unlikely to be prepared to lose harvesting fees.)

Rhoda Louw – Interventions with Wild Rooibos - INDIGO development & change, Nieuwoudtville, South Africa

Wild Rooibos suffers because there is only a small niche international market for it. It is **severely under studied** there are only 4 academic papers to be found on the plant.

Climate change makes a difference also to the pests that are prevalent at different times of year, so the old systems of managing pests not working anymore.

Is there a mix of small and large scale farmers in the co-operative? Who's driving the move to certification? Does it pay off? Who pays for the certification? What are the farmer's perceptions of organic and fair trade?

Organic grew out of the need to find a way to differentiate themselves from the other tea traders who held the monopoly on the rest of the rooibos. They were organic anyway, so it fit with their way of life. The co-op members are very knowledgeable on their money flows, etc. and it's also an iterative learning process for the members. The organization pays its own fees for certification now, but it is a very expensive process. They get 4 rand per kilo more than other farmers for their tea. The fact of the S African standard actually being higher than the Fair Trade standard means anyone can get the fair trade label, and the large farmers getting the label will mean the Small scale farmers will lose the advantage they have hard won.

Since there is no sustainable harvest certification label, which in this case is the USP anyhow, they are placed at a strange sort of disadvantage due to the existence of the certification/labeling scheme.

Is there a perceived difference between the wild and the cultivated, as there is in India, that some consider the wild resource purer? Earlier the cultivated variety had higher status, but now the cultural status of the wild variant is being reinstated. The emerging problem seems to be that the Fair trade people are trying to set a minimum price, which could be lower than the prevailing price the farmers from the cooperative get!! These can be the messes with the northern markets and such organizations lowering the bar seem to not be very fair.

Experiences from India with regard to the roleplayers in trade of NTFP-

Winfred Thomas, an academician from Madurai, Tamil Nadu, South India who feels he can get to see the **positive as well as the negative sides of the NTFP trade**.

In the course of botany fieldwork found out that the Paliyan community who are more or less bonded labour in the area. They know no cultivation. 50 years ago they lived in rock crevices; now temple authorities have got them to live near the temple to help with temple activities. Traders have started paying them a little bit to get them to collect medicinal plants and other plant materials in and around the area. Landless labourers are also a target group, poverty is the main push factor for these people to be collecting medicinal plants.

Found the trade is not consistent. Trade in a particular plant will last for 3-4 years, and then it switches to another plant. Trade secrets include where the plant is available, when to get it, how much to lift, when to lift, where to take it, all closely kept information within a clan/kinship networks.

Made Gowda a harvester and office bearer of the LAMPS (a governmental agency set up for the trade of NTFP, Karnataka, South India) and a member of the Soliga community of the BR Hills feels that the market for NTFP was small before the LAMPS came in. ATREE helped to **build capacity of harvesters** and to reform LAMPS.

Once a month there is a LAMPS meeting and tenders are called for on a regular basis. The tender is given to the highest bidder. There are 862 members in the BR Hills LAMPS.

Questions and Responses:
Has LAMPS been effective in getting the Soligas a higher price for the NTFP? Ambiguous answer- he says they must sell through LAMPS, and will not answer about if they want an option to sell to any other entity. Wouldn't it be better if they could interact with the buyer directly instead of through the LAMPS directors?
What do they feel about the control of the FD on the resource and the trade? They feel pleased that the rich who would get timber and other material from the forest are now out of the picture and it's in the hands of the FD.
Have they ever tried to cross check the weights of the trader who gets the tender, to see if the trader is using the weights right? In BRT, its doing well, but everywhere else in South India it's doing pretty badly.
Has the LAMPS ever rejected any material that's come to it? No, never rejected.

Mihir Jena from RCDC – an NGO, Orissa, Eastern India

RCDC is working in Orissa and has approached the issue of NTFP by making sure that the prices **are not controlled by arbitrary role players** – Though there are several marketing units in Orissa who were active in the NTFP trade in the state, those agencies couldn't really do justice to the primary producers. With PESA, the Gram Panchayats got the right to fix the price of NTFPs in the locality and no one can sell below the fixed price. This could not work but due to lack of attention to empowerment to the Panchayat about how to police this price fixing; in the end primary producer was still at the mercy of the trader. RCDC has stepped in to try to help panchayats and primary producers to a) set the price, b) negotiate with the traders. RCDC's Lotika resources helped to connect the trade houses with the informal coops, and through this the intermediaries to some extent could be kept at bay.

PAs still pose a problem. There are arbitrary decisions governing collection and sale of NTFPs in these areas that play havoc with people's livelihoods.

RCDC has tried to establish a market promotion board consisting collectors, Panchayat representatives and government agencies. This has started working in Raigada and Kalahandi districts and hopefully this model will work.

The challenge remains ensuring that the **primary collector gets a fair price**. The Panchayat setting the price has also treated it as an arbitrary task just to be completed. Wrt getting information to the primary collector, RCDC has set up information feedback with a District Coordination Committee with representation form different departments at the district level in regular meetings; and put up the prices information fortnightly on www. banajata.org

Experiences of harvesters from South India:

Indrani, with ITWWS- NGO- Chengalpet, Tamil Nadu, South India

We do a lot of herbal medicinal collection we do this **harvest very carefully**, keeping even hair covered so that nothing gets mixed with the medicine. We make sure that people who are ill should not collect, menstruating women should not collect. We used to harvest seeds, flowers, tubers. If there are a lot of seeds, we don't harvest what has fallen on the ground because there needs to be regeneration. We leave some of the flowers and some of the tubers, for the same reason. We have **a right to collect NTFP**, and the FD and district administration knows that, and we don't face problems in this regard. We used to catch snakes for venom extraction, but it's not possible to collect snakes without licenses. We are hunter-gatherers. We still hunt animals such as rabbit and porcupine, and leave pregnant animals.

Irulas are well known for treating ailments and as healers. The snake venom production is more recent. SHGs have allocations for collection based on need. There are other income opportunities for them, such as the nurseries, etc. they don't have a need to over harvest. Nor to enter the 'mainstream' of commercialized medicinal plant production, wherein the medicinal plants have pesticide residues even in them.

We have a license for preparing Irula tribal medicines; we have a facility for preparing and processing the plants in hygienic conditions. We even help regeneration to the extent that if there are too many saplings under an adult tree, we will transplant some of them.

Can anyone in the community collect or are there person specifications as to who can collect? There are no such restrictions, anyone can collect.

Lakshmi – Specialized midwife – ITWWS, Chengelpet, Tamil Nadu, South India
After the sangams have been formed, anyone belonging to the community can collect. Earlier only elderly people used to collect. There are various **rituals and salutations** that must be gone through before going for collection/hunting. A certain song reciting names of a thousand or more names of plants that lasts about 6 hours has to be sung on certain occasions.

We maintain a register of what collected, how much, when, what quality. Also talking about improved methods of harvesting bark, etc – e.g. applying a paste of soil to a bark extraction wound to prevent fungal infection. They are thus well aware of improved harvesting techniques.

Come and see what we do, and take some seedlings from us, go and plant them in your homes!

Rasu - Honey Hunter from the Kurmba community, The Nilgiris, Tamil Nadu South India.

Before honey collection we **worship the honey cliff**. We never use any iron on the cliff or the comb, it has to be bamboo. We use only a certain plant for the smoker. Instead of harvesting twice a year, we harvest only once a year when the honey is matured since the other way affects sustainability of harvest. If there are 30 combs, we take only 20 and leave the rest for perpetuation of the population.
Questions and Responses:
Do you leave the 20 because you can't reach them? No, even if we can take it we leave it for reserve because we have to come back next year.

How do they know if they have already worked a hive or if it is a fresh one? In a cliff hive, it's almost impossible to take only the honey and leave the brood portion. Thus in a cliff hive you have to

take the whole hive (whereas on a tree you can scoop out the honey).

Do you get a difference in your income by harvesting once rather than harvesting twice? If they take it twice a year, the yield is dropped considerably for the next year [they are looking for maximizing long term rather than short term harvest levels].

Are there honeys that are used for medicinal purposes and can't be sold commercially? There is a bitter honey from the Syzygium flower, but it doesn't cause diarrhea or anything.

Is there any Tenural system on the cliff hives? Of the 20 hives that are left on the cliff, would anyone else come collect them? Or is it only you guys who have right over them? There are marks left on the cliff, which marks that this cliff has been collected. There is village ownership over cliffs. Rasu's community is the only one in the village to collect there. There are limited numbers, so they all know each other and that's why they don't transgress that much. Plus on these cliffs it's a highly specialized activity.

Does the younger generation fancy this occupation? He hopes that some of his kids would like to do honey collection for his life…one seems to be interested. Since it's an occupational group in the village as a whole, some kids are likely to be interested to take it up. Indrani - no matter how far our kids go from our tradition, when they come back we will be very happy to teach them.

What trends have you seen w.r.t the number of hives in your area in the last 20 years? Rasu hasn't seen any reduction in the number of bee hives.

Janaki – from the Kurumba community, Nilgiris, South India **- We collect soapnut, soapberry and amla**. Have to **observe certain rules** of cleanliness etc, when collecting the amla. We also take cycad fruits when they are the colour of ripe areca, we leave the more ripe ones which the bats eat and they regenerate around our village. The seeds that we collect are ground into flour and steamed and eaten as a cake. We also take the tender leaves of the cycas, cooked and eaten as spinach. We leave the protective leaves but those coming from the town don't bother with those niceties.

S. Ganesan-Kani community, Kalakad Mundanthurai Tiger Reserve(KMTR), South India – Hearing these people, I get the knowledge that they are well off w.r.t. collecting from the forest, I on the other hand am not allowed to do any of these things since KMTR was declared. Now only honey and resin from *Canarium strictum*. An unsustainable harvest of the latter, so now I am only left with honey. I don't want to sell it to the first person who comes; I would like to wait with it till I can take it to the town or get a good price- though I don't have the opportunity to have formed collectives like those here.

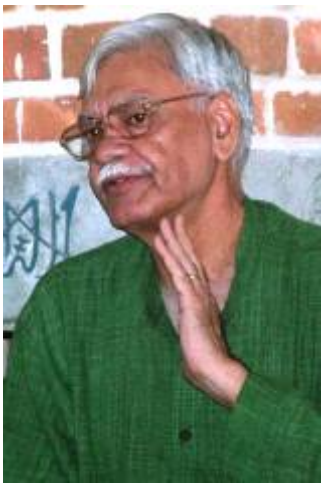
Questions and Responses:
Are your children interested to harvest honey? Yes, without my knowledge the kids got together and harvested the same way we do. So there is every chance that they will take it up. We follow the same techniques as Rasu and others for harvesting.

P.P. Hegde, Indigenous Farmer from Sirsi, Karnataka, South India

The FD has established a system that puts someone between the collector and the trade; there is now a barrier in the trade. The contractor is awarded the auction and pays a certain amount for the contract. He makes some money – the collectors don't make as much money as the person in the middle. The amount that the FD gets is very small – the money is made neither by the FD who owns the forest, nor by the collectors who live in it. Finally the effect on the ecological condition is negative, because the contractor is not interested in the ecological condition. It becomes open access because all he is interested in is getting all there is to harvest in a particular year. As a result, people harvest immature fruit (first person to the tree kind of scenario), chop branches, all sorts of destructive stuff. Instead of this, there should be a village level committee that gets access to trees within a certain radius around the village. There is **a sense of belonging with the people for the forest produce –** affection would develop.

Forest Manager's session : Interactive sharing through questions and answers

K. C Malhotra, Resource Person, India



Is there actually only one manager or are there more who are concerned with NTFP/biodiversity/natural resources. We have first the Forest Department – a centre and then state department.

- Within the FD there are **multiple managers** at different levels:
  - Range officer,
  - at beat level there is beat guard,
  - at state there is PCCF,
  - Ministry of Environment & Forests at the Centre.

We therefore have a very big structure in place – thousands of managers whose task we are talking about. Looking more closely, while these managers have a critical role, there is little focus on NTFP; mostly on timber and large animal species.

In most states we now have federations who purchase NTFP. The nationalized NTFP have to be sold compulsorily to the federation and the rest can be sold on an open market. The GCCs etc also exist (different from marketing federations), and neither have any monitoring mechanism of any sort. Then there are the park managers. **Still no monitoring**.

The **Joint Forest Management** cells at centre and state are monitoring the institutional aspect of JFM, but not the status of the NTFP. Pharmaceutical companies are also managers. They are the end user (or thereabouts) for so many products. They should be managing, but many efforts of engaging them have resulted in naught – no company is interested in monitoring. They are only interested in being able to procure, from wherever in the world they are able to get it.

Traders have been mentioned, who in many ways are managers too. One positive development is that the National Biodiversity Authority (NBA) and the NBSAP under the CBD are requirements. With the establishment of the NBA there is now one agency with a mandate to monitor the biodiversity in the country, across all levels of diversity. It is now mandatory to prepare biodiversity registers for villages under the establishment of the NBA. The register process and manuals thankfully are well established.

On the **tenure** question, JFM allowances for territorial control combined with the **people's biodiversity register** mechanisms (under the Biodiversity Act) are powerful for creating a space. Remember as we develop the protocols etc. that we have to work with the institutions around JFM and such like that have been set up and are managing forests. Working plans, including micro-plans under JFM, are a good tool.

The **micro-plans** are currently mainly budgetary allocation oriented, i.e. there **is scope for improvement there**.

Prodyut Bhattacharya, Indian Institute of Forest Management, Bhopal, India

There are several decisions managers make day to day that affect the **Tenural rights of tribals at a village level**.

Management is closely tied in to tenure – e.g. *Boswellia serrata* is well managed for gum, because families own the trees, while the certain gums are harvested indiscriminately.

There are policy problems as well – re. **Nationalized products**. NTFP has also become a political issue. The dimensions of this are huge. e.g. in Madhya Pradesh *amla* was nationalized for 3 days and then a lobby stepped in immediately to get it de-nationalized. Management/sustainability of course suffers.

There are also **difficulties in monitoring** that managers face that are almost impossible to overcome – e.g. DFOs need to give letters of proof/export passes for Ashvagandha, as to whether it is being sourced from an agricultural field or forest. Unless the DFO **tracks every piece** of Ashvagandha from its point of origin- clearly impossible, this information **cannot be reliably** had. In many places the boundaries for micro-level managers, including JFM, are not clear at all.

Working plans currently do not have instructions on what to do about/with NTFPs. It is beginning to emerge; **hopefully we'll have it in the next ten years**.

The territorial department is responsible for collection. In states where there are no federations, the territorial and production departments are doing the buying – they realize they need to develop a business model keeping the sustainability aspect in the forefront. There are many models, e.g. co-op model, GMCL, Chhatisgarh model. The responsibility to develop a business model can't be left to the FD alone.

Certification – can be at two levels, product and habitat certification. Manager's perspectives are important here – they should give due weight to certification, involving local communities perceptions, priorities, etc. Certification should not be confined to an FSC type endeavour, certification standards and schemes should be locally developed. Managers though are not trained for meeting certification requirements they are trying to assess production levels of NTFPs in various different situations. **Database development on different aspects of NTFP** is needed.

P. N. Unnikrishnan, IFS, Kerala Forest Department, formerly Chief Conservator of Forests, Participatory Forest Management

In **Kerala NTFPs are handled by the co-ops**, creating all sorts of confusion and the FD is unable to impress upon the co-op department the **need for sustainability**. Tree farming is a traditional part of Keralite culture.

The situation in 1998 was that the FD was skeptical of communities adhering to PF – they thought the communities because of heightened political atmospheres would overrun the forest. But the WB project wanted to do PFM, and eventually the government relented.

A Manual for Gene Pool conservation Areas is being prepared – **bringing together tribal/local knowledge and scientific communities** to identify areas that need special protection for genetic conservation.

On the issue of Scheduled Castes' collection of MFP – SCs are tribal for all practical purposes it's just a series of historical accidents that have made their labels different. Yet tribal ministries, etc. are not able to appreciate this, leaving the SCs disadvantaged on counts of participation in PFM, being allowed to collect MFPs, etc. In some places where there is no tribal population, only SC, the SC can't collect or manage - the tribal population comes in from far away to collect.

Is there scope for training programmes in Kerala to take the primers on NTFPs further?

It's possible in Kerala, where there is a lot of shared work between NGOs and FD, etc. can't say for other states. Still need prescriptions to be arrived at jointly between scientists and managers and harvesters.

We need post-graduate/higher **education for Natural Resource Managers** specifically, akin to the specialized training received in management institutes. Also on the subjects of value addition for forest products, is it possible to develop a plan of action to bring the tribals up to a place where they can make management or value addition interventions such that they can take over the space currently taken by private traders? So as to ensure that the returns accrue to those who actually need and deserve them most?

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B. 3. Top Tips from the Workshop

Rules need to have teeth. An example is of Bwindi Impenetrable National Park where the access was suddenly stopped; and after a long consultation process multiple use zones were decided and rules such as that honey hunters could not trap animals. Someone disobeyed, and was fined banana beer and a goat – a huge amount relative to the income.

A summary of the workshop or as Tony put it twelve "top tips" serve as take home messages

WHY THE INTEREST IN NTFP'S

- *Worldwide, 1.6 billion people rely on forest resources for their livelihoods;*
- *NTFP harvesting for commercial trade is a common entry point into the cash economy for millions of rural poor;*
- *1.2 billion people in developing countries use trees on farms to generate food and cash income;*
- *"Minor" forest products can have MAJOR importance, economically, socially & ecologically.*

COMMON KEY QUESTIONS (CONTEXT: SUSTAINABLE USE & EM)

- *What context will support EM protocols?*
  - Policies, institutional context & tenure
- *What should be monitored & who should do the monitoring?*
- *What synergies are there between formal scientific approaches & knowledge of harvesters?*
- *How do we scale up ecological monitoring?*

Twelve Top Tips

1. NEW POLICIES, IMPORTANT OPPORTUNITIES

- *Biodiversity Act (South Africa), 2003, SANBI*
- *Biodiversity Authority (India), 2003*
  - Policy link through State Biodiversity Boards to District & local levels through Forest Department;
  - Role of People's Biodiversity Registers (PBR's) & synergy with Gene-Pool Conservation Areas.
- *Global Strategy for Plants Conservation (2004)*
  - 16 targets, link between EM, livelihoods & sustainable harvest.

2. LAND & RESOURCE TENURE & LOCAL INSTITUIONS ARE CRUCIAL

- *Clear boundaries & secure tenure (guided by customary tenure)*
- *Homogenous communities & specialist user groups (eg: ITWWS)*
- *Outsider "resource miners" detectable;*
- *Penalties: rules must have teeth;*
- *Conflict resolution mechanisms;*
- *State supports decentralized control: but plays a crucial role when support needed (technical, law enforcement).*

3. SELECT SPECIES & SITES

- *Choose indicator species - you can't monitor everything;*
- *Local resource users do monitor….but less formally (eg: Acanthaceae)*
- *Monitoring can be done by different people in different places, through partnerships:*
  - Forests (FD, researchers, local harvesters);
  - Markets (researchers, traders)
  - Industry bodies (GMP, GACP)

4. NTFP CERTIFICATION IS NOT THE MAGIC SOLUTION

- *Only provides a "softer" market when the market cares*
- *Costly for small-scale producers unless group certification schemes are possible.*
- *Two main incentives crucial for producers: access to a wider market & premium above market price*
- *Need for simplification & international standards*
  - Fairtrade & Organic simplest, FSC more complex & geared for large scale producers, geographic origin an option
  - Many FSC current certifiers unused to complexities of small-scale NTFP trade

5. PRACTICAL TRAINING

- *EM tools available for NTFP's, but less known or little taught in forestry colleges or universities;*
- *Field courses & learning by doing, with local people: we need to finalise & disseminate protocols;*
- *Interdisciplinary skills needed:*
  - Systematic ethnobotanical surveys of markets & trade;
  - Sensitive &insightful interactions that integrates local harvester knowledge into research, monitoring & management (eg: rooibos tea)

6. USE APPROPRIATE PRECISION

- *Forestry & conservation organisations: may have funds for random plots & statistical precision but rare in high diversity sites;*
- *Rapid surveys together with harvesters better than nothing & a valuable source of information (eg: Devils claw study);*
- *Don't forget landscape level events.*

7. CLOSE THE DIGITAL DIVIDE

- *Communications technology*
  - (cell-phones & e-mail)
  - E-libraries & e-learning modules
  - "virtual voices" (research results, training & consumer awareness)
- *Resource assessments & monitoring*
- *Processing technology (value adding & time-saving)*

8. DEVELOP INCENTIVES TO MANAGE, NOT MINE RESOURCES

- *Producer associations in southern Africa (low impact harvest, local resource users (not contractors), local value adding)*
- *Avoid situations where tender processes & outside interests create incentive to overexploit resource for short term gain.*

9. PAY ATTENTION TO MARGINALISED GROUPS

- *Who? Landless or living in landscapes with low arable potential (arid, high mountain, sub-tropical/tropical sands)*
- *Ethnic minorities*
- *Women & children as important NTFP users*

10. LINK MICRO TO MACRO-LEVEL PLANNING

- *Mapping technology (PRA maps at micro-level into larger scale maps for resource management plans)*
- *Monitoring in markets gives a bigger picture due to extensive trade networks*
- *Recognising & planning for land-use change: need to maintain not just evolutionary & ecological processes, but also social & cultural ones (eg: beekeeping)*

11. PLAN WELL & GET THE RIGHT SUPPORT

- *Good communication & appropriate tools (eg: radio, TV, VCD for small-scale audiences);*
- *Plan well, as powerful interests are involved with high value products (eg:* Catha edulis*)*
- *Think & plan over a realistic time-frame (8-12 yrs).*

12. YOU CAN MAKE A DIFFERENCE

- *Visionary individuals, with a clear plan can enable great positive change;*
- *New forms of netWORKing, linked to practical problem solving can build "critical mass".*

B.4. Ways forward- from your perspective, how do we take this forward?

3 broad highways – Tony's summary gives us a foundation of where we are and where we can go from here, how we can go forward.

- FD plays a huge role, whether we like it or not. Unnikrishnan can from a perspective of the southern states speak about how to change governance for ecological monitoring of NTFPs; KCM can give us a national perspective on it
- what is our plan for ecological monitoring in our sites?
- markets and product development, and showcasing how what we do makes a difference.

Unnikrishnan – FD isn't really interested in ecological monitoring yet. But research must be done with the FD because researcher can give only an academic perspective. FD must be part of it because they own the areas; they must be in a joint negotiation place as primary stakeholders and communities as also stakeholders. FD is unlikely to undertake this with their limited finances and resources, need external support to

take it on. Maybe MoEF can be the locus of support, but state departments can't afford it.

Ecological monitoring will be successful if tribals come together under FPC banners rather than the current societies that are more concerned with trying to get more agricultural land. A concept of Tribal Development that has a meaning of "forest living in more meaningful ways" has yet to develop. So far it still means replacing the forest with something else.

KCM – the 1988 Forest Policy gives us a nice swathe of space for ecological monitoring, where it says it will maximize the conversion of non-tangible benefits' to tangible benefits. Another window of opportunity is the National Biodiversity Authority and the People's Biodiversity Registers. We also need to have manuals for monitoring and present them to the NBA for wider dispersal.

There are opportunities too – in the KFD, e.g. there are score cards etc for monitoring JFM institutions a necessary corollary to the ecological monitoring. These can provide pointers to build on.

A pictorial manual for local people's monitoring activity should be prepared, to facilitate for community based monitoring. But a monitoring protocol should be situated within a much broader socio-economic-political context. Maybe we could go through the PBRs manual (CES's manual, which covers all three), and find the space for the manuals etc. that we will come up with as a result of the work in this project.

Plan of action for developing the product – use the India wide network to get the diversity of perspective and experience, and use the Africa experience that is here as well.

Ideas –

- Formally establish an Ecological Monitoring network and platform
- create a performance indicator type of approach based on the twelve tips that Tony listed
- Make a primary list of dos and don'ts (like the resins dos and don'ts), then give a species specific set of guidelines – making it a workshop output rather than a proposal for another project.
- An exchange visit? S. Africa might be able to learn a lot from the level of advancement that India seems to be at in terms of work with communities.
- Other steps needed to complete the protocols: more inputs from the harvesters; Field course; case studies
- The manual should be made by people in the field

One of the things we have learnt from the S. African work is that ecologists have taken the route of looking at things through a market, or trader or other such lens, instead of how in India the protocols seem to have been concentrated on landscape only, or genetics only, or populations only. None of the perspectives the S. Africans have taken have made them less of an ecologist in any way.

Lets pinpoint cases to start work with, expanding from the two organizations who have currently been doing it to those doing more livelihoods work, so as to have more 'good examples' to showcase when we eventually take it to the NBA. Going from the NBA first seems to be grabbing the wrong end.

In southern S. Africa, we have actually managed to forge good partnerships in all government departments, which have worked very well for the area. And identifying champions to work with can be a very powerful strategy.

Outputs/outcomes will be:

- Manuals and other outputs from the workshop
- Concept paper including others such as ITWWS.
- Working with champions concurrently.

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C. 1. INTRODUCTION

Sustainability is commonly viewed from an ecological perspective in terms of plant or animal populations. Thus, a sustainable system for harvesting MAP is of often defined as one where fruits, seeds or other plant parts can be harvested indefinitely from a set area without detrimental impact on the structure and dynamics on the harvested plant populations (Peters 1994; Cunningham 2001).

This definition, however, does not take all the necessary aspects into consideration. What is needed is a sustainable harvest approach that takes **four interlinked scales** into account: (1) the landscape level; (2) the community and ecosystem level; (3) the plant population level and (4) the genetic level (Noss 1990). For example disturbance processes can directly affect sustainable harvesting through the influence of disturbance on some plant populations. Positive links between plant diversity and disturbance factors, including medicinal plants such as *Arnica montana* in traditional meadows in Europe are a good example. In these systems, annual mowing and seasonal grazing by livestock without artificial fertilizer inputs enable diverse and often rare species populations to thrive (Ellenberger 1999; Myklestad and Sætersdal 2004).

The susceptibility or resilience to collection pressure of MAP can be assessed based on a number of criteria. The seven forms of rarity described by Rabinowitz (1981) make clear that a species which (i) has a narrow geographic distribution, (ii) is habitat specific, and (iii) has small population sizes everywhere, is more easily over-harvested than species of any other pattern (Table 1).

Table 1. Seven forms of rarity (after Rabinowitz 1981)

Geographic distribution			
	Habitat specificity		
		Local population size	
Wide	Broad	somewhere large	***least concern***
		everywhere small	
	restricted	somewhere large	
		everywhere small	
Narrow	Broad	somewhere large	
		everywhere small	
	restricted	somewhere large	
		everywhere small	***highly susceptible***

In addition, the susceptibility or resilience to collection pressure varies among species owing to biological characters such as different growth rates (slow growing vs fast growing), reproductive systems (vegetative or generative propagation; germination rates; dormance) and life forms (annual; perennial; tree). Species can be distinguished quite well in their susceptibility to over-collection if their life form and the plant parts collected are viewed together (Table 2). For example, harvesting fruits from a long-lived tree presents a far lower threat to the long-term survival of the species than does collecting seeds from an annual plant. In the latter case, if the seed is gone the plant is gone. In some cases the harvest impacts are more complex, e.g. with slow growing trees which reproduce from seed but only produce few, large fruits (example: *Araucaria araucana*, monkey puzzle tree). This will increase their susceptibility to over-harvest from low to medium or even high. A thorough summary of predictors of resilience or vulnerability to harvesting wild populations is presented by Cunningham (2001).

Table 2. Susceptibility of species to overcollection as a function of Life Form and Plant Parts Used (from Cunningham 2001)

	Wood	Bark	Root	Leaves	Flower	Fruit / Seed
Annual	---	---	High	Medium	Medium	High
Biannual	---	---	High	Medium	Medium	High
Perennial	---	Medium	High	Low	Low	Low
Shrub	Medium	Medium ?	Medium ?	Low	Low	Low
Tree	Medium	Medium ?	Medium ?	Low	Low	Low

Overall, species most susceptible to over-harvest are habitat specific, slow growing and destructively harvested for their bark, roots or the whole plant. These species suffer most from harvesting and many of them have been seriously depleted, for example *Prunus africana* in West Africa, *Warburgia salutaris* in southern Africa and *Saussurea costus* in the Himalaya.

Community-based monitoring of MAP

A community-based monitoring approach that takes the **four interlinked scales** into account can play an important role in ensuring long-term local conservation of susceptible MAP and other culturally and economically important wild resources, as well as of local livelihoods. For example, it is often the case that different stakeholders involved in MAP harvest (harvesters, traders, managers, biologists..etc) monitor resources in their own ways, but this occurs as disjointed processes (Table 3). Effective community-based monitoring, however, can allow for information flow among the different stake-holders and in this way lead to diverse social and ecological benefits over the long-term (Table 4).

Table 3. Monitoring is typically carried out by different stakeholders as disjointed processes so that the flow of information is restricted. Community-based monitoring should allow for the flow of information across all the stakeholders involved.

Stakeholders	Type of monitoring usually practiced
Harvesters	Maturity, time for harvest, viability of harvest (worth time/effort)
Traders	Yields, markets, trade routes, selection of harvest groups
Forest managers	Yields, as well as weeds, fire, parasites
Scientists	Regeneration, population dynamics, productivity, harvesting methods; usually in protected areas and results are not shared or implemented

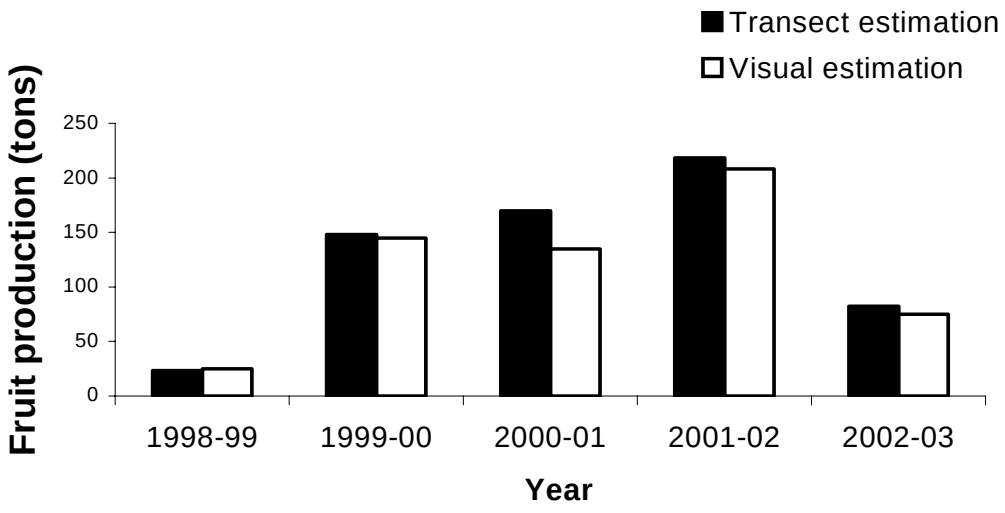
Table 4. If carried out effectively, community-based ecological monitoring should provide benefits for all stake-holders involved

Potential benefits provided by community monitoring	Description
Information for sustainable resource management	Monitoring provides key baseline and management data for both communities and managers, using methods appropriate for both
Formation/strengthening of partnerships between communities and managers	Monitoring provides a link between communities and managers and in the long-term can help to build partnerships. Link can help reduce the 'fear' and 'policing' elements common in community-manager relationships; in this way informed negotiations can take place
Formation/strengthening of partnerships between communities and researchers	Monitoring is internalized by communities through enterprise component and help build partnerships between communities and researchers
Improvement of trade	Monitoring provides ecological terms to improve trade by providing valuation for the product based on how much of the material is conserved
Increase in environmental awareness	Monitoring improves environmental awareness about larger ecological issues that are linked to local practices
Increase in understanding of sustainability on a larger scale	Monitoring allows for comparisons across resource rich and poor zones can allow for broader understanding of ecological processes and sustainability on a larger scale

One of the keys to effective community-based monitoring efforts is for the stake-holders involved to identify which monitoring methods should be used. For instance, the idea of community-based monitoring is not for local harvesters to necessarily learn to take scientific measurements, but rather for local harvesters to monitor according to local perceptions and measures, which can also be combined with scientific quantitative methods when appropriate. For example, for those MAP harvested for their fruits, the monitoring of annual levels of fruit production can be necessary. However, this does not necessarily need to be done by systematically counting fruit on subsamples of trees as would be done according to established scientific protocols. Rather, local methods of assessing fruit production levels can be used. For example, Setty *et al*. showed that visual estimates of amla (*Phyllanthus emblica*) fruit production by local amla harvesters are very similar to those obtained by systematically counting fruits, and therefore provide equally accurate and more appropriate and efficient tools for local monitoring efforts (Fig 1).

Fig 1. Amla fruit production estimated using the transect method (counting the number of fruits on each tree within a number of randomly selected transected) and using visual estimation by local amla harvesters (from Setty *et al.* in prep).

The identification of local/traditional methods of monitoring that are appropriate, effective and efficient needs to be carried out by working with the different stake holders involved to record local traditional knowledge and perceptions. Indeed, community-based monitoring is effective when the monitoring agenda is internalized by communities, traders, managers, scientists and has an impact on the valuation of the product (Box 1). For example, in the case of honey harvest in the Niligiri Hills, monitoring has been internalized though the enterprise component. Similarly, amla monitoring in BRT has been internalized by the LAMPS.



Community- based monitoring can be effective when…

- ✓ *Both commercial and subsistence NTFPs are monitored.*
- ✓ *Traditional Knowledge is incorporated into the parameters to be monitored. One can find thumb rules and simple quick methods.*
- ✓ *Target ecological processes (regeneration, mortality, fecundity) that need to be monitored are identified*
- ✓ *Ecosystem health is monitored simultaneously and when monitoring helps to identify gene pool areas that need to be maintained as well as target vegetation types for evaluation of harvest impacts*
- ✓ *Analyses of monitoring results are quick and translated for different levels simultaneously*
- ✓ *The monitoring agenda is internalized by traders / markets, communities, managers, scientists and has an impact on the valuation of the product*
- ✓ *Monitoring leads to new technologies /techniques that can raise the profile of research results for policy reforms.*

Base Protocols for Community-Based Monitoring

The impacts of harvest on any NTFP depends on the plant part harvested and therefore monitoring protocols should vary according to this factor. Of course, the impacts of harvest also depend on many other ecological factors acting at different scales,
as well as on socio-economic and political factors. Therefore a holistic approach is always necessary when carrying out community-based monitoring.

In November 2005 we carried out a workshop in Auroville, India, with NTFP harvesters, traders, managers and NGO biologists to discuss protocols for community-based monitoring. The current context of NTFP harvesting in India provides an important opportunity to develop of community-monitoring initiatives in this country (Box 2)..

The current context of NTFP harvesting in India provides an important opportunity to develop of community-monitoring initiatives:

- ✓ NTFP extraction occurs in both protected areas and non protected areas.
- ✓ Indigenous communities have traditional know how on regulating/ restricting harvests for some species but this knowledge varies across species and regions.
- ✓ The present day forest areas are managed by the Forest Department, which is trying to some extent to come out of their policing attitude.
- ✓ Community participation has been internalized in the Forest Department's management procedures by the constitution of Village Forest Councils.
- ✓ These councils are being given the powers and skills which the Forest Department had viz. of trading in the forest produce.
- ✓ Monitoring and sustainable harvests have not yet become their agenda. At this stage we should be able to devise a monitoring plan that can be taken up by VFC's and which will be translated into policy directives.

One of our objectives was to identify some monitoring methods or indicators currently used by harvesters that could be used for community-based monitoring and related adaptive management strategies – either alone or integrated with scientific approaches. To do so, we discussed series of questions with harvesters and traders that were aimed at bringing out knowledge and perceptions with respect to broader concepts of sustainability (at the population, community, ecosystem and landscape levels) (Table 5).. Note there are many appropriate questions that can be asked, these questions are examples of those that were appropriate in this context. In designing a community monitoring, the documentation and systematizing of local harvesters responses to these kinds of questions is an important tool.

Table 5. Questions aimed to bring out harvester and trader knowledge and perceptions with respect to broader concepts of sustainability. These perspectives should help bring about more cost effective and focused (to key species) directions for monitoring and related adaptive management strategies.

Question asked	Perceptions and indicators towards which the question is intended
What are the tenural considerations with respect to the species/ life forms that you harvest?	*Type of tenure is key factor in sustainability of any harvest system and needs to be identified from the start*
Has the harvested resource fluctuated over time, and if so, why?	*Is there a perception that fluctuation is linked to harvests, prices, scarcity etc?*
How do you tell if it is the right individual to harvest? Are there substitutes to the product in focus and what is the status of the substitutant? (adulturants)	*Might lead to indicators that that harvesters use to identify what is a good or healthy plant to harvest, and could therefore be used for monitoring; harvest/trade of subsistituents may serve as indicator*
When (and why) is it the best time to harvest?	*Perceptions of when plants should be harvested (and can be compared to when they actually are harvested)*
Who are the kinds of harvesters? (Perrenial, Oppurtunistic, Hired etc…..) Are their impacts different?	*Perceptions of what kinds of harvest methods/patterns are best or not*
What is the best way to harvest/	*Adds on to the above question, but more explicit; useful monitoring indicators can involve both ecological indicators on what a good or healthy plant is or needs, as well as the rates of 'bad' or destructive harvest*
How far do you live from the resource? Is there awareness about the disturbance to the resource?	*Perceptions and indicators at the landscape level*
How could we improve the harvests / how could we get more yield?	*Perceptions of what causes overharvest, if there is overharvest, and indicators or protocols for better management*
What are the biggest threats to maintaining or conserving the resource? How could we best save the resource base?	*Relates to the above question, but aimed to identify/include more socioeconomic and landscape level issues*
Can you predict productivity and what are your indicators?	*Indicators for what conditions are needed for good harvests*
What are the links of the species in question to other species?	*Perceptions on potential effects of harvest on plant-plant or plant-animal interactions*
What could happen within the ecosystem if the species in question was to become extinct?	*Perceptions of an ecological role the species could play, impacts at the ecosystem level*
How often do the prices fluctuate and to what extent?	*Perceptions of resource and market fluctuations over time*
Percentage of wasted produce – unripe, harvested in the wrong way, shelf life, transport… what is the reason for this wastage?	*Indicators that could be used to detect overharvest*

In the following sections, we present reviews the scientific literature on the ecological effects of harvest for each plant part. We then list the responses of the harvesters at the MAP workshop to the series of questions listed in Table 5, and based on these, summarize indicators that may be effective in each case. These are aimed to provide examples of ways to integrate scientific and traditional knowledge in monitoring protocols. Finally, for each plant part, we propose some suggestions for community-based monitoring methods.

These materials should be useful for local researchers, NGO biologists, forest managers and others who are looking to work with communities to help establish community-based monitoring. Each 'plant part' section has been written by a different person, and therefore they vary greatly in content and style and content. There are many diverse ways to go about community-monitoring and therefore the diversity of methods presented here should be seen as examples and suggestions based on what has worked elsewhere, each of which is appropriate for certain circumstances and should be adapted and modified to the local context.

Types of protocols that are used in community-monitoring of NTFP

- ✓ Use of PRA (participatory resource assessment), interviews, or discussion groups to document traditional knowledge, local activities that relate to harvest, and perspectives on trends in harvest, and current harvest methods. From these appropriate thumb roles and local monitoring indicators are selected
- ✓ Use of local indicators of resource condition and production such as visual estimates of production, size, colour etc.
- ✓ Monitoring of harvest *methods*, such as rating proportion of harmful harvesting
- ✓ Monitoring at the level of trade cooperative or at the market: colour, size, weight of plants harvested – i.e., a fundamental role for traders in monitoring.
- ✓ Use of plots or transects that allow for visual estimates and/or counts of annual production and regeneration levels.
- ✓ Recording of predictive signs such as rains or flower production to plan appropriate harvest levels
- ✓ Annual rating of disturbance factors perceived to affect (increase or decrease) resources such as fire or grazing
- ✓ Annual rating of habitat health, including perceptions of abundances of other animals and plants
- ✓ Annual community mapping of NTFP resources, indicating which forest areas have high and low MAP production for the current year and local estimates of production (using local methods)
- ✓ Pre and post harvest meetings to discuss monitoring outcomes, harvest levels and harvest outcomes and plan accordingly
- ✓ Local experimentation on harvest levels

C.2. FRUIT, FLOWER AND SEED HARVEST

An attempt to evolve ecological monitoring protocols should be truly encompassing of the complexity of ecological systems and the human societies that are using these systems. Currently ecological monitoring, as practiced, is reductionistic. We thus focus on the population harvested, on specific aspects of the population itself and measure how one variable in the population, be it seedling numbers or flower production responds to harvest. There are however more inclusive and diffuse, but not necessarily less dependable, methods employed by harvesters that might give us a clear picture of how species and ecosystems respond. More importantly these methods when combined with scientific methods might ensure that forest users will adopt and use these methods. We therefore need a mix of methods.

Rather than a comprehensive review of the effect of fruit harvest on the species or ecosystem I have attempted to provide some indication of the hypothesized impacts of fruit harvest. This will then enable us to identify indicators that might be monitored to assess how populations are responding to harvest.

The ecological impact of fruit harvest

There are several stages along the life cycle of an individual tree as it goes from seed to adult. An adult tree produces flowers which are then pollinated to produce fruits. The seeds fall or are dispersed to the forest floor to germinate. While some seeds die others germinate and grow through the seedling and sapling stage. The mortality at each step is high resulting in the establishment of only a few adults that then reproduce and the cycle starts all over again. Thus only a fraction of seeds produced actually survive to become trees.

Most studies on the impact of fruit harvest (Peters , Zuidema and Boot , Rai 2003) have shown that harvest of fruits has little effect on the population studied. These studies have used multi-year data on populations. Zuidema and Boot (2002) for instance studied Brazil nut and found that 93% of the seeds could be removed without little reduction in population growth rate. However Peres et al. (2003) showed that the size class distribution of Brazil nut populations that were harvested over long periods showed that nut harvest had adversely affected seedling recruitment.

Another interesting case with conflicting results comes from India, were the fruits of Amla (*Phyllanthus emblica*) have been harvested for decades. Many studies have been

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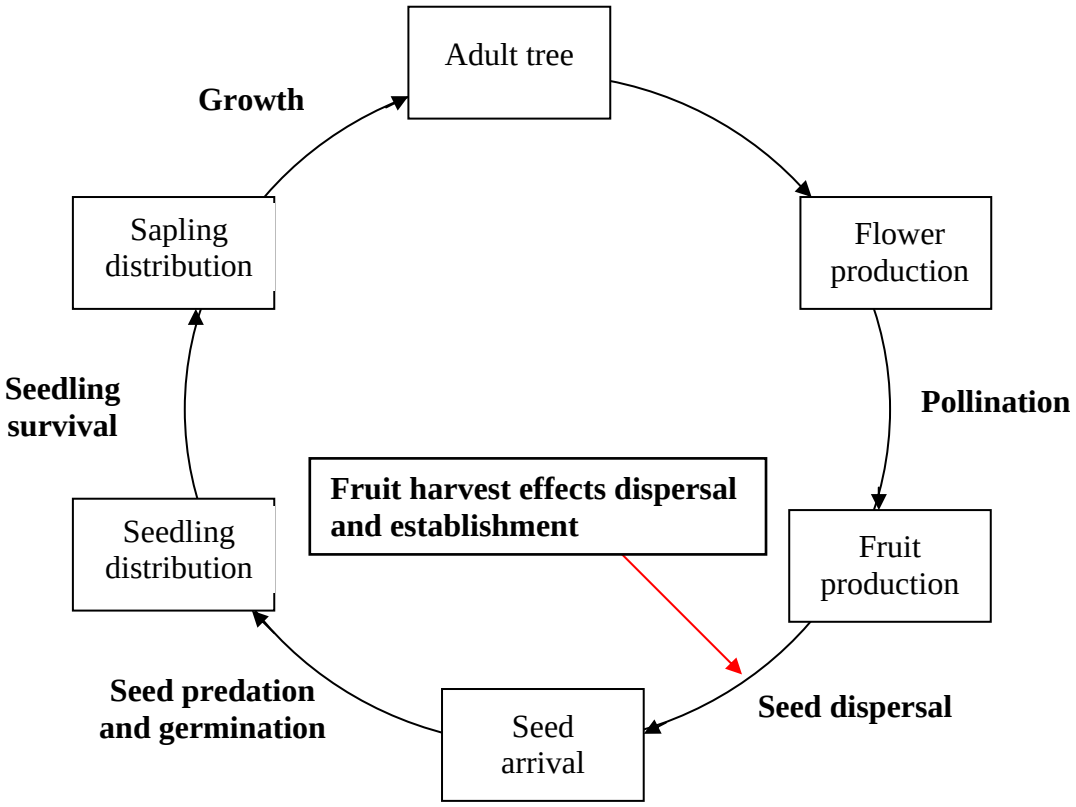
carried out in BRT Wildlife Sanctuary over the last decade. Initial results suggested that harvest has indeed affected seedling recruitment (Murali et al 1996). However later studies have shown that it is not harvest but fire and hemi-parasite infestation that affects seedling and adult tree survival (Ganesan and Siddappa 2004).

These findings show us that even straight forward assessment of impacts of harvest on populations of single species is fraught with uncertainty. The effort becomes more complicated when one attempts to estimate levels of sustainable harvest. The identification of levels of harvest is a futile exercise given that we know so little of how plant populations respond to harvest and given that there are a multitude of factors that affect plant population growth and survival. So do we say 60% of fruits will be harvested at the tree level, stand level or forest level. How then with the spatial distribution of harvest occur. Then there are institutional questions: who will harvest less and from where? Who will ensure that harvest is regulated?

What is then to be done? Ecology can provide guidelines to evolve rules of thumb and to identify indicators to monitor how populations are doing. Such indicators might include seedling numbers, the distribution of individuals in a population, the inter-annual trend in production of fruits. This is further complicated by socio-economic parameters of the harvesters, such as social structure and inequities, land holdings and tenurial rights, type of forest access and the economic status of individual harvesters. Monitoring should then include a number of downstream adaptive management protocols to address the role of institutions, the role of markets, and the role of the state. The workshop will need to address these issues as vigorously as the ecological monitoring ones.



The stages in the life cycle of a plant

It is possible to hypothesise the impacts of the harvest of seeds, flowers or fruits on the adult tree, the population and the ecosystem at large. Lower regeneration is the most direct effect. The removal of seeds reduces the seeds available for regeneration and thus fruit and seed removal will reduce the number of seedlings. However studies have shown that seed removal up to 90 to 95 % has little impact on the long term growth rate of the population (Zuidema and Boot 2000, Peters 1990, Bernal 1998). Ganesan and Setty (2004) have shown that despite high levels of harvest of fruits of *Phyllanthus indofischerri* the population size class distribution shows adequate recruitment.

Impact on other species:
Fruits are consumed by a range of species from mammals, birds to insects. The removal of fruits might impact the feeding behaviour of these foragers which in turn might affect the seed dispersal process. For instance if all fruits are harvested from an area frugivores will be forced to switch their diet to other resources. This might result in those fruits that are left behind being unable to find their way to micro-habitats that would enhance their chances germination. There are however not many studies on the effect of fruit and seed harvest on frugivore populations (but see Prasad 2003)

Importance of security of access:
The case of *Garcinia gummi-gutta* fruit harvest shows when tenure access to fruits are secure people harvest fruits in a far more benign manner that in the open access forest. Not only are the ecological costs lower, but the economic returns (as only ripe fruits are harvested) are higher. Further, the damage caused to trees is also significantly lesser in the secure tenure areas.

Some suggested protocols/components for community-based monitoring of fruit/flower/seed harvest:

1. Participatory rural appraisal methods are a powerful way to initiate participatory monitoring. A thorough understanding of the resource profile, tenurial regimes, institutional arrangements is crucial for the success of any effort. For instance why should communities monitor a resource if access to that resource is not guaranteed from one year to the next, or if the control and management of the resource vests with the state. Also such an exercise provides an entry point for organizations.

2. During the PRA explore if there are any current methods used by local communities in monitoring their resource. There might not be an explicit method but harvesters might be keeping track of a host of indicators of resource condition and production. An attempt to document and systematize this information might result in valuable information. this In BRT for instance there was seen to be a startling correspondence in estimates of Amla production between those obtained from scientific methods and those used by Soligas.

3. Establish plots of some convenient size (30 x 30 m). Enumerate trees within the plots, and saplings and seedlings in nested sub plots. Generate size class distributions to determine which size class, if any, is being affected. Involve local harvesters in these efforts. De-mistify these methods and the analysis. For instance just the presence or absence of seedlings in small plots established in random could be a good rapid assessment of whether recruitment is adequate. Local knowledge on the periodicity of fruiting and germination is invaluable in assessing if the mere presence of seedlings is an adequate indicator. Variability in seedling numbers depend on such factors as fruit production, seed dormancy, or low rainfall: parameters that local harvesters might have good information and understanding about. A useful source is Sheil et al 2002.

4. Information on the damage caused to trees should also be assessed in the plots. Fruit harvest invariably results in tree damage from either cutting of branches or some times even whole trees.

5. Data that is generated from long term plots could be used to model the population rates of growth of species. Although there are problems with using such models (deterministic and data intensive) they might be useful for heuristic purposes in showing that harvest of fruits might not be causing as much damage to the resource as previously believed. Population models have largely been used for such easily aged or fast growing taxa as tropical palms (Svenning and Macia 2002, Bernal 1998, Pinero *et al*. 1984, Ratsirarson *et al*. 1996, Silva-Matos *et al*. 1999, Pinard 1993, Olmsted and Alvarez-Buylla 1995), pioneer species (Alvarez-Buylla 1994, Martinez-Ramos *et al*. 1989), shrubs (Shea and Kelly 1998, Pascarella and Horvitz 1998), understory herbs (Horvitz and Schemske 1995, Bierzychudek 1982), and bromeliads (Ticktin *et al*. 2002). In the few applications of population matrix models to tropical canopy tree demography, Zuidema and Boot (2000) and Rai (2003) concluded that matrix models are insensitive to changes in fruit removal, but sensitive to the survival of the larger individuals. Peters (1990) and Bernal (1998) have similarly shown that simulated changes in seed production results in extremely small changes in population growth.

Responses to the Questions discussed at the workshop on fruit / flower harvests:

This group did not have a range of tenurial arrangements – both the areas discussed here were reserve forests. However there were very different institutional arrangements. ITWWS (Irula Tribal Womens Welfare Society) is a strong homogenous institution closely regulating medicinal plant harvest in an area; PP Hegde represents an individual household with no larger institution that it fits into. PP has had large problems with the Forest department, due to the closing down of access after independence. ITWWS on the other hand have cordial relations with the Forest Department, and even manage to keep the menfolk out of collection in the area.

Variation in harvest over the years?: ITWWS doesn't see much, PP Hegde sees pepper, mace and nutmeg, shikakai all badly affected because of overharvest; notwithstanding the natural variation.

ITWWS – when do you collect? "When its ready". PP felt mature fruit should be collected but rarely is, easy to tell with colour, but not all fruit ripens at the same time, so hard to ensure that mature fruit harvested in open access areas. ITWWS only have perennial collectors, so the impacts of their harvest are small. PP sees the effects of external harvesters. The landless are most dependent on the collected fruits, but hired labour have the most impact since there is a lack of connection.

Garcinia seedlings are affected by livestock grazing (they love the garcinia seedlings), and fire that catches due to resin content. There are areas of high and low densities in Garcinia, probably affected by fire and grazing, and PP Hegde feels there is a positive feedback in these areas of high and low density. Not possible to increase yield, just protection is possible. ITWWS feels it's not possible to increase yield; but when certain plants they have collected don't get sold, they collect the seeds from to replant.

PP- Some indication of what the fruit production is going to be in a given year can be obtained from the number of flowers. ITWWS feels good rain is a sign for good production, high heat will mean less production.

Ecosystem services – they are aware that squirrels, monkeys, civets eat the fruit. ITWWS women know the predators and the dispersers and pollinators. They feel that loss of certain species would impact the economics and the psychology of the ecological community. They also state that manufacture of medicines would disappear if the species were to be lost.

Price increases from year to year because ITWWS demands a higher price from the trader and they in turn from the manufacturer. In Sirsi, the prices fluctuate with the routine boom-bust cycles based on demand.

On wastage - 20% of the fruit in Mattigatta (PP Hegde's village) is wasted, 5% during drying, 5% due to fungal attack, 2% during weighing. ITWWS loses their entire harvest if it rains during storage.

Making efforts for local people to use the fruit of Garcinia gummi gutta would make the ecological monitoring easier. Even attempts to graft, domesticate, etc. have not yielded much benefit as long as the fruit is not locally used. It is different with Garcinia indica, because of local use. But how do you say that local use would help ecological monitoring? There is a stake for sustainable harvest then. Nitin Rai (biologist) however feels that price due to an export market seems to be the determining factor for sustainability – e.g. now that gummigutta is back down to Rs 30 a kilo, its not being destructively harvested any more.

What about collection regimes in private forests in Karnataka? There are three regimes: RF (Reserve Forests), Minor forests (given to the village as a collective grazing land for grazing, small timber and leaf collection) and soppina betta. Depending on the history and type of use, there have been successful attempts to regenerate soppina betas (some of which were changing to dry deciduous because of the leaves of those species being preferred). In the evergreen soppina betas, the undergrowth is cleared and the gummigutta is harvested sustainably in these places. There is a difference between harvest practices in soppina bettas and open access forests.

With tall trees, the trees are climbed and the fruits are pulled down with a stick. This is a widespread practice. Only in some places are the branches pulled down.

Summary: key points to consider

1) **Tenure arrangements greatly affect harvest methods and sustainability, therefore need to address this issue in monitoring plan**
2) **Variation in relationships with forest dept - monitoring could be a chance to either build on, or establish/improve these**
3) **Perceptions of overharvest of various species -monitoring could therefore focus on these key species to begin**
4) **Perception that overharvest is caused by external harvesters, therefore need to address this as part of community-monitoring initiative**
5) **Color used as indicators for appropriate harvest time and therefore could serve as monitoring tool**
6) **Number of flowers, rain maybe appropriate measures to derive predictions of yield and plan harvest accordingly**
7) **Perception that disturbance factors such as fire and grazing can be a major threats, therefore should be monitored as well (simple ratings can be effective)**
8) **Importance of monitoring locally useful products**

C3. LEAF HARVEST

These guidelines consist of a review of the ways in which leaf harvest can affect the health of individual plants, populations, communities and ecosystems, as well as how the effects of leaf harvest can vary with differing conditions. The review is followed by some suggestions for rules of thumb for leaf harvest and some suggested components for community monitoring of leaf-harvested plants.

1. In what ways can leaf harvest affect the health of individual plants, populations, communities and ecosystems?

Leaf harvest can affect the health and long-term viability of individual plants, populations, communities and ecosystems in a number of ways:

*Note that almost all studies on leaf- harvest have been carried out on palms or ferns and therefore this review focuses on them.

a. Leaf harvest can lead to decreases in growth and reproduction of harvested individuals.
Leaf harvest involves the removal of photosynthetic material and nutrients from the harvested individual and therefore can have differing effects on growth and reproduction of the harvested individuals.

For example, total leaf harvest of various species of palms in different parts of the world has been shown to result in decreases in reproduction (e.g. Mendoza et al. 1987, Flores & Ashton 2000, Ratsirarson et al. 1996, Zuidema 2000). It some palms, total leaf harvest can also lead to decreases in growth (Fong 1996; Zuidema 2000), while for others, growth may increase after harvest, at least short term (Mendoza et al 1987, Oyama & Mendoza 1990, Ratsirarson et al. 1996).

Partial leaf harvests of palms have been shown to lead to increased or equal levels of growth for many species (e.g Mendoza et al.1987; Chazdon 1991; Endress et al 2004; Fong 1995; Oyama & Mendoza 1990; Ratsirarson et al. 1996; Fong 1996). For most of these species, partial leaf harvest also results in increased or equal rates of reproduction (Mendoza et al. 1987; Chazdon 1991; Fong 1995; Oyama & Mendoza 1990; Ratsirarson et al. 1996).

However, these studies have all been short-term (2-3 years) and therefore the long-term effects of leaf harvesting are unknown. Indeed, ecophysiological studies have illustrated that some species can allocate resources to growth and reproduction after defoliation through reallocation of stored reserves (Whitham et al. 1991). This could allow for higher rates of growth in the short-term but not necessarily over the long-term. Alternatively, partial leaf harvest may allow for sustained rates of growth due to increased rates of photosynthesis in remaining leaves. However ecophysiological evidence from palms suggests that this may not be enough to compensate for overall canopy carbon loss (Anten and Ackerley 2002).

Leaf harvest has also been shown to negatively impact some species of ferns. For example, frond-harvest of the South African ferns, *Blechnum giganteum*, *B. punculatum, Polystichum lucidum*, and *Rumohra adiatifolium* growing in the indigenous forests of the Southern Cape, resulted in highly significant decreases rates of new fronds produced and fertility (Milton 1987; Milton and Moll1988; Geldenhuys and van Merwe 1988). These impacts could be due to a combination of factors, including interference in nutrient transfer from old to new fronds and depletion of nutrient reserves (Geldenhuys and van der Merwe 1988); reduced nutrient uptake due to reduced root growth and depletion of photosynthates (Crawley 1983); or decreases in photosynthetic material.

Alternatively, frond harvest of two Hawaiian ferns, *Microlepia strigosa* and *Sphenomeris chinensis* does not appear to negatively affect growth or reproduction (Ticktin et al. in review). This is due, in large part, to very short life-span of their fronds (in contrast, for example, to the above-mentioned South African ones).

Finally, leaf harvest, like any harvest, can negatively affect regeneration if there is heavy trampling during harvesting so that emerging seedlings are killed.

b. Leaf harvest can lead to decrease in survival of the harvested individuals
Leaf harvest often involves harvest of the whole plant, which of course, leads to mortality and can lead to changes in rates of population growth (Flores and Ashton 2000; Ticktin and Johns, 2002). When leaf harvest is carried out on trees, this can also involve branch-cutting, which can also lead to decreased rates of survival (as well as growth and reproduction).

Leaf harvest alone though, can also weaken the plant and lead to increased mortality in different ways. For instance, leaf harvest can alter C, C:N ratios and chlorophyll content in new leaves of *Sabal mauritiiformis* palms, making them more succeptible to herbivores and decreasing photosynthetic capacity (O'Hara 1999). Leaf harvest when combined with other kinds of harvest can also increase mortality. For instance,

Chazdon (1991) showed that over a period of three years, combined leaf and ramet removal in *Geonoma congesta* palms in Costa Rica resulted in higher rates of mortality.

c. Leaf harvest can affect population structure and persistence
In cases where leaf harvest negatively impacts rates of rates of growth, reproduction or survival of individuals, it can also lead to decreases in population sizes and changes in population structure over the long-term. For example, frond-harvest of the South African ferns, *Blechnum giganteum*, *B. punculatum, Polystichum lucidum*, and *Rumohra adiatifolium*, resulted in highly significant decreases in frond density as well as in frond size for the latter two (Milton 1987; Milton and Moll1988; Geldenhuys and van Merwe 1988). Similarly, for some species of palms, partial defoliation of fronds results in a decrease the size of fronds (Cunningham & Milton 1988; Endress et al. 2004; Ratsirarson et al. 1996; Joyal 1996). For other palms, such as *Brahea dulcis* in Mexico and *Hyphea petersiana* in Botswana, leaf harvest leads to reduced sexual reproduction, smaller stature and increased vegetative reproduction (Cunningham & Milton 1988; Sullivan et al, 1995; Illsely et al. unpublished data).

However, populations of other species may be quite resilient to leaf harvesting, especially when they are subject to management practices that allow for optimal growth conditions (see example in section 2 below).

Clearly, the impacts of leaf harvest on population persistence vary greatly across life-histories, environments, harvest and management strategies etc (see section 2 below). However, Table 1 provides some examples of estimated maximum harvest leaf rates that population are able to withstand:

Table 1. Estimated sustainable rates of leaf harvest for obtained for different species (from Ticktin 2004).

Species	Life History	Environment	Annual Sustainable Harvest Rate (%)	Reference
Neodypsis decaryi	Canopy Palm	Tropical evergreen forest	25	Ratsirarson et al. 1996
Livingstonia rotunidifolia	Undersory Palm,	Tropical evergreen forest	<20	O'Brien and Kinnaird, 1996
Geonoma deversa	Understory Palm	Tropical evergreen forest	All leaves on 8-16 yr rotation	Zuidema 2000
Aechmea magdalenae	Herb (bromeliad)	Tropical evergreen forest	75	Ticktin et al. 2002
Rumohra adiantiformis	Fern	Montane evergreen forest	50	Geldenhuys and Van der Merwe 1988
Mattecuia struthiopteris	Fern	Temperate deciduous forest	<50	Bergeron and Lapointe 2000
Microlepia strigosa	Fern	Tropical evergreen forest	<50	Ticktin et al. in review
Sphenomeris chinensis	Fern	Tropical evergreen forest	<50	Ticktn et al. in review

d. Leaf harvest could remove important resources for other herbivores
Herbivores, including grazers, also depend on leaves so that very heavy harvest of leaves by humans could affect their food supply. Similarly, where there are high populations of herbivores, yields of leaf harvested plants and sustainable leaf harvest rates will be lower. Little research has been done in this area (see review by Ticktin 2004).

e. Leaf harvest can lead to a depletion of soil nutrients
The role of NTFP species in cycling nutrients and the effects of extraction on nutrient dynamics at the plant and at the ecosystem level have been quantified in only a few studies. However, both temporal and spatial variation in environmental conditions can influence the effects of leaf harvesting on nutrient cycling. For example, O'Hara (1999) illustrated that harvesting the leaves of the palm *Sabal mauritiiformis* in Belize does not remove significant nutrient levels of limiting nutrients from harvest sites. However, she demonstrated that *S. mauritiiformis* appears to contribute significant sources of P, K and Zn sources during certain seasons, and that the magnitude of the contributions of *S. mauritiiformis* to total ecosystem cycling is much greater for dense populations than for sparse populations. These results suggest that although harvesting high density NTFP populations maybe least damaging from a population perspective, it could be more damaging from an ecosystem perspective if harvest results in the removal of important contributions to ecosystem cycling. This highlights the need to concurrently carry out research at different ecological levels.

The extent to which nutrient cycling may be altered by leaf harvest depends, of course, on how nutrient-rich the leaves are. For instance, long-term picking of blooms in *Banksia hookeriana* in nutrient poor soils of Australian heathlands depletes nutrient levels of individual plants and may affect nutrient cycling at the ecosystem level (Witkowski and Lamont 1996); one major reason for this is that the nutrient-rich leaves are harvested along with the blooms.

2. The potential effects of leaf harvest at any ecological level (individual, population, community, ecosystem etc) vary according to many ecological and social variables, including:

a. The life-history of plant – how many leaves, how fast the leaves grow, how fast new leaves are produced.
Clearly, plants with faster growing leaves and higher rates of leaf production may be able to withstand higher rates of harvest than those which produce leaves slowly.

b. The longevity of leaves harvested
Harvest of longer-lived leaf – in which the plant has invested much in making and defending them - clearly represents a much greater cost to the plant than does removal of shorter-lived leaves. Same for size (and thickness). Similarly, leaf harvest will have less impact on plants that are deciduous than on those that are evergreen. Note that specific leaf area (leaf area/mass) is often correlated with leaf life-span and growth rates and could potentially be used as a predictor.

c. The amount of leaves harvested
Clearly the more leaves harvested the greater the impact.

d. The sizes/stages of the harvested plants
Leaf-harvest may have greater impacts on growth and survival of juvenile plants than on larger, adult plants.

e. The frequency of leaf harvest
The impact of harvesting leaves may depend on how frequently they are harvested. For some species, frequent harvest at low levels may be best for populations, while for others higher intensity harvest at less frequent intervals may be ideal. However, in terms of socioeconomics, this may or may not be practical for harvesters.

f. The seasonal timing of leaf harvest
The harvest of leaves before the plant reproduces could lead to lower reproductive rates due to the decrease in photosynthetic capacity. Similarly, leaves that are harvested when growth is greatest (for example, during rainy season) may allow for quickest recovery. This is important since for many leaf-harvested NTFP, rates of leaf growth and production vary with environmental conditions such as rainfall (Joyal 1996; Milton 1988; Geldenhuys and van Merwe 1988; Ticktin et al. 2003; Ticktin et al. in review).

g. The environmental conditions in which the harvested plants are growing
Leaf-harvested plants growing in environments that are more conducive to higher productivity (light, nutrients etc) may be able to better withstand harvest than those growing in poorer environments. For instance, tropical leaf-harvested understory plants growing in higher light environments have been illustrated to grow faster (e.g. Svenning 2002) and have higher tolerance to harvest (Ticktin and Nantel 2004; Ramirez, unpublished data) than those growing in lower light (Ticktin et al.2003). Similarly, none of the understory palms studied appear to be able to tolerate high levels of leaf harvest (Zuidema 2000; Endress et al. 2004; Svenning and 2002; Ramirez unpublished data), at least in oldgrowth forest conditions. In contrast, several of the canopy and open-environment palms are can withstand higher rates of heavy leaf harvest (Joyal 1996; Fong 1995; Ratsirarson et al. 1996), indicating that light availability may be a limiting factor for the understory species.

h. Other management practices
Management practices carried out in association with leaf harvest can greatly affect – both positively and negatively - the impacts of harvest. For instance, weeding, thinning, transplanting, overstory light management etc can increase rates of growth

and allow for higher rates of harvest. For example, the terrestrial bromeliad *Aechmea magdalenae* can withstand rates of leaf harvest rates of up to 75% when it is managed to optimize density and light conditions. Indeed, leaf-harvested populations may grow at faster rates that non-harvested populations (Ticktin et al. 2002). Similarly, populations of *Sabal mexicanum* palms can withstand high rates of leaf harvest when growing in the favorable conditions of homegardens (Martinez-Balleste et al. 2002). Alternatively, additional pressures such as heavy grazing, fire, logging etc, which can decrease rates of growth, reproduction and survival of harvested plants, can decrease tolerance to harvest.

i. Other non-human induced pressures
Leaf harvest may be more damaging where there is heavy grazing pressure or herbivory from wild animals.

j. Tenure system
As for any NTFP, when resource tenure is weak, overexploitation often occurs. Strong land –tenure has been shown to be a fundamental element in sustainable harvesting.

3. Some Draft Rules of Thumb for Leaf Harvest:

a. Always leave some leaves on the plant to recuperate. Try to determine what proportion should be left so that growth and reproduction are not negatively affected.

b. When possible, harvest after seeds have been produced

c. When possible, harvest during the season when growth and leaf production is highest.

d. Harvest less or postpone harvesting when environmental conditions are stressful for the plants – eg. in dry years.

e. Decrease harvest rates if leaf size is decreasing as this may indicate stress

f. Decrease harvest rates if seed production appears to be decreasing

g. Decrease harvest rates if plant sizes in a population appears to be decreasing, even if vegetative sprouting is increasing (ie populations are becoming more dense).

h. Decrease harvest if there is heavy pressure from grazing, fire or other events that may negatively affect the plants

i. 'Spare' plants –leave some plants and some areas unharvested to allow them to recuperate and to be available for other organisms that may depend on them. Rotate the spared areas over years.

j. Observe whether leaves are short-lived or long-lived; if they are long-lived, harvest sparingly and look for ways to increase the number of plants (planting, transplanting, etc). Thick leaves, often sclerophyllous, may be indicators of long life-span.

k. Try to determine what kinds of conditions (light, soils etc) the plant grows best in and manage populations to optimize these conditions

Some suggested protocols/components for community-based monitoring of leaf harvest:

a. **Discussion of local knowledge of the plant with harvesters**: Where does it grow best? Why? How is it harvested? What are best ways to harvest? Why? What harvest produces the best product? Why? Is regeneration or reproduction decreasing or increasing? Why? What else eats the plant? How does the plant respond to grazing? Or fire? Or (other common threats?) How do you decide how much and which plants to harvest? Why? Etc etc.

b. **Discussion of local activities/schedules that relate to harvest**: When is the best time of year to harvest? Why? What are other activities are carried out when harvesting? What income is provided? etc etc.

c. **Discussion of local perspectives on harvest**: What changes have population shown over the years? Why? What are ways to address this? How have prices changed? How has the market changes? Etc etc.

d. **Local mapping of resources and quantity**: harvester-drawn maps of populations and their estimates of quantity of resources in each

e. **Markets, prices, demands, quality and trends in these..**

f. **Establish permanent plots in a few (selected number) populations where harvesters can record the following every year:**

a. Number or estimated proportion of leaves harvested per plant
b. Number of plants harvested for leaves
c. Number of times harvested per year
d. Season of harvest
e. Any other pressures (fire, grazing etc)
f. Visual or other estimates of fruit production per plot
g. Number of new seedlings emerging per year (count)
h. Mortality of any existing plants
i. *PLUS* identified protocols based on local knowledge/perspectives, which may also take the place of the above.

(Initial would include size and number of plants in plot)

g**. Integrate the local knowledge, activities, perspectives with the monitoring in permanent plots to collectively interpret results for adaptive management.** Based on local knowledge, activities perspectives, the plots can also be monitored managed/harvested in different ways to test what is best..

This includes both preharvest and postharvest meetings:

Preharvest meetings: how much to harvest this year and how..(assessment of regeneration/health based on harvested quantities, local perceptions, observations from plots) and therefore plans for following year - ie adaptive management.

Post harvest meetings: Record price for year and use locally drawn map to get estimates of quantities extracted, discussion of conditions, observations of health availability etc.

Responses to the Questions discussed at the workshop on fruit / flower harvests:

See 'Whole Plant' as both were done together.

C.4. WHOLE PLANT HARVEST

Need for ecological monitoring/ sustainable harvest of whole plant harvest

In the recent past, due to commercialization of plant-based medicines and a big hype created in cosmetic industry about the herbal based products, the demand for medicinal plant parts had grown manifolds. In addition to this, NTFP harvesting and value addition is considered as a viable option of income generation for the forest dependent community under the new paradigm of biodiversity conservation. It has put the natural resource bases (mostly forests) under pressure, as the demand for these products is greater than their regeneration capability.

Medicinal plants are harvested in the form of seeds/fruits, stems, barks, exudates (resins/gums), leaves, roots and tubers and the whole plant in the case of herbaceous plants and climbers. Among these practices, it is generally considered that the whole plant harvest can have greater impact on the regeneration of the resource plants as compared to harvest of plant parts. However, overharvesting or high intensity harvesting of the plant parts can also equally impact the resource plant population as each and every part of the plant plays vital role not only in the biology of the individual plant but at the population as well as ecosystem level. Overharvesting of the whole plant can wipe out the entire plant resource at least locally, as the harvesters may not leave enough plants to produce seeds/ propagule for the population to perpetuate. The few leftover unharvested plants will be generally weaklings and over generations, the resource plant at local scale will become non-viable. For example, Law and Salick (2005) illustrated that long-term harvest of the Himalayan snow lotus (*Sausserea laniceps)* led to a decrease a significant decrease in plant size over time.

Whole plant harvest refers to the practice of harvesting whole medicinal plants including herbs, shrubs and herbaceous climbers. In the process of harvesting these medicinal plants, they are uprooted completely to extract the part of raw drugs. For example in some cases plants are uprooted to collect the tubers (*Kattukaranai* Arisaema spp.), roots (*Nilapanai* -Curculigo orchioides, *Mahali kilangu*- Decalepis hamiltonii), seeds (*Auvri* -Tephrosia spp) etc, while the other aerial parts are discarded. This practice will not be referred to here as part of whole plant harvest. Rather, I will focus exclusively on the uprooting of herbaceous plants and pulling down the herbaceous climbers.

Whole plant harvest is done basically to extract the chemical components in the aerial parts such as leaves, stems etc. Generally harvesters prefer to collect the larger

quantity of the biomass, preferably leaf biomass, and they do not wait until the plants complete fruiting and seed dispersal. However, when this happens, plant resources will eventually be exhausted and the harvesters will be deprived of income. Practicing improved harvest practices based on the biological and ecological understanding could help the community ensure regeneration of the resource species. Also practicing ecological monitoring based on the sound biological and ecological understanding can help the community to take care of the resource species and the ecosystem health in which the biological resources and the dependent community live together.

Plants such as *Sida rhombifolia, Sida acuta, Andrographis alata, Andrographis paniculata, Aloe vera* are herbaceous plants that are uprooted, processed as raw drugs, and sold in the Indian market. Some herbaceous climber plants such as *Cissampelos pariera*, *Gymnema sylvestris*, *Tylophora asthmatica* are harvested as whole plant but the leaves alone are extracted and processed for the raw drug market. In the case of rattans, the whole plant is harvested though they are not uprooted.

Since whole plant harvest and its trade involves major players such as harvesters, primary traders and raw drug traders, their participation in the entire process of ecological monitoring has to be taken care of by ensuring suitable methodologies for all. Monitoring objectives for whole plant harvest should therefore include:

- to assess the resource availability
- to assess the level of harvest and status of the regeneration of the resource
- to assess the impact of harvesting on the regenertation of the resources species
- to assess the trends in the price of the resource species in the trade

To illustrate how community monitoring can be carried out, I use the example of as an example, since this plant has strong roots in the Indian indigenous medicine system as well as in the modern medicine.

Example of community monitoring of *Nelavempu / Siriyanangai* (*Andrographis paniculata*)

Local Names
Kannada- Nelaberu
Tamil- Nilavembu, Siriyanangai
Telugu – Nilavembu
Malayalam- Nelavepu, Kiriyatu
Hindi- Kalmegh

Botany of *Nelavempu / Siriyanangai* : Botanically this plant is called *Andrographis paniculata* and placed in the family Acanthaceae. As a herbaceous plant it grows not more than 2 to 3 feet tall. It is a dark greenish plant that grows mostly in red soil. The most preferred forest type is open scrub forest and dry forest. Also it is found most commonly in fallow lands where rain fed cultivation is practiced. It is found as weeds among the crops such as millets, red gram, ground nut etc. In the forests,

abundance of this plant is not so high as compared to the density in the fallow lands. In cultivated lands it is considered as a weed.

All the plants can produce seeds as there are no separate male and female plants. The plants produce white flowers, and most of the flowers set fruits and seeds. They are pollinated by *Apis cerana, A.mellifera* and other solitary bees. On average there are four seeds per fruit. Not all the fruits have seeds in a plant. Seeds are dispersed mechanically.

Though this plant is indigenous to southern India and Sri Lanka, its is found growing in Asia as well as tropical America due to its introduction in those locations

Economic Importance: All the parts of the plant tastes very bitter and this property might have legitimately crowned the plant as "King of Bitters" in the world of herbal medicine. Since time immemorial this plant has been extensively used as an important component in the system of medicine practiced by tribes as well as by other medicinal systems such as *siddha, ayurvedha* and *homeopathy*. In the indigenous medicine system, *Andrographis* is considered to have cold properties and is used to rid the body of heat, as in fevers, and to dispel toxins from the body.

The plant contains antibacterial and antifungal chemical components. This makes the plant to be prescribed as an antibiotic for wide variety of diseases. In the medicinal systems it has been used for jaundice (antihepatotoxic), malarial fever (antimalarial), blood clotting (antithrombogenic), dissolving blood clots (antithrombotic, thrombolytic), pain in the joints (anti-inflammatory), snakebites (snake venom), reduce blood sugar (hypoglycemic) etc. Basically this wide variety of applications is due, in addition its antibiotic properties, is dues to its immunostimulant activity as a result of the presence of andrographolide. This could be the reason that in the recent times it has been reported as a potential immunostimulant against HIV.

Harvesting practice: The whole plant is harvested and shade-dried before it is sold to raw drug markets. In south India, it is harvested during November – January, after the monsoon. Plants are uprooted and shaken of the soil in the field itself. Based on the interaction with the harvesters it seems that the harvesters are not aware of the population status as well as sustainable harvesting practices.

Trade information: Both roots as well as aerial parts are used in medicinal preparations. In Kerala and Tamil Nadu the major marketing centers are located in Palghat, Madurai, Chennai, and the raw drugs are procured though the primary collection centers such as Virudhunagar, Dindigul and Nagercoil.

Ecological Monitoring

The practice of sustainable harvesting of whole plants need to consider all the stages of harvesting - starting right from resource plant availability, its biology, harvest methods, regeneration, pricing and trade, habitat quality etc. Also it is critical that the monitoring of all the stages is well connected so that they are properly linked.

Resource availability – Resource surveys in a given habitat is an important element to practice sustainable harvest for the harvesters as well as traders in general. The specific advantages of resource survey and assessment are as follows:
Harvesters can assess the production of the resource and availability of the resource to harvest. Secondly it helps the harvester to assess the potentiality of trading the resource for the particular season so that s/he can evaluate the marketing potentiality.

Methods

Participants – Harvesters and field level trader /primary trader.
The trader should participate with the harvesters in assessing the resource availability and harvestable limit as they are the ones who will be concerned with the resource available at a local scale.

Habitat assessment and demarcation of resource-rich patches of forest/vegetation/habitat of the resource species.

Transect walks
(i) Subjective assessment: Transect walking can be carried out in the representative vegetation/forest/habitat types to asses the status of resource availability. This can be more of subjective as part of preliminary assessment. At the end of the transect walk harvesters and the primary trader/field trader can infer that the vegetation/forest/habitat has enough resource and is profitable for collection. Here profitable means the effort of the harvesters is worth to invest in harvesting. Also the harvester and trader will have an idea of harvesting potential as well as the price they can expect from the primary trader and the primary trader from the active trader who owns the regional trade unit of raw drugs.

In certain areas where the community often frequents the forests for grazing, fuelwood collections etc they need not do the above subjective assessment of resources as they observe it daily. Discussion among harvesters along the trader can instead provide the idea about resource rich area in the forest surrounding their village.

After demarcating the resource-rich areas where the harvesters feel that the effort of plant collection is profitable, quantitative assessment should be carried out by the following methods.

ii) Quantitative assessment: For herbaceous plants, series of square plots of approximately 1 m x 1 m dimension are appropriate to assess the density of a resource plant species. Over time, experienced harvesters can eyeball estimates of the density of herbaceous plants with in a 1m x 1 m plots. (These can be measured out either using two hands with all four fingers closed except the thumb – this will measure 1 foot; or with a long stride of a person for measuring the plot size- each long stride will be 1 m).

For herbaceous climbers, line transect walking and counting is the preferred methodology. It is not necessary for a harvester carry a tape or any such scale to

measure the distance. While doing the line transect / transect walking, the person should make slightly longer strides than usual walking to make more or less 1m long stride. May be after every 100m stride he should stop, while the other harvester should count the medicinal plant climbers within a distance of 1 m on either side. The transect line need not be straight as this may not be possible in scrub forests where the climber plants are abundant. Using forest trails and bridle paths should be sufficient to monitor the climber medicinal plants. The same method can be used to assess the climber plants found trailing over the hedges and life fences in the village environment.

In this way, the harvesters and the primary trader can assess the quantity of herbaceous plants and climber plant resource available in different forest/vegetation or a habitat type.

Mapping & high density area of resource: A map on a white sheet of paper should be prepared using local landmarks such as forest trails, small hillocks, ponds, streams, temples etc to delineate the area of their interest or rights to harvest medicinal plants. As a first step, by using the subjective assessment of the medicinal plant resource, harvesters should demarcate resource rich and poor area on the map. Secondly, harvesters should incorporate the quantitative assessment details collected based on the plots or transect walks of the resource species in the map. The same map should be later used to record the information regarding quantity of harvested plant resource.

Harvest records will be useful to monitor the annual differences in harvest level and the intensity of harvest in a given forest/habitat. This will help the harvesters to decide on the intensity of harvest over years based on the production level of the resource. Harvest records can also show the impact of non-destructive harvest practices on the regeneration, population structure, productivity and changes in the ecosystem in which the resource plant grows. Without monitoring the harvest levels it will be difficult to understand the impact of harvesting on the resource level.

Improved harvesting practices: As whole plant harvesting practice does not provide opportunities for the plant to produce fruit and seeds, the regeneration will be affected locally. One could suggest as a better option to postpone the harvest until the population set fruits and disperse the seeds. However, if harvesters wait until this point, many plants species would have exhausted their resources through the process of producing the fruits and dispersing the seeds, and leaves may have withered or turned yellow. The plant often loses its biomass and therefore all of the preferred properties important for the raw drug trade.

The other option could be leaving some proportion of plants in the whole population unharvested so that they set the fruits and take care of the regeneration. Here comes the critical questions such as what is the proportion / number to be left unharvested; what kind of plants should be left; etc. This is not only a daunting question for the harvester but also for the biologists who work on the biology and ecology of the NTFP. However, by practicing the 'learning while doing' method, harvesters can

devise and fine tune the methods of improved harvesting practices based on some simple methods along the biological and ecological principles.

Those plants selected to be left unharvested should be healthy ones, as the seeds from healthy plants can help guarantee the healthy populations in the future. In fallow lands, thinning by harvesting can also help the unharvested plants grow much healthier after the harvest of the herbaceous plants.

In the case of climber plants, the entire plant should not be harvested. Leaving a part of the plant that is large enough to produce fruits is important so that it will have chance of setting seeds and can help ensure the sustenance of the population.

Testing the impact of different harvesting level:
As each plant has its own life strategy, assessment of harvesting level should be learned while harvesting the resource plants. In general, some plants produce very few seeds per plant and some may produce more seeds per plant. Similarly plants vary according to the percent of seeds that germinate. For instance if germination rates are very low, then harvesting for example 7 out of every 10 plants may not be appropriate.

Therefore, as a part of understanding the regeneration / reproductive biology of the resource plant, carrying out a small manipulative study could be worthwhile for the harvesters as well as primary trader to learn about sustainable management of the resource. For example, the following experimental design can help the harvesters to understand the level of regeneration more systematically for the interest of conserving the medicinal plant resource:

In a unit area, since the plants are small herbs and closely packed, 90% of the plants should be removed and 10 % of plants should be left unharvested to become seed plants. Seed plants should be selected randomly form those that are the healthiest. This should be repeated in a few areas. Similarly in other sites with almost same abundance 70 % of plants should be harvested and 30% of plants should be left for regeneration. In other sites, 50 of plants should be harvested and another 50% of the

plants should be left unharvested as seed plants. Information should be recorded in the resource assessment map. In the following year, the above- marked locations should be assessed for the population status of the resource plant. If harvesters are satisfied with the level of regeneration in a location with any of the above three treatments, that particular harvest level could be used to maintain the abundance of resource plants. In this way, harvesters also will learn the impact of harvesting intensity on the abundance of the medicinal plants and regeneration status. However, it is important to keep in mind that there may be other reasons that may strongly influence the abundance of resource plants, including their biology as well as changes in the habitat or climate.

Monitoring and evaluation to ensure sustainable harvest
It will useful to maintain records of production, availability, quantity harvested & unharvested, regeneration status, price at which sold to primary trader, and if possible the price at which the primary trader sold to wholesale agent in a raw drug market, so that monitoring can help the harvesters and traders to understand the trends and manage resource species.

Evaluation: The recorded information should be referred annually after assessing the production and availability for harvest and regeneration. Differences between years in production should be evaluated to get to know the status of the target species as well as the health of the habitat. In addition to that the fluctuations in the abundance should be analyzed to find the impact of harvest levels and frequency of collection cycles on the regeneration of the resource species. Analysis of the pattern of pricing at the harvester – primary trader should be carried out to understand the production level and the trend in pricing. This can indicate the proportion of the price come to the harvester compared to the primary trader from the sale of the raw drug to the wholesale agent.

Evaluation of the information gathered at different stages starting from production, harvest, regeneration, income generation, trade should be used to fine tune the dynamics at every stage of the medicinal plant harvest and trade annually. For example, if in a particular collection area the abundance of the resource plant is found to be decreasing over years, the strategy should be to take decisions not to collect the plant resource or alter the strategies until the harvesters get desirable results. Also the quality of the habitat should be kept monitoring to arrive at proper conclusion regarding the reduction in abundance. Similarly data on the price shows reduction over years, harvesters should find the reasons to get a reasonable price.

Ecosystem monitoring of the habitat of the resource species: Monitoring ecosystem health should be an important component of the ecological monitoring of the NTFP harvest. Intensity of fuelwood collection, grazing, fire, logging, can have deleterious impact on the habitat in which the plant resources are regenerating. Observational records should be sufficient to maintain as part of sustainable harvest practice.

Whole plant harvest for the plants vegetatively propagated.

Plants such as *Aloe vera* is harvested as whole plant by uprooting though the pulp in the leaves are used as raw drug. It is not an annual plant and also a slow growing plant. Plant has a very short stem and the succulent leafs are produced very few in a year. It flowers once after many years and regeneration through seeds is very low. However, it regenerates through vegetative propagation by producing off-shoots around the mother plant. The newly produced off-shoots will grow as new plants. Instead of harvesting the leaves harvesters uproot the entire plant.

Appendices: the following appendices provide examples of data sheet that can be used by local harvesters and/or traders to monitor resources.

Appendix 1 : Phenology Records

Date: _____

Locality: _____

Species Name: _____

Name of the Population (site)	Flowers + or – 1, 2, 3, or 4	Fruits + or – 1, 2, 3, or 4	Vegetative + or – 1, 2, 3, or 4

Key to category values

1: <25% of the individuals shows the feature
2: between 25-50% of the individuals shows the feature
3: between 50-75% of the individuals shows the feature
4: between 75-100% of the individuals shows the feature

Appendix 2 Estimates of Productivity by Harvesters

Date: _____

Locality: _____

Species Name: _____

Forest Type: _____

Visual Estimate of Productivity by Harvesters: _____

Total Area (in hectares): _____

Productivity Estimate per Hectare: _____
After quantitative estimation done

Appendix 3: Estimates of Productivity by Transect Method

Date: _____

Locality: _____

Species Name: _____

Forest Type: _____

Transect # and length: _____

Number of climbers Encountered: _____

Average Productivity Estimate per plant: _____ (in kg)

Total Area Covered by Transect: _____ (in hectares)

Productivity of Transect: _____ (in kg per hectare)

Appendix 4 : Estimates of Extraction (Harvesters)

Date: _____

Species: _____

Locality: _____

Estimate of Extraction in Terms of Percentage of Productivity Harvested

Individual	% of Productivity Harvested

Appendix 5 :Estimates of Extraction (Local Traders/ Local Harvesters Association)

Date: _____

Species: _____

Taluk: _____

Estimates of Total Extraction: _____ (in kg or tons)

Appendix 6: Estimates of Regeneration

Date: _____

Locality: _____

Species name: _____

Quadrat/ Transect #	Number of plants

Total number of Adults per hectare: _____

Responses to the questions discussed at the workshop on leaf and whole plant harvests:

(Note that sometimes the leaf collectors take the whole plant and then deleaf, so the groups were combined).

1. *The license to collect is only a partial ownership for the tribal populations, which has ramifications for the sustainability of harvest practices. The nonforest sources of the leaf NTFPs are again areas where tribal folk do not have tenure, with attendant ramifications (but this does not apply to all harvesters, e.g. the owners of the non-forest leaf plant resources). Janaki has shown that she can keep the harvest sustainable from 12.5 acres, to 25 acres, and probably to the whole hillock, as long as she has tenure.*
    a. *Note: however with cinnamon there was no apportioning of the right to collect leaf at all, and with the tender floated, the trees were stripped bare.*

2. *There was no demand 10 years ago, but more resources; now there is greater demand but the resource appears a little less – it's a little difficult to say because this is a relative factor (ie resource appears to be less in relation to the amount of demand). Seasonal fluctuations, external collectors, etc. – all these things affect the resource trends.*

3. *Quality control is practiced indirectly through what the trader will and will not buy. The collectors observe insect or pest attack, leave immature fruits and seeds. With organized traders they don't fear adulteration during the weighing and payment process, but when the trader is unorganized they worry about it. The co-op looks at weight, colour, size of the plant- which is a form of monitoring right there. The ITWWS monitors the season in which the plant part is collected, and have even developed a phenology calendar of the medicinal plants parts. They can tell the buyer to come back when the part is actually is in season. They are careful about the plant part to the extent that if a particular flower needed for tea, they only collect the petal because that is what is needed for the tea. Discourage plant collection before the plants have flowered or fruited.*

4. *The same phenomena as with other plant parts are observed in the case of opportunistic and hired harvesters. However on the whole these collectors live close to their resource, and don't need to worry about whether anyone else will take it. The proximity also enables them to wait till the right time.*

5. *Also know fire and grazing to be a major threat for the herbal resource base.*

6. *Strategy to get more yield is to protect and cooperate with the Forest Department. A participant in the workshop asked 'If I asked you to collect all 50 plants in your plot'… the answer from the collector was that she wouldn't do it. She will only pluck after the second year, and can tell the difference between a mother plant and a plant in its second year, and will pluck only the second year plant.*
7. *Rain is a major predictor of whether it is possible to get a good harvest. The collectors are well aware of soil type and associations of medicinal plant availability.*

8. *Eco-system services- e.g. about ten tuber and bulb producing plants all predated by porcupines (which shows that she knows about the interaction, and ended up saying the porcupines also have to live, though initially talked about them negatively). Though the collectors could not directly name bees and butterflies for pollination, they were aware of that function.*
9. *Aware that prices are fixed by external market and not supply fluctuations. Aware that moisture conditions and other storage conditions make a difference to wastage.*

In Uttara Kannada a tender was floated for cinnamomum and it all went to an outsider. The villagers protested this bringing of people from outside – the response from the trader was to bring back even more people, so many that the locals could not fight them. This shows up some of the intractability of the problems faced.

Summary: key points to consider

1) Tenure arrangements greatly affect harvest methods and sustainability, therefore need to address this issue in monitoring plan
2) Monitoring already takes place at the cooperative through documenting the color, weight and size of plants harvested. This could be a fundamental component of community monitoring plan
3) Much other monitoring also already takes place such as noting seasonality of picking etc, these measures are ideal for incorporating into monitoring plans.
4) Perception that disturbance factors such as fire and grazing can be a major threats, therefore should be monitored as well (simple ratings can be effective)
5) Recording rainfall levels can help predict potential yields and therefore help to plan accordingly for harvest
6) Knowledge of other organisms that depend on the harvested species: monitoring could include perceptions on abundance of these species
7) Great need, and challenge, to work together with traders towards sustainable harvest

C.5. RESIN HARVEST

What are Resins

Resins are solid or semi-solid materials, usually a complex mixture of organic compounds called terpenes, which are insoluble in water but soluble in certain organic solvents. Resins are very widely distributed in the plant kingdom although a few families are notable in accounting for a large proportion of the resins which are traded (e.g. *Leguminosae*, *Burseraceae* and *Pinaceae*). Resins include three main chemical groups (resin ester, resin acids and resenes) and dissolve in organic solvents like alcohol, ether, vegetable oils, etc. (Gupta and Guleria, 1992)

Resin groups

(Subansenee, Wanida, Denrungruang, Pannee, 1995)

- Hard resin: *Shorea , Hopea, Agathis,…*
- *Oleoresin: Dipterocarpus, Pinus,…*
- *Gum-type: Canarium, Umbelliferae,…*

Uses of Resins (and Gums)

Resins are essential elements in the manufacturing of paints. They are also used in balms, natural coatings, cosmetics and glue products. Traditional uses include, torch wood and bamboo preservatives, caulking boats, food and food processing, decoration of temples, incense, caulking coffins. Industrial uses like varnish, natural lacquer, painting manufacture and pharmaceutical use, food and food processing, wood-work, water proofing paper, ceramics (Gum Arabic), inks, coating additive, textiles, paints and adhesives.

Ecology of Resin Tapping:

The commercially traded resins are harvested by tapping the bark. This is also the case for many latexes and gums. The resin and latex from existing canals in the bark and wood and need to be damaged for the resin to flow out. In the case of gums the ducts maybe formed only after the bark is slashed. There may be an opportunity to tap trees periodically by making cuts in the bark but only monitoring the population over a longer period of time will answer the question of whether this is sustainable. Since tapped plants maybe paying a higher physiological price when exudates are removed growth and flowering maybe affected. In the case of gums the production of gums is attributed to the attack by a fungi, presence of certain bacteria or normal metabolic functions. Though much research has gone into the composition and process of exudate production in the plant much remains to be understood on the effects on the population.

Markets & Trade

It is difficult to get disaggregated data on the different species of gums and resins. The following data gives an overview of the world market and the main imports and exporting countries. An estimate put the value of the world market for gums used as food additives at about US$ 10 billion in 1993, of which the two largest "forest" gums (gum arabic and locust bean) accounted for just over 12%; the remainder were mainly the seaweed gums, starches, gelatin and pectin (Naude, 1994). This takes no account of non-food uses of gums.

Indonesia, India and the People's Republic of China are among the world's major producers of gums and resins. Sudan and Indonesia are among the world's major exporters of natural gums and resins.

Some idea of the quantities of natural gums and resins entering international trade can be gained through examining trade statistics. The source of the data presented below is predominantly the ITC TradeMap (www.trademap.org).

Imports

- Total world imports of the product group falling under HS code 130190 – natural gums, resins, gum-resins and balsams (excluding gum arabic) – were estimated at US$ 147.2 million in value and 100.7 thousand tonnes in volume.
- Between 2002 and 2003, total world imports in terms of value increased by 11 percent. However, when seen over a longer period of time, 1999-2003, average annual change was -1%.
- India is the world's leading importer of natural gums, resins, gum-resins and balsams, accounting for 12 percent of global import value in 2003. During the period 1999-2003, value imports into India showed an annual 8 percent increase, and a staggering 30 percent increase between 2002 and 2003.
- Other leading import markets are mostly the USA and several EU member countries, notably Spain, France, the United Kingdom, Italy and Germany.
- Most of these countries had shown decreasing imports over the longer term, although increasing imports over the short term (2002-2003). Notably Spain and Italy increased their imports considerably.

Table 4.1 Imports of product group falling under HS code 130190

Leading importers	Import value 2003, US$ thousand	Import volume 2003, tonnes	Annual value growth 1999-2003	Annual value growth 2002-2003	Share in world value imports
World estimation	**147,207**	**100,690**	**-1%**	**11%**	**100%**
India	16,943	19,026	8%	30%	12%
USA	11,961	7,252	-5%	38%	8%
Spain	9,395	4,067	27%	71%	6%
France	9,387	2,918	-3%	-15%	6%
United Kingdom	8,794	4,049	-6%	24%	6%
Italy	6,838	3,449	25%	19%	5%
Germany	6,778	2,583	-1%	10%	5%
Singapore	5,961	1,712	-5%	-2%	4%
United Arab Emirates	5,425	2,842	12%	32%	4%
China	5,025	3,627	-9%	2%	3%
Philippines	3,480	4,359	5%	-7%	2%
Argentina	3,348	8,401	17%	8%	2%
Thailand	2,377	3,700	N/A	N/A	2%
Mexico	2,329	2,788	-32%	-42%	2%
Canada	2,311	777	20%	91%	2%
Malaysia	2,139	2,241	-3%	-3%	1%
South Africa	2,033	935	17%	58%	1%
Other	*42,683*	*25,964*	-	-	*29%*

Source: ITC TradeMap (2004)

Exports

- In 2003, total world exports of the product group falling under HS code 130190 was estimated at almost US$ 196 million in terms of value and 131 thousand tonnes in terms of volume.
- Although between 2002 and 2003 the export value decreased by 9 percent, it by far exceeded imports in both terms of value and volume. Over the period 1999-2003, average annual growth of world exports remained relatively stable.
- World export of natural gums, resins, gum-resins and balsams is dominated by Asian countries like India, Pakistan, Indonesia, Singapore, Taiwan and Afghanistan.
- Besides being the world's leading importers, India is the also the world's biggest exporter of natural gums, resins, gum-resins and balsams, accounting for more than a quarter of the total export value in 2003. India kept its leading position despite a 32 percent decrease compared in 2002-2003.
- Pakistan is the second leading world exporter, accounting for 10 percent, followed by the USA (8%), Indonesia (7%) and Singapore (5%).
- Changes in exports over the recent past vary from country to country. Particularly Afghanistan and Iran managed to increase its exports substantially over the past few years.

Table 4.2 Exports of product group falling under HS code 130190

Leading exporters	Export value 2003, US$ thousand	Export volume 2003, tonnes	Annual value growth 1999-2003	Annual value growth 2002-2003	Share in world value exports
World estimation	**195,927**	**131,026**	**0%**	**-9%**	**100%**
India	51,892	13,769	0%	-32%	26%
Pakistan	20,389	24,613	-	-	10%
USA	16,461	3,917	-4%	-7%	8%
Indonesia	13,864	24,639	2%	-8%	7%
Singapore	8,979	4,529	-9%	-16%	5%
Ireland	8,204	34	1%	10%	4%
Taiwan	8,180	4,680	9%	26%	4%
United Kingdom	6,338	1,155	-2%	6%	3%
Afghanistan	5,933	781	28%	851%	3%
Germany	5,923	1,177	-4%	4%	3%
Brazil	4,745	12,733	-2%	2%	2%
France	4,224	906	1%	15%	2%
Iran	4,113	1,744	22%	109%	2%
Ethiopia	3,520	2,339	-	-	2%
Greece	3,071	63	-3%	61%	2%
USA (re-exports)	2,748	1,431	92%	18%	1%
Thailand	2,626	5,308	0%	0%	1%
Senegal	2,117	927	4%	-4%	1%
Sudan	1,778	1,495	2%	-47%	1%
Vietnam	1,473	3,948	-11%	-40%	1%
Other	*19,349*	*20,838*	-	-	*12%*

Source: ITC TradeMap (2004)

Gums and Resins in the Western Ghats – An Overview
[Ref: Proceedings of Workshops held in Nilambur & Karjat, NTFP-Exchange Programme, 2004]

Resin Tapping of *Canarium Strictum*, Roxb. -

Indigenous people of the Nilgiris, in the Western Ghats in Tamil Nadu collect NTFPs for their own use and livelihood needs. The collection of *Canarium Strictum* resin, locally called Dhoopa, has been a traditional activity as it is used for religious ceremonies, birth and funeral rites, etc. This has also been an item of barter, and now trade.

The Keystone team has been monitoring the populations of the Canarium strictum in areas where they are harvested. We have found many big trees (GBH 150)of this species fallen in the forest, always trees which were tapped for resin. Leading us to the presumption that constant tapping weakens the base of the tree making it

susceptible to termite attack or weakening it at the base resulting in the falling of the tree.

In the Nilgiris, the extraction of resin is done by making incisions on the bark, with a knife or chisel and leaving it for some time – till the resin exudes out and hardens. This is then collected. These scars can be seen at the base of the tree – from the ground to 4 feet, all around the circumference of the tree. Another method adopted by some of people especially in Kerala is to light a fire at the base of the tree, which the harvesters believe speeds up the exudation process.

Commercial Resin species of the Western Ghats:

Region	*Canarium strictum*	*Vateria indica*	*Ailanthus triphysa*	*Boswellia serrata*
Karnataka	Y	Y	N	Y
Kerala	Y	Y	Y	N
Tamil Nadu (Nilgiris)	Y	N	N	Y

Forest types:

Forest types	Karnataka	Kerala	Tamil Nadu(Nilgiris)
Semi evergreen	Y	Y	Y
Moist Deciduous	Y	Y	Y
Dry deciduous	Y	N	Y

Seasonality:

Region	*Canarium strictum*	*Vateria indica*	*Ailanthus triphysa*	*Boswellia serrata*
Karnataka	All year	Dec.-Feb	Nil	Nil
Kerala	Monsoon	All year	Monsoon	
Tamil Nadu (Nilgiris)	Dec-Feb	Nil	Nil	

Average Quantity in Kgs per tree:

Region	*Canarium strictum*	*Vateria indica*	*Ailanthus triphysa*	*Boswellia serrata*
Karnataka	-	1-2	-	-
Kerala	1-8	5-6	750ml	-
Tamil Nadu (Nilgiris)	3	-	-	-

Methods of resin harvest from other species-

V.indica trees are not tapped but the resin oozes out of bark fissures and solid pieces of the resin are collected. But the resin may be found high up on the tree therefore it was necessary to make ladders of bamboo or small logs to climb up to that point. For *A. triphysa* the harvesters used a small hand drill to bore into the wood and insert a hose, through which the resin would flow out into a collection vessel at the base of the tree.

Harvesters generally say that with every harvest the resin yield would go down. They also observed that the termites would attack the tree at the points where the incisions were made and these trees survived only for another ten years (observations from Kerala). Each year the incision was made on a fresh side. **The first incision is made on the side of the tree which receives maximum sunlight.**

Product Quality Parameters-

In Kerala the resin of *Canarium strictum* was sold in three grades.

Grade	Local Name	Size	Colour	Quantity collected last year at Co-operative Society - Nilambur
1	Kaalpandham	2ft long block	Glassy black	200kgs
2	Katapandham	3-5 inch blocks	Brown black	6-7 tonnes
3	Podi pandham	Dust	Brown	-

The 3 grades are obtained from the same tree, the first resin which oozes out is black then becomes brown. The 3rd variety is essentially scraped off from the bark after the harvest and has dust and pieces of bark with it and fetches a low price. But this is preferred for prayers since it is easier to handle. In Karnataka and Tamil Nadu there was a demand for only the first two grades. The traders felt that the commercial demand for the resin is still high but there is not enough supply.

Tenural Rights to collection-

While in Kerala and Tamil Nadu it was the adivasis who had rights to collect the resin in Uttara Kannada the contractors were coming in with hired labor to tap the trees. In Tamil Nadu resin collection is banned officially but it is permitted in the neighboring states of Kerala and Karnataka. The ban does not stop the collection because the significance of the resin for many of the local cultural rites is high. Also if the harvester cannot find a market in Tamil Nadu he just walks across to Kerala to sell his produce.

Improved methods for harvest :

Use of improved tools would make the incisions cleaner and less impurities would find their way into the resin. The distance of the incision could be staggered to tap the resin along the flow of the vascular tissues. Longitudinal incision do less damage to the tree and the bark regenerates faster. Also, if the resin was allowed to collect into a bowl then the shape could be uniform and it would be easier to transport such material (reduce breakage).

Case: Boswellia paryfera oleoresin in Ethiopia (Gebrehiwot, 2003)

- *Family: Burseraceae*
- *Tree up to 12 m*
- *Occurs in Ethiopia, Nigeria, Cameroon, Central African Republic, Chad, Sudan, Uganda and Eritrea.*
- *Main product: frankincense (= franc encens = pure incense) for burning incense, perfume, medicine, chewing, industry, backery and foods.*
- *Other uses: traditional medicine, fodder, wood, honey, plantation for protecting soil.*

Frankincense

- *Producers of frankincense: southern Arabia (B. sacra), India (B. serrata) and Africa (3 species)*
  Biggest: Somalia (800-900t), Sudan and Ethiopia (2,000t) in 1987.
  India: mostly domestically consumed and 90t for export annually between 1987-1993.

- *Biggest market in 1984 : China with import of 1,000t, Europe and Latin America: about 500t. Northern Africa and Saudi Arabia: about 500t.*

Lessons from the study

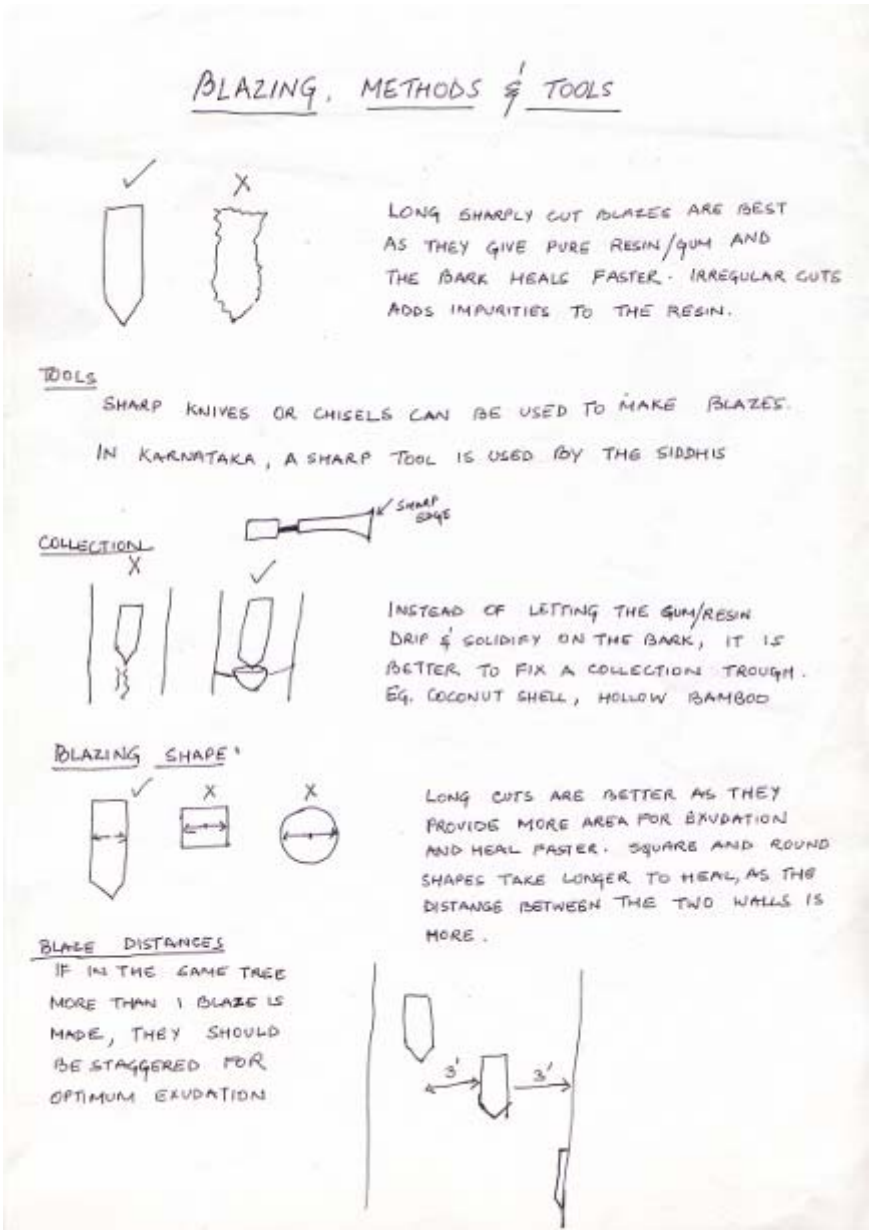
- *Declining populations.*
- *Livestock grazing reduces natural regeneration, recruitment of forest stand and crown diameter (= reducing oleoresin productivity?) while increases mortality.*

  Question: tapping=reduced crown diameter?
- *Possible rehabilitation if pressure from livestock is reduced.*
- *Lower moisture and increased salinity strongly affect the population.*

Recommendations by the author

- *Improvement of existing incising technique*
- *Protection of regenerating seedlings.*
- *Strict law on damage to adults and seedlings due to incense harvesting/pasture*
- *Research on propagation, seed collection, nursery practice, choice of suitable planting sites*
- *Not promoting income from export*

(Adapted from Presentation made by L.H Truong, SIERRES, Vietnam)



Responses to the questions discussed at the workshop on resin harvest:

It's good to be able to formulate a series of basic do's and don't regarding collection. In the case of resins it may not be so hard. Based on our case of Canarium strictum, we have the following:

- *Do not harvest from a young tree (Canarium – 15 years, girth should be more than a 'grip')*
- *do not set fire.*
- *do not take out the bark while harvesting the collected resin*
- *do not harvest too frequently*

Kanis in KMTR recognizes 7 layers of bark and that they need to harvest only by injuring upto the 3rd layer. They harvest only every 3 months. Only ¼ of the girth should be blazed in rotation. Straight sharp cuts needed. Rough cuts cause injuries to the tree. They have noted population of the tree declining due to unsustainable harvest- see that there are only 'male' trees now, there are no "females" (ie with a high resin yield) left.

Tenure questions- in KMTR all tenure has been disallowed now, by declaration of the Tiger Reserve. In MP and Chhatisgarh, with Boswellia serratus and Sterculia urens there has been a traditional allocation of 50-100 trees per family, which are harvested in rotation. Even in this situation there remains the issue of illegal harvest by outsiders.

Blazing of Boswellia is through superficial blazing up to about 3-4 feet around the girth, but with a specialized instrument which makes only a very thin abrasion. The gum appears in regular drops which can be taken. Harvest can be taken after every 3 years. The gum was nationalized but has been open access for about 2 years. The blazing method for the Sterculia developed by the Kovel Foundation is the same as that which the Kanis have described for Canarium

Sharing experiences with two species in Uttara Kannada. Siddhis use sustainable techniques for the extraction of these resins (even in open access areas). Forest Department on the other hand gives contract, and those labourers make huge gashes and upto 200 trees died in one forest range.

Policy issues include not only tenure, but there also needs to be some interstate understanding. Kerala allows Canarium harvesting, but in TN we aren't allowed to study it or share the results because its not supposedly allowed for harvesting in Tamil Nadu. Seasonal collection- greater resin production when the winds were high (May to September) (this connection with wind has been noted in Brazil also, but also the phenology of the tree for in this case it's the growing season)

(It's important to remember that the reduction in number of individuals may also have to do with the succession stage also – e.g in East Africa Canarium is an early secondary stage species and will not show up in late secondary stage, which is more due to the shade situations than the harvest. This has shown up in other species as well).

Additional comments from biologists:

- *Spring and fall is when the tree is producing a lot of resin to produce leaves or get through the winter is the best time to harvest for the human but worst from the tree's point of view. It does work, e.g. in Boswellia, but tenure is again essential.*

- *Dangers of generalizing - In Cameroon, Prunus Africana was being debarked on one side of four every year. From Nepal a tree from the next genus to Prunus (Daphne) bark was being used for paper, and being used to the extent that unless there was a move towards cultivation there would be at least local extinctions. Based on the Cameroon experience it was suggested that the Prunus protocol be used for Daphne too. But the different physiology meant that the whole population of Daphne was then threatened. It would have been much better to fell the whole tree completely debark and let it resprout. Major lessons for the replicability of protocols here. Because bark is harvested from the wild and usually in small amounts, protocols such as the one suggested here are usually ok; but this could become dangerous as quantities go up.*

In India - Terminalia arjuna bark hugely demanded in Ayurvedic formulation. Lydsia (maida lakdi) bark used widely for agarbatti. In Kerala and Tamil Nadu, acacia nilotica for alchohol brewing. Cinnamomum destroyed in large swathes by smuggling. because of difficulty in record keeping whether it comes from a wild or cultivated source, its very difficult to stop. Another danger is the tanning chemicals that used to come from barks. With chemical tannins being used, the bark based tannins fell into disuse; with the new fad for natural leathers, these natural tannins are coming back into favour, but there are no longer any plantations to meet the demand.

Summary: key points to consider

1) Tenure arrangements greatly affect harvest methods and sustainability, therefore need to address this issue in monitoring plan
2) Rules of thumb suggested and practiced by harvesters can be used a tools for monitoring (e.g. # of trees harvested young, % set fire, % bark removed etc),
3) Perceptions of decline in population due to overharvest- these are key species to initiate monitoring with
4) Great differences in harvest methods and ecological consequences by local versus external harvesters; as well as differences in policies across states. This needs to be addressed in monitoring plans
5) Protocols and thumb rules for harvest should be based on specific species, as there may be great variation across species; not everything works for all species.

C.6. BARK HARVEST

INTRODUCTION

In this section, I first summarise why there is a need for guidelines on bark use, then review factors affecting the resilience or vulnerability to harvest at different scales (at the individual plant, plant population and landscape levels). Unlike harvest of leaves, flowers or fruits, the impact of bark harvest on individual plants is high. It is also variable across different plant families and under different ecological situations for the same species.

Worldwide, forestry training has concentrated on timber production (Philip, 1994), with little emphasis on studies of non-timber forest products like bark. Although Junikka (1994) has reviewed terminology for descriptions of bark and Langenheim (2003) has recently reviewed the use of plant resins, whose extraction often involves cutting incisions in bark, studies of bark production, yields and sustainable harvest are few. Although there are notable exceptions, this gap in knowledge and training is surprising as billions of people use bark and bark extracts for herbal medicines, dyes, spices and a range of other uses. Despite bark's multiple values, methods of studying bark use and production are poorly known and rarely taught. Until the mid-1990's for example, Cameroon allocated bark harvest quotas without any inventory or yield assessments at all, despite a lucrative international bark trade in medicinal *Prunus africana* bark (Cunningham et al, 2003). In Chile, the international trade in saponin rich bark from *Quillaja saponaria* similarly threatens wild stocks (San Martino and Briones. 1999). With the income, livelihoods and herbal health-care of many people being undermined by unsustainable bark exploitation, this needs to change through recognition in social forestry training and in forest inventories.

BARK HARVEST: A REALITY CHECK...

While low level bark harvest for subsistence use can be sustained from faster growing tree species, this is often not the case with commercial harvest. Realistically, commercial scale wild harvest is a short-term measure unless the intensity and frequency of bark harvest is low. Even then, secondary effects of even small-scale harvest need to be borne in mind. For example, some tree families and genera (such as the Proteaceae and Podocarpaceae) are vulnerable to fungal attack into the tree trunk or roots even with small-scale harvest.

It is no co-incidence, therefore, that bark production from many tree species commercially harvested on a large scale is from production in agroforestry or plantation systems. Familiar examples are cinnamon and cassia bark, cork oak, quebracho (*Schinopsis quebracho-colorado),* chestnut (*Castanea vesca*) and black wattle (*Acacia mearnsii*) bark. All were originally wild harvested, but the need for economic efficiency, stronger tenure for long-term crops and ecological sustainable harvest have all driven the shift to cultivation. Bark production for bark cloth in East Africa (from *Ficus natalensis*) and the Pacific (*Broussonetia papyrifera*) or for bark-based paper in Asia (*Wikstroemia, Edgeworthia, Broussonetia*) has also made the shift from wild harvest to more intensive, farm-based production. Even industrial bark products from fast growing species such as jute and Sunn hemp (*Crotalaria juncea*) (Cook, Scott & Chow, 1998) are cultivated rather than being wild harvested.

Current levels of commercial harvest from wild populations of trees such as *Prunus africana* and *Quillaja saponaria* is unsustainable, and the transition to agroforestry or plantation production needs to be made. *Prunus africana* cultivation is an economic proposition (Cunningham et al, 2002) – but is this likely for all commercially harvested species? Realistically, this is not going to occur, and small to medium-scale harvest from wild plant populations, often by the rural poor who have limited access to land, is likely to be the case for most plants used for bark. In Africa, Asia and Latin America, the highest diversity of species are harvested for bark at a local community level, with a much lower diversity of bark products entering international trade. Plant species currently in plantation cultivation for commercial production does not exceed a few dozen world-wide. On the other hand, however, we recognize that many more species are cultivated on a small-scale in home gardens, in agroforestry systems or through enrichment planting in "family forests".

BARK YIELDS, QUANTITIES & IMPACTS

Damage to or removal of bark therefore has serious consequences for the plant. For this reason, girdling of trees is often used as a management tool in forestry and farming. Examples are girdling to deliberataely kill and thin out certain species such as *Quercus laevis* oak trees in Florida (Provencher et al, 1991), clear woodlands for farming in Australia (Fensham and Fairfax, 2003) or to stimulate cone production in Douglas firs (*Abies amabilis*) (Owens et al., 2001). In other cases, the management focus is on sustainable harvest, rather than deliberately causing tree death by girdling. Avoiding resource depletion and bark overexploitation through practical resource management plans brings long-term benefits for local livelihoods and for national industries. Just as local craft producers, herbalists or paper-makers lose their self-sufficiency when bark stocks become scarce (Cunningham and Milton, 1987; Peters et al., 1989; Shanley and Luz, 2003), so national industries are unable to grow when resource stocks decline. In Chile, for example. the market for *Qulilaja saponaria* bark could grow three-fold to $30-40 million per year, but is unable to do so due to overharvest of wild stocks. Bark sustainable yields and harvest impacts are therefore important to take into account in management planning.

TWELVE STEPS FOR SUSTAINABLE BARK HARVEST

1. ***THINK ABOUT BARK RESOURCE MANAGEMENT AT MULTIPLE-SCALES****: Sustainable harvest of bark from trees needs to be considered at different levels: individual plants, plant populations and at the landscape level*

2. ***AVOID BARK DAMAGE IF YOU CAN****: Bark removal, which results in loss of nutrients and moisture or even fungal infection or insect attack, is a major stress for any tree and even if it does not kill the tree, reduces tree growth rate and lifespan. Bark is like a tree's skin, protecting plants against injury attack by herbivores (from elephants and porcupines to beetles and termites). Chemical components of bark also protect trees against fungi or fire. Healthy bark is essential to the life of the tree and therefore to timber production. The protective function of bark can be through one or a combination of three main bark properties: (i) long, strong fibres, reducing the ease of girdling by large mammals such as elephant; (ii) thickness conferring thermal resistance to fire (van Mantgem and Schwartz, 2003) or (iii) chemical defense due to secondary metabolites, which protect plants against herbivores, viruses, fungi and even competing plants. Rather than girdle Berchemia discolor trees for dye as happens in Botswana (Cunningham and Milton, 1987), basket makers in Binga, Zimbabwe, for example harvest flakes of outer bark, which is completely sustainable.*

3. ***RESILIENCE TO BARK HARVEST VARIES BETWEEN PLANT FAMILIES:*** *Bark harvesting by people is often highly selective for plant families, genera or species based on particular bark qualities. The effects of bark removal therefore depends on the physiology and chemistry of the plant species harvested, on whether exudates are produced or not and on the intensity and frequency of bark removal. It also varies with microclimate (see 4 below). Although anti-microbial compounds are widely documented in tree bark (eg: Omar et al., 2000) they appear to be rare or absent in some plant families. Shape of the tree trunk has an influence. It is more difficult, for example, to girdle trees with fluted trunks (such as Balanites maughamii or Bombax ceiba) than it is to girdle trees with smooth cylindrical trunks. Many Proteaceae and Podocarpaceae, for example, are highly susceptible to fungal infection or attack by wood-boring insects. Fungal attack reduces the chance of sustainable harvest and for this reason, cork oak harvesters in Spain spray the exposed stem with an anti fungal compund after debarking to prevent infection of the tree (Missouris, 1999). On the other hand, plants in some families, such as the Euphorbiaceae, Moraceae and Pinaceae show a marked resilience to bark removal, in part because the cambium is protected after bark removal by exudates.*

4. ***BARK HARVEST IMPACTS VARY WITHIN SPECIES POPULATIONS:*** *Bark regrowth varies with microclimate. Trunk-bark regrowth in windswept, drier sites is often poor compared with regrowth on trees in shady, moist sites protected from wind. It is for this reason that East African bark cloth producers immediately wrap the whole fig tree trunk in a bandage of banana leaves to protect it from drying out. After about a week the tree has already regenerated sufficiently for this protective covering to be removed.*

5. ***SEASONAL HARVEST FACTORS & TREE PHYSIOLOGY NEED TO BE CONSIDERED:*** *Knowledge of the "best" time to debark trees amongst indigenous peoples is usually based on use values or ease of bark removal, rather than sustainable harvest. In Canada, for example, indigenous people harvest pine bark for its sweet "sap" in spring (May/June) to get maximum sweetness (Gottsfeld, 1992). In Chile, Quilllaja saponaria bark is also harvested during the spring growth period when it is easy to stripfrom the trunk (San Martin and Briones, 1999). Similarly, in South-Central Africa, beekeepers in miombo woodlands also harvest bark to make beehives during the spring and summer growing season. This is when it is loose and easier to remove, yet this is the worst time for the tree itself. Ugandan bark cloth makers, on the other hand, prefer to debark Natal figs at the end of the growing season when the leaves have started to turn yellow and harvest impact is reduced*

6. ***TREE TENURE IS CRUCIAL:*** *Overharvest of trees for bark often occurs when land or tree resource tenure is weak. It is no coincidence, therefore, that sustainable, small-scale agroforestry production of some bark products such as Broussonettia bark in the Pacific, Ficus natalensis in*

Uganda, Cinnamomum bark for spice in Indonesia and Vietnam or Trema micrantha bark in Mexico occurs through more intensive production in people's fields where tenure is strong

7. ***RETAIN ADULT TREES WHICH PRODUCE SEED:*** *Particularly for trees that reproduce mainly from seed (rather than vigorous re-sprouters), harvest has more chance of being sustainable if the large, seed producing trees are conserved, not harvested. For example, matrix population modelling showed that Prunus africana population growth rates are most sensitive to death or low survival rates of the large trees producing the most seed (Stewart, 2001). With commercial bark harvest, the opposite often occurs*

8. ***SIZE CLASS SELECTION & THINNING CAN BE GOOD MANAGEMENT TOOLS:*** *Bark harvesting is often selective for tree size or bark quality and the age at which bark is removed from trees. Inner bark fibre for binding purposes is often stripped from young saplings which have smooth bark, rather than older trees with rougher, thicker bark. Herbalists, on the other hand often prefer to harvest thick bark from older trees, as this is considered more potent. In Uganda, herbalists were even more selective. Not only did they select mature Rytigynia kigeziensis (Rubiaceae) trees, but preferred trees with small yellow-green leaves growing close to or on top of hills, rather than in valleys (Kamatenesi, 1997). The common forestry practice of thinning plantation trees to boost timber production also applies to commercial management for bark, for example in Acacia mearnsii and Quercus suber plantations. Fuelwood is one of the by-products of this thinning process. The type and intensity of management depends on the diversity of products for which the planted landscape is being managed and in Portugal, practical decision-making models have been developed for cork bark production (Borges, Oliveira and Costa, 1997).*

9. ***TAKE TREE REPRODUCTIVE STRATEGIES INTO ACCOUNT:*** *Whether a tree species reproduces from seed or by resprouting from vegetative shoots strongly influences vulnerability to bark removal or stem cutting. Where stem harvesting occurs, resprouting adds resilience to the individual plant and plant population, so it is important to consider the importance of seeds or sprouts (vegetative shoots) in regeneration of harvested plants. Most trees tend to resprout - some very vigorously, some weakly, and a few, like some Podocarpus, not at all. Intensive harvesting of bark has very different effects on reseeder or resprouter populations. In contrast to the harvest of thick bark regenerating on large Ficus natalensis trees (Figure 2c) without felling the tree, bark cloth production i n the Pacific is based on a coppice rotation from young stems which are felled, then stripped of bark. Growth rates after coppicing are a key factor in determining rotation times if coppice rotations are proposed as a management strategy*

10. ***SELECT THE APPROPRIATE ROTATION TIME:*** *Rotation times vary with tree reproductive strategy, growth rates and the type of bark product required. Bark cloth production in the Pacific from Broussonetia papyrifera agroforestry systems is based on selection of young stems grown on a short term (c. 3 year) rotation. In south-western Spain, cork bark harvest takes place on a 10 yr rotation and on a 14 yr rotation in Catalonia. After 13-14 rotations, when trees are approximately 170 years old, good quality cork is no longer produced and trees are either cut or kept for shade (Moussouris, 1999). In contrast, the average age of the 50000 Quillaja saponaria trees felled from the wild in Chile per year is 50 years (San Martino and Briones, 1999)*

11. ***MORE INTENSIVE MANAGEMENT BRINGS POSITIVE OUTCOMES:*** *More intensive management and resilience to bark removal both enable bark regrowth to occur. In Uganda Ficus natalensis trees can be debarked 40-50 times over the life of an individual tree for bark cloth production due to an intensive mangement system where banana leaves are wrapped around the tree trunk to reduce harvest impact and facilitate bark regeneration (Figure 2c). This is similar to what was called "mossing" in the 19th century. Mossing involved wrapping moss around the tree trunk from which strips of bark had been removed in order to enhance regeneration of bark from cultivated Cinchona trees in the Nilgiri Hills, India (Hobhouse, 1999)*

12. ***DEVELOP ADAPTIVE MANAGEMENT PLANS THAT KEEP BARK HARVEST INTENSITY & FREQUENCY AT A LOW LEVEL.*** *When there are incentives for good manmagement practices (due to tree tenure and high bark values) we can develop more precise*

knowledge for sustainable bark harvest through linking local and scientific knowledge. As we learn, we should update and renew harvest management plans.

AFRICAN CASE-STUDY, PRUNUS AFRICANA BARK HARVEST

Prunus africana (Hook f) Kalkman (Rosaceae) is the only indigenous representative in Africa and Madagascar of a genus of over 200 species (Mabberley, 1997; Schatz, 2001). Often referred to by its previous name, Pygeum africanum, Prunus africana is a wild relative of several commercially important fruit crops (peaches, plums, almonds, apricots) and a plant genus of great commercial significance (Phillips and Meilleur, 1998). Endemic to high conservation and catchment value mountain forests in Africa and Madagascar, Prunus africana was listed as a CITES Appendix-II species in 1995. Although cultivation is taking place on a small scale in Cameroon, Kenya and Madagascar, all bark entering the international market is from wild harvest. Over the past 40 years, Prunus africana bark harvest has shifted from subsistence use to large-scale commercial use for international trade. From two initial brand-name products produced in France and Italy to treat benign prostatic hypertrophy (BPH), there now are at least 40 brand-name products using Prunus africana bark extract. These are marketed directly in 10 countries and globally through the internet. Patents for new Prunus africana bark products have proliferated where doctors received approximately 4.5 million visits per year for a diagnosis of BPH (Wei, Calhoun and Jacobsen, 2005). Since 1995, international trade networks have become more complex and seven range States now export Prunus africana bark. Encouraging developments since CITES Appendix II listing are that an inventory and estimation of sustainable harvest have been carried out on Mt. Cameroon (Acworth et al, 1998), and that in 2003, the Ministry of Environment, Water and Forests of Madagascar has worked with multiple-stakeholders to develop a National Plan of Action for sustainable production of Prunus africana (DGEF, 2003). In both range States, it was assumed that wild harvest of half the tree trunk bark (a quarter taken from opposite sides of the trunk) on a 5 year rotation would be sustainable. Recent studies on the impacts of wild harvest on Prunus africana populations in Cameroon show that this is unlikely (Stewart, 2001, 2003a,b). Based on detailed research and matrix population modelling, Stewart (2001) showed that exploitation of large Prunus africana tree is unsustainable and leads to population decline. Matrix population modelling showed that Prunus africana population growth rates are most sensitive to death or low survival rates of the large trees producing the most seed (Stewart, 2001). Harvest was only sustainable if the large, seed producing trees are conserved, not harvested (Stewart, 2001). With commercial bark harvest, the opposite situation to Stewart's (2001) sustainable harvest scenario generally occurs: bark harvesters focus on the largest trees. This easily occurs in remote forests or rough terrain where controls over harvest are limited by few forestry staff and funds. As large trees become scarcer, harvesters are travelling further and further to find mature trees to debark. In Cameroon, bark harvesters are now exploiting trees in the Adamawa Plateau (Laird et al, 2004). Debarking of Prunus africana often occurs within Afromontane forest habitat of global conservation significance (Olson and Dinerstein, 2000; Stattersfield et al, 1988; Stattersfield et al, 1998; Butynski and Koster, 1994). Clearing for agriculture, followed by timber extraction by small-scale loggers (pit-sawyers), forest understorey browsing and trampling by livestock and fire on forest margins are major threats to this forest type. Control over these factors is difficult in range States that are currently affected by armed conflict (Burundi, DRC, Sudan). Five main recommendations are made. Firstly, that Prunus africana is maintained under CITES Appendix II listing. Secondly, that the terms "extract" and "powder" is clarified for reporting purposes. Thirdly, that independent, peer reviewed ecological studies and matrix population modelling are conducted in Kenya, Tanzania, Madagascar, Equatorial Guinea and Uganda. Neither research nor managed, sustainable harvests are likely in Burundi and the DRC until political stability returns, and then only with adequate training and support. Fourthly, it is recommended that when a bark harvest quota is set by exporting countries (such as Cameroon and Equatorial Guinea), that European Union (EU) importing countries adopt the quota level set by the exporting Range State. To date, no EU importing country has implemented this simple measure. Finally, it is recommended that range States and international agencies support and monitor cultivation of Prunus africana. Prunus africana can do the same.

Although the most rational perspective of harvesting impacts is at the larger spatial scales of plant populations and landscapes, we also need to understand how much bark is available from individual trees.

BARK YIELDS

By comparison with trees studied for timber production, few data are available for bark yields or regression equations to estimating bark biomass from tree standing stocks, whether from wild or cultivated species. Data on bark yields, fibre quality and genotypic variation is also available for faster growing plants cultivated as sources of fibre (sunn hemp (*Crotalaria juncea*), industrial hemp *(Cannabis sativa)* and kenaf *(Hibiscus cannabinus)*.

Regression equations for trees: Bark yields and prediction equations have mainly been developed for commercially valuable tree species cultivated for their tannins (*Acacia mearnsii*), cork (*Quercus suber*) and paper (*Pteroceltis tatarinowii):*

- multiple-regressions for black wattle (*Acacia mearnsii*) of bark mass on diameter at breast height (dbh), height, bark thickness based on studies of over 1300 trees in South Africa (Schonau, 1972, 1973), which highlighted the importance of taking accurate measurements of bark thickness, in calculations of bark mass for each tree. For example, *Acacia mearnsii* trees with the same height (20 m) and diameter (15 cm dbh) but with different bark thickness (4mm vs. 7mm) respectively had a bark mass of 22.3 kg and 34.7 kg, or a difference of 55.6%. In general, if height and dbh are constant, a 1 mm difference in bark thickness will cause an increase or decrease of about 10% in bark mass (Schonau, 1973);

- more recently, prediction equations have also been developed to for air-dry bark (cork) production from cork oaks (*Quercus suber*) in Portugal using dendrometric variables of the tree as predictors (Fonseca and Parresol, 2001; Ribeiro and Tomé, 2002). Recognising the needs of cork harvesters stripping cork oaks after 9 years, Ribeiro and Tomé (2002) developed a range of cork bark production models of varying complexity, from a simpler one, using variables which bark harvesters could gather in the field, to more complex ones that maximise the prediction ability. In their study, Fonesca and Parresol (2001) tested eight tree variables. The most reliable of these variables was the interaction between tree circumference (outside bark at 1.3 m) (CSC) and debarking height (H_{DEB}).

- A recent study in China investigated differences in above-ground biomass and bark yield in 33 plantations of *Pteroceltis tatarinowii*, (Ulmaceae), which is used to make Xian paper on a coppice rotation (Fang, Li and Fu, 2004) . Bark yield and tree biomass production were influenced by soil depth, geological factors and soil chemistry. Bark yields were highest from plantations on deeper, slate derived soils (>20 cm depth) high in N, P and K. Planting density also influenced bark yield and biomass. Bark yield was highest occurred in plantations of 4200 stumps/ha, whereas biomass production was

highest at a lower density (3300 stumps/ha). An initial planting density of 3333–4200 plants/ha, and harvest on a 3-year rotation maintaining 8–12 sprouts per stump were recommended for biomass and bark production in a coppice system in *P. tatarinowii* plantations.

Regressions for assessing bark mass in wild species are less well developed and there is a real need for additional research. Exceptions are regression equations developed for bark production from *Prunus africana* in Cameroon (Cunningham et al, 2003), *Rytigynia* species in Uganda (Kamatenesi et al, this volume) and medicinal trees in southern Africa (Williams et al, this volume).

Bark yields from cultivated trees such as in the examples given above is not only useful from an forestry economics perspective, but also as a conceptual tool placing tree cultivation and bark production into perspective as an alternative to overexploitation of wild stocks. Relatively small areas are required ro cultivation of medicinal plants. The estimated total annual world demand for *Prunus africana* bark, for example could be produced by a total plantation area of 2743 - 4200 ha or a 12 year rotation of a total of 230 - 350 ha of trees felled and totally stripped of bark each year (Cunningham in press).

Regression equations for shrubs: Growing demand for paper products has been matched by growing interest sources of fibre from faster growing species as alternative sources of fibrous for the paper industry. Research has focused on how fibre yields from inner bark (bast) and stems is influenced by planting density, genotype, harvest date, irrigation and fertilization (Mambelli and Grandi, 1995; Mediavilla, Leupin and Keller, 2001). Cook and Scott (1998), for example, studied two sunn hemp (*Crotalaria juncea*) cultivars to assess the effects of cultivated plant population density (161300, 225800, 290320 and 354840 plants ha^{-1}) on plant and stand height, bark fibre percentage and stem yield. In contrast to *Pteroceltis tatarinowii,* planting density did not affect stem height or biomass production, although stem basal diameter was greater in *Crotalaria juncea* plants cultivated at the lowest density. Planting density significantly affected bark fibre yields, which were highest in more densely planted stands. Cook and Scott (1998) therefore suggest that planting density could be an important crop management tool to manipulate bark fibre yields for industrial production. Although there was little difference in yields between the two *Crotalaria juncea* cultivars studied by Cook and Scott (1998), a study of kenaf (*Hibiscus cannabinus)* and eight other *Hibiscus* species comprising 103 genotypes found differences yields and in the timing of maturity (with early and late types) (Siepe, Ventrella and Lapenta, 1997). In *Cannabis sativa*, maturity is known to affect fibre yield, as it correlates closely with stem and bark development. In a Swiss field-trial of industrial hemp (*Cannabis sativa*), Mediavilla, Leupin and Keller (1997) found that fibre yield was highest (4.1 tons dry matter/ha) at the time of flowering of the male plants.

CULTIVATION, CASH AND COMMON PROPERTY

For many over-exploited species, there has to be a shift from wild harvest to cultivation, either in plantations or agroforestry systems. This has occurred for wattle

bark production from *Acacia mearnsii*, first harvested from wild populations in Australia to cultivation worldwide, as well as *Quercus suber, Brousonnettia papyrifera*, *Ficus natalensis* and various *Cinnamomum* species. The price paid to local producers and strict tenure over the land on which the trees grow are crucial components for success. With few exceptions, prices paid by middlemen to local people harvesting bark are low, bearing no relation to annual sustainable off-take, and do not reflect the real cost of resource replacement. In many cases, trees harvested for bark are an open access resource, rather than being under private or communal tenure. Low prices also mean that few slow growing species are cultivated. To make a living, commercial medicinal plant gatherers therefore "mine" rather than manage these resources. If cultivation of tree species is to be a viable proposition as an income generating activity then either (i) the flood of cheap bark "mined" from wild stocks is reduced through better protection of conserved forests in order to bring prices to a realistic level or (ii) wild populations will have to decline further before cultivation is a viable option (as is the case with *Warburgia salutaris* in Zimbabwe which became locally extinct before small-holder cultivation started with conservation organisation support . Cultivation for profit is therefore restricted to a small number of high priced and/or fast growing species. In most source countries, subsidised production of these species is unlikely to occur, and collection of seed or cuttings for establishment of field-gene banks (for recalcitrant fruiting species) and seed banks must therefore be seen as an urgent priority.

Responses to the questions discussed at the workshop on bark harvest:

The harvesters the workshop no longer harvest bark – they used to, but then over harvest caused it all to stop.

For bark its absolutely critical to have rights of access so as to not have a free for all.

People will look at the state of the leaves to see when it's a good time to debark. Of course a good time to debark is not always a good time to sell. In fig bark production, sometimes the trunk is rapidly wrapped in banana leaves to keep the moisture in and other methods are used to prevent fungal attack. But tenure is again essential for these management practices to be undertaken.

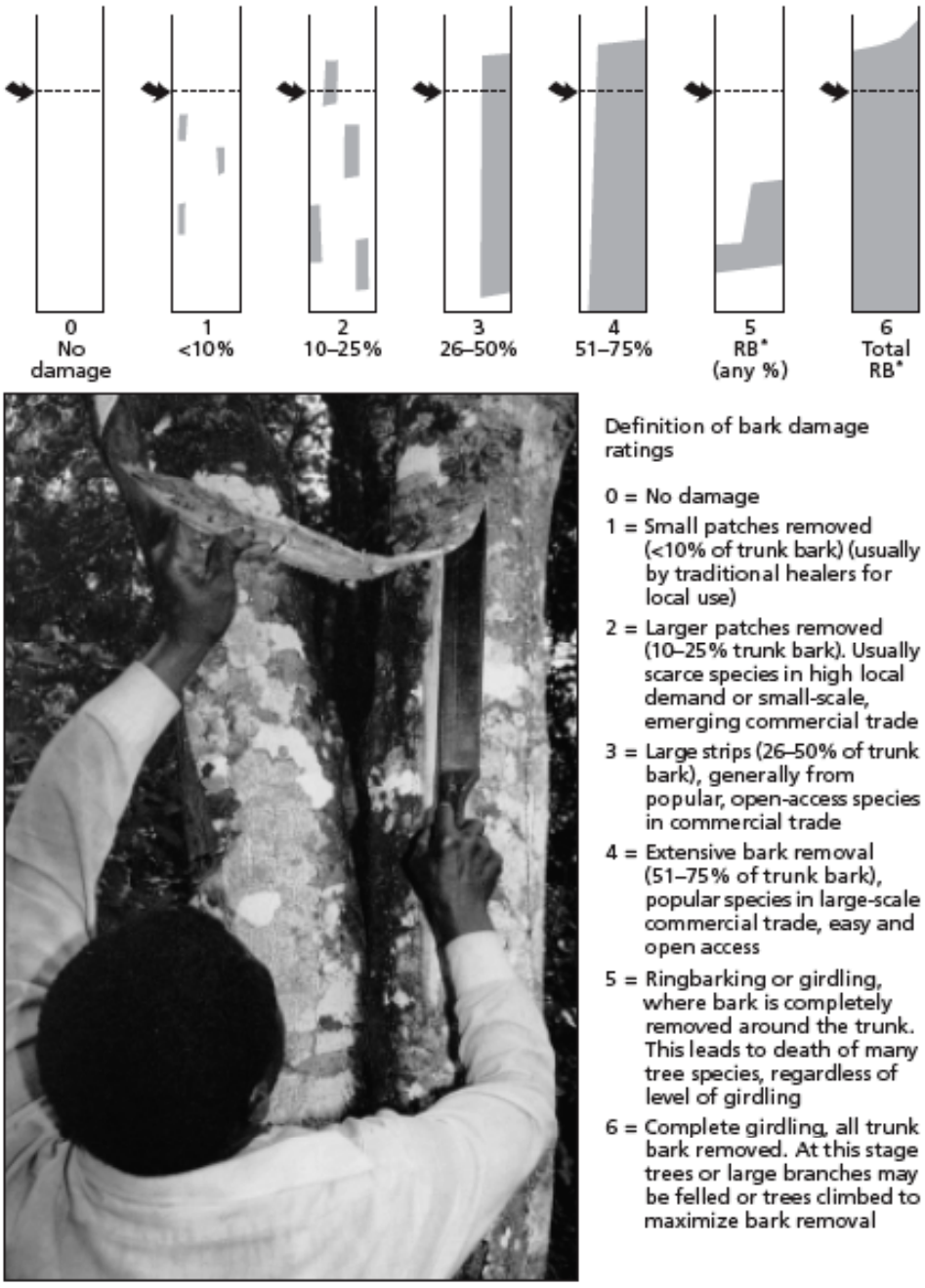


Figure 1. A seven-point scale used for bark damage ratings. The photograph shows a harvester removing medicinal bark from an Afromontane forest tree (from Cunningham 2001)

C.7. LICHEN HARVEST

Introduction

Across the world and in India, lichens represent an important non-timber forest products. Lichens provide food and shelter for small mammals and a source of readily labile nutrient capital (Pike 1978; Coxson and Curteanu 2002). Lichens growing on trees and play a very important role in the maintenance of plants in the forest and the presence of lichens can be an indicator of the health of a forest. However, in some forests, lichens may be absent due to natural causes. Lichens are important as bio-weathering agents of rocks, as well as for food and medicines for humans. People harvest lichens during the rainy season, and lichen growth rates changes as they respond to new gradients of light and moisture availability (Renhorn et al. 1997). Overharvesting can cause lichens to eventually disappear from the forest.

Based on the participatory resource monitoring work carried out in Biligiri Rangaswamy Temple wildlife sanctuary by Ashoka Trust for Research in Ecology and the Environment (ATREE), I am proposing the following methods for estimating production, extraction and regeneration of lichen by harvesters and scientists.

Natural History

Lichens are formed from a combination of a fungal and an algal partner. Lichens will grow almost anywhere where stable and reasonably well-lit surfaces occur. Lichen may absorb certain mineral nutrients from any of these substrates on which it grows. Lichens growing on trees are not parasites, rather lichens growing on trees are simply using the tree as a home. Lichens growing on rocks, though, may release chemicals which speed the degradation of the rock into soil, and thus promote production of new soils. Lichens may dry completely when moisture is unavailable. Several studies have shown serious impacts on the growth and health of lichens resulting from factory and urban air pollution. . Lichen obtains nutrients from the air (including dust), water and some from the substrate they are growing on. There are about 20,000 species of lichen worldwide

Economic Importance

Among the different group of lichens, the crustose lichens are more tolerant to pollution followed by foliose and fruticose forms (Gilbert 1973). As lichens grow and die, they contribute their organic matter to the ground to start the process of creating the first soils. This lichen is not only food for the Reindeer, but in Lapland it is also used as cattle-fodder. In former days, lichens played an important role in the fabrication of pigments. Nowadays they are only used for the dying of wool of very good quality.

Lichens hold importance as traditional medicines.. *Lungmoss (Lobaria pulmonaria)* was used against lung diseases while *Leatherrmoss (Peltigera sp.)* was a cure against rabies. *Icelandic moss (Cetraria islandica)* is still processed in coughing-mixtures. Species like

Evernia prunastri and *Pseudevernia furfuracea* are used in perfumes while *Umbilicaria esculenta* is on the banquet-menu in Japan.

Lichens are important food sources in extreme environments. The Lapp people, who live above the Arctic Circle in Scandinavia and Russia, harvest lichens as winter food for their reindeer, just like farmers in temperate zones who stockpile hay for cattle. Apart from their food value, lichens may be important as a source of free water during periods of cold temperatures. The arboreal lichens in the genus Bryoria are dark-colored and therefore a good absorber of solar radiation. They probably provide liquid for the northern flying squirrel and other animals (Thomas and Rosentreter, 1994) In the deserts of Libya, Africa, sheep often survive by eating crustose lichens that grow abundantly on the rocks.

In countries like Russia lichens are utilized in the production of alcohol and many dyes are also extracted from lichens. A few species of lichens have been used for a long time as a cure for jaundice, fevers, diarrhea, epilepsy and various skin diseases. Lichens can also be used for food. Some species can, after being soaked overnight, be eaten raw or added to stews and soups. A century ago, lichens were used to make dye to colour woolen cloth. Most lichen dye colours are shades of brown or yellow. Blue can also be produced from a few species. The discovery of synthetic (man-made) dyes ended the demand for lichen dyes. The synthetic dyes provided many more colours, and did not fade. Lichen dyes are still used by some weavers who like their soft, quiet hues.

Biligiri Rangaswamy Temple (BRT) wildlife sanctuary

Biligiri Rangaswamy Temple (BRT) wildlife sanctuary is located between 11-13´ N latitude and 77-78´ E longitude, in the southeast corner of Chamarajanagar district in the state of Karnataka, India. The sanctuary is a confluence of Western and Eastern Ghats and is rich in biodiversity. The western range has an undulating terrain, a network of valleys, slow west-flowing streams, and a number of hills with an average elevation of about 1350 m. The annual rainfall is 1362 ± 159 mm based on averaged annual totals from three stations for ten hydrologic years from 1989 to 1998. Ramesh (1989) has broadly categorised vegetation into five forest types (Dry deciduous forest 61.1%, scrub jungle 28.2%, evergreen forest 6.5%, savanna 3.8% and shola 0.8%). Kammathy *et al.,* (1967) recorded 776 species of higher plants.

The *Soligas* are an indigenous tribal community that lives in the BRT. According to the last census there are about 5000 *Soligas* who live in inside the forest villages called *podus* (tribal settlements). Traditionally, the *Soligas* were hunters and shifting cultivators, and collected a wide range of NTFPs. When the BRT area was designated a wildlife sanctuary in 1972, shifting cultivation and hunting were completely banned, and the *Soligas* were allocated small pieces of land to practice settled agriculture. The *Soligas* retained the sole right to NTFP extraction under the aegis of a tribal cooperative called the Large-Scale Adivasi Multi-Purpose Society (LAMPS).

Extraction of NTFPs still remains a major source of income for the *Soligas*. In the interior, NTFPs may account for as much as 50% of the cash income in certain households, though the proportion of such households is low. Hegde *et al* (1996) estimated that harvesting of fruits from two *Phyllanthus* species, lichen and honey (*Apis dorsata*) contributes major cash income and minor cash income from soapnut (*Acacia sinuata*) and soapberry (*Sapindus laurifolius*).

Lichen and its preference

Shorea robusta – an excellent host tree for lichen growth in India (Satya et al 2005). From the studies available on epiphytic lichens of different trees in India (Upreti 1996, Upreti and Chatterjee 1999), the sal trees exhibit the maximum diversity of lichens represented by 64 species. The other two common associate trees of *Shorea*, *Syzygium cumini* and *Mallotus philippensis* have 45 and 9 species respectively. A lichen study has been carried out in Biligiri Rangaswamy temple (BRT) wildlife sanctuary and lichens have been found on a variety of tree species (Table 1).

Table 1. Lichens grow on the following species in BRT wildlife sanctuary:

Local name	Name of the Species	Family
Tare	*Terminalia bellerica*	Combretaceae
Matti	*Terminalia crenulata*	Combretaceae
Honne	*Pterocarpus marsupum*	Fabaceae
Itchi	*Ficus*	Moraceae
Bite	*Dalbergia latifolia*	Fabaceae
Karavadi	*Persea macrantha*	Lauraceae
Dadasalu	*Grewia tiliaefolia*	Tiliaceae
Bende	*Kydia calycina*	Malvaceae
Kallumutaga	*Ougenia oojeinensis*	Fabaceae
Nerale	*Syzigium cumini*	Myrtaceae
Hanase	*Glochidion zeylanicum*	Euphorbiaceae
Nelli	*Embilica officinalis*	Euphorbiaceae
Uluge	*Terminalia paniculata*	Combretaceae
Aranelli	*Meliosma pinnata*	Sabiaceae
Bura	*Bombax ceiba*	Bombacaceae
Buluga	*Dalbergia lanceolaria*	Fabaceae

Lichen harvest

Lichens are usually harvested by scraping them off on the tree surface. The scraped lichen is gathered and collected in bags. After harvest lichens are dried and bark debris is removed. Lichens are then filled in sacks by the harvester, which is weighed by the LAMPS agent in the settlement and then agent supplies lichens to LAMPS. Finally LAMPS sells to the highest bidder through tender.

It is mainly men who participate in collection. The quantity of lichen produced by each tree varies over space and time, and depending on the rainfall. Trees in the scrub, evergreen and shola forest produce much less lichens, and dry deciduous forest produce the maximum amount of lichens. People harvest only from dry deciduous forest - they do not harvest from all the other 3 types of the forest.

Contribution to the cash income
In BRT the average income from lichen collections varies from 10% to 20% of the total cash income for all households in a given settlement (podu). However, when only households that participate in collection of lichen are considered, then lichens contribute from 50% to 65% of the total cash income. Value addition at the source of collection could substantially increase the income of Soligas (Umashankar et al. 1996). However, since it is technically difficult processing of lichen, it is difficult to process at the decentralized level.

Lichens collected by people vary from 462 kg - 15217 kg per year, with an average of 7475 kg per year. Money received from lichen sale also varies from 8316 to 379742 rupees, with an average of 197946 rupees per year from 1993 to 2000.

Some suggested protocols/components for community-based monitoring of lichens (based on BRT experience)

Lichen harvesters from different settlements - with the help of social workers - should estimate the production at different areas within their demarcated land. In each area the group can walk along a one km long stretch of the forest and can estimate the amount of lichen available visually. At the end of the walk, harvesters should discuss their estimates and reach a consensus estimate. The harvesters then draw a map on the ground using charcoal, and using the estimated Lichen yield, they can estimate a comprehensive estimate for their entire forest range. The information can be recorded and maintained on yearly basis. Lichen production estimated by this method could be compared with the scientific methods.

In addition, scientific estimates for estimating Lichen production can be carried out simultaneously if desired:
To estimate the quantity of lichen in forest area or range, transects should be established based on the size of the forest area. Transects of 500 to 1000 meters length and 10 meters wide are appropriate and should be laid randomly. All trees greater than 10 cm diameter at breast height (DBH) and number of lichen yielding trees should be counted every year in the transects. To estimate productivity the survey can be conducted in the month of monsoon season that is before the harvest to understand the stock of the Lichen in the forest and the same transects must be checked to estimate extraction levels after people stop harvesting lichens.

To estimate lichen productivity per tree, five to ten trees can be sampled at random from each transect, one tree per every 100 meter section of transect. To estimate lichen yield per tree, lichen samples should be collected from the tree surface in four randomly selected locations of 25X25 centimeter. Sampled lichens should be weighed to calculate an average lichen yield (in gms) per unit area. The diameter of tree boles and height of tree should be measured. Using diameter, height and average lichen yield per unit area; total tree surface and potential lichen yield per tree can be estimated. Based on the average lichen yield for the sampled trees and the number of lichen yielding trees per unit area, lichen yield can be estimated for transects. This can be then extrapolated to obtain potential lichen yield for the entire forest or range.
Height = (Distance X Top canopy) /100 – (Distance X Lichen started) /100
Tree surface = (Girth X 0.01) X Height X 3.14
Potential Yield = [(Average yield per unit area / 0.0625) X (Total area)] / 1000

Pre-harvest meetings

Pre-harvest meetings should be initiated before harvesters go for Lichen harvest. The goals of the pre-harvest meetings is to make people aware of the importance of Lichen monitoring; assess traditional knowledge of Lichen production, extraction, and regeneration; devise a format for recording observations; and to discuss follow-up procedures. These meetings can be used for discussing harvesting methods and to emphasize the importance of certain conservation measures on Lichen, such as leaving a proportion of Lichen on the tree and not to scrape Orchids along with Lichens and not to cut branches just to harvest Lichen.

Participatory estimation of extraction

After harvest, rates and quantities of Lichens extracted can be estimated using three different methods.
The first method involves estimates made at the level of individual trees. On a given harvesting day, 4-5 trained people should accompany the Lichen harvesters to the forest and visually estimate the amount of Lichens harvested per tree and proportion or number of Orchids been scraped out with the Lichens.

A second method involves visual estimation at the forest level. The same harvesters, who prepared Lichen productivity estimation maps for their respective sites and years, also estimates the quantity of Lichens extracted. Extraction levels are then marked on the same maps that were prepared for Lichen production.

The third method is based on the actual amount of Lichen sold by the LAMPS society each year. That is, extraction at the level of the entire sanctuary that was recorded in LAMPS that was purchased from harvesters.

Post-harvest meetings

During the harvest season, summarized results of the extraction monitoring data should be shared with the harvesters to improve the method of harvest for the next day. The objectives of these meetings are to review the harvest, both in terms of the amount of Lichen harvested and the harvest technique used and also to assess reactions towards the monitoring.

Estimation of regeneration

Monitoring of regeneration should be initiated and carried out once a year during December after the harvest is completed. Every year, a team of 10-15 harvesters can estimate regeneration of Lichen in the harvested trees making observations by estimating the Lichen regrowth on last year harvested trees.

Suggestions for better harvest techniques

The following are suggestions for better harvesting techniques based on the experience and observations made in BRT wildlife sanctuary. In the site, work has been carried out on production and extraction of Lichens. Lichens are usually harvested by scraping them off on the tree surface, and the scraped lichen is collected and gathered in bags.

1) As Lichen are very slow growing plants, instead of harvesting lichen every year from the same trees, its better to harvest once in three or four years from the same tree. To facilitate Lichen growth and development, its better to leave some Lichen on the trees for regeneration instead of over harvesting.

2) Some orchids species grow in association with Lichens. Generally harvesters scrape the Orchids while scrapping lichen. This need to be controlled and its better not to harvest lichen around the Orchids.

3) Usually men harvest Lichen, though sometimes with women accompany them. However, only men climb trees to harvest Lichen as they are huge trees. Therefore men cut the Lichen yielding tree branches for women to remove the lichens on the ground Cutting these branches to harvest Lichen need to be avoided as its not economically and ecologically feasible.

Responses to the Questions discussed at the workshop on lichen harvests:

1. *Collection being linked to the Soliga within the Protected area helps a great deal in ensuring sustainability- there is no conflict. But w.r.t tenure there's the problem of NTFP ban.*
2. *Lichen is not used by the people, nor is there any other trader. Its only going to the LAMPS , so the quantity has been recorded rather closely.*
3. *Adulteration is grey area, not so much information about it. Collections go up to 18 tonnes in that one area (varying from 7-18 tonnes in a year). But because there are other mosses and lichens growing close by and in association, you may be extracting more than just the lichen in question. But this adulteration removed before delivering to the LAMPS. Because this is such a small resource, people look out for trees where there is a lot of lichen – we harvest where there's ample resource to make the effort worthwhile. This means that there are always patches left where there is growing lichen but its just available in smaller quantities. Though there are no traditional uses of the lichen, only recent commercial use, the tree where it occurs is worshipped on Mondays and Thursday and harvest can't start before the prayer has been done. Harvesting is actually being done in the growth season – monsoon. So maybe some scientific intervention can be required.*

4. *Everybody follows the same kind of procedure with lichen, there isn't much difference between individual collectors. It's a male dominated profession; on the rare occasions that women go, its been seen that the men chop the branch and drop it down to the woman who then scrapes the lichen off it on the forest floor.*
5. *Resources close to the homestead affected more. Does lichen harvest affect the tree? No, its probably good; one harvester gave the example of - e.g. if you have a beard and let it keep growing and never trimmed, it would probably not be very good for you!!*
6. *About 20% of the patch is left behind, and its been seen to grow in the same season – regeneration is happening. They also follow a chequered pattern – taking large patches and leaving small ones.*
7. *Little information (including amongst scientists) on what exact role the lichen play in the eco-system.*
8. *Prices for lichen have risen, but there are slumps too, and its not been as though they go and plunder when the prices rise. Wastage issues come up more in the society's storage than the collectors' end. There is also a special tool, a chisel of Pterocarpus wood used to scrape the lichen. No ladders or such like used. No restricted zones or gene pools. Likely that more lichen harvested from dry deciduous patches, but within those there seems to be patches of local abundance – why not known.*

Other comments (from biologist etc)

- *An important factor in sustainable harvest of lichen is probably that harvesters probably can't get to all the lichen in a tree, because of small branches, etc.*
- *Lichen can be slow growing – is it conceivable that even leaving growth on a tree its faster than the rate of regeneration? The Soligas seem to be harvesting once in a couple of years from the same tree.*
- *There must be species in the lichens – is more detail at that level important to know? Indigenous communities sometimes generalize among these lower life forms; we asked but they didn't differentiate beyond mosses, epiphytes, lichens.. they did note that they need the white floral-looking variety.*
- *With reference to generalized nomenclature – in the case of species that are used in differentiated ways, there tend to be names for species. Similarly for animals, where there are uses there are specific names but e.g. for lower animal taxa also the specific names tend to disappear (unless there is a use, insects are generally insects)*

Summary: key points to consider

1) Harvesters harvest from high density areas only, so there are always parts of the forest unharvested. Monitoring could potentially include counts of the # of areas harvested or frequency with which each is harvested
2) Since harvest is patchy, monitoring should also include those areas where harvest did not occur that year
3) Monitoring can involve measures like rating the number of trees with branch cutting
4) Monitoring should also be based on local recognition of species/varieties if they exit (not just lichens all lumped together).

C.8 HARVEST OF WILD HONEY

Introduction to Bees & Honey Collection

Honey Bees

Throughout history and in all regions, beekeeping has been a specialized occupation of certain communities or families, remaining an enigma to the rest of the population. This stands true even today. Today, modern beekeeping is based on a scientific knowledge of the structure, life history, habits and habitats of honey bees and it began with the invention of the artificial hive in 1789. Traditional methods involve honey hunting or making suitable nesting areas from local materials. Traditional Honeyhunters are highly skilled and their activity has evolved over a long period to suit local resources and local bees.

Each area has it's own distinctive style of honeyhunting and beekeeping to suit different bees, each of which has it's own characteristics. The indigenous species of honey bees found in India are:

The Rock Bee *(Apis dorsata Fabricius)*

It gets its name from the habit of nesting beneath overhanging rocks. It is also known as the Giant Bee and is a tropical species found throughout South-East Asia and the Indian sub-continent. Rock paintings from Singanpur, India, which are more than 2400 years old, show Honeyhunters collecting honey from a nest of *Apis dorsata*. This bee is till today the source of a substantial part of the honey used in South-East Asia.

Apis dorsata is the largest, known, social bee. It builds a single comb nest, from bees wax, attached to a high branch in trees, under a rock overhang and sometimes under the ceilings of large buildings. Nesting places built in the open but protected from rain and direct sun during summer and with abundant sources of nectar and pollen in surrounding areas, are preferred. Aggregations of up to 100 colonies in one tree are found in good areas. The upper part of the comb can store anywhere between 2 to 40 kgs of honey. Pollen and brood are stored in the lower part. Worker bees cover the comb as a curtain for protection and to maintain optimum temperature. A strong colony can have 60,000 to 1, 00,000 worker bees.

Apis dorsata colonies are known to be vigorous, vicious and swift to attack intruders. Colonies migrate over large distances to areas with abundant nectar flow, in different seasons. Attempts to domesticate *Apis dorsata* have failed. These bees are valuable pollinators with a foraging range of several kilometers.

The Asian Honey Bee *(Apis cerana Fabricius)*

Being indigenous from Afghanistan to Japan and China, *Apis cerana* exhibits a number of races and sub-races, which differ widely in productivity, behaviour and body size.

Feral (wild) colonies nest in cavities of trees, rocks, stone walls and other dark enclosed places, building several parallel combs. Honey for rearing of brood is stored in the upper part of central combs while pollen and brood are stored below. Surplus honey is stored in the outer combs.

Apis cerana often absconds (leaves) the nest in case of severe disturbance or lack of food. Their temper is gentle to moderately aggressive, with a distinct positive correlation between colony size and aggressiveness.

Beekeeping with *Apis cerana* in simple hives has been practiced in India for at least 2000 years. In Tamil Nadu, some Honeyhunters only hunt *Apis cerana* honey. It is a valuable pollinator with a foraging range of 800 metres. The bee has been domesticated for honey production. Now it suffers from a viral disease, the Thai sac brood virus – making it a vulnerable population.

The Little Honey Bee *(Apis florea Fabricius)*

The small single comb nests of *Apis florea* is often found in dense, shrub vegetation, in cavities of trees and rocks or under roofs of palm leaves. Workers form a multi-layered protective blanket covering the comb. Sticky plant resins are used on the branch supporting the comb, to protect the colony from ants.

Honey is stored in the upper part of the comb while pollen, brood and drone cells are stored below. Honey usually sells at better prices than honey from *Apis cerana* and *Apis dorsata,* due to reputed medicinal properties. The annual yield from a colony is about 1-3 kgs. Honey can easily be harvested, without destroying the colony by applying a little smoke. Unfortunately, honeyhunters often collect the whole comb. If disturbed, the bees desert the comb, but often return within a short time. It is a valuable pollinator with a foraging range of up to 500 metres.

Dammer Bees *(Trigona spp. and Melipona spp.)*

They are the smallest among the honey-yielding bees. They are often called stingless bees because they do not sting but bite. Their nests are built in trunks of trees, logs, wall crevices or under the roofs of dwellings. In Tamil Nadu, there is a tradition for keeping Dammer Bees in bamboo hives. The bees are easily hived and seldom abscond from their nest.

Dammer bees gather propolis (plant resins) and use it together with wax, to construct their nest. In the nest, there is a group of separate cells for brood rearing and another group of larger "sacs" for storage of pollen and honey. The dark and

bitter honey is valued for its medicinal properties. Information on honey yields range from 20 grams to 1 kg per colony per year. They are probably valuable pollinators but information is not available.

Honey Hunting

Honey hunting is a traditional activity undertaken by adivasi communities in the Nilgiri Biosphere Reserve. During the honey season, groups of honey gatherers prepare for the collection. This activity is rich with traditions, beliefs and superstitions, which vary from one community to another. In general, honey collection is done after a period of abstinence, following strict measures to ensure purity and cleanliness. Preparation for honey collection entails the making of ropes and ladders from forest vines and barks and making smokers of green leaves, bamboo spears, baskets for collection, etc.

Usually a group of 4-5 people go for honey collection on cliffs and at least 2 persons when harvesting from the trees. Singing Bee Songs and eating of bee brood and honey, is a way to celebrate a good harvest in the village. These traditions are followed mainly for the collection of *Apis dorsata* - the Giant Rock Bee. The sections below describe the honey gathering techniques of the different groups.

From a traditional activity for food and barter, today honey collection is mainly done for commercial purposes. Over the years, some of the traditions have eroded and more practical tools adopted. However, by and large, honey gathering is special to these people and has retained its role as a cultural activity. In the following section, the status of honey collection in the area is elaborated – covering both, the traditional aspects and the present commercial exchanges.

Resource Organizations:

1. Bees for Development, UK
2. Central Bee Research and Training Institute, Pune
3. National Honey Board, Ministry of Horticulture, Govt. of India, Delhi
4. International Bee Research Association, UK
5. Keystone Foundation, Kotagiri, Nilgiris
6. Asian Apiculture Association, Tokyo

Observation, Science & Thumb Rules in *Apis dorsata* ecology & wild honey collection:

1. *Apis dorsata* is a migratory bee. Honey collection is seasonal. Harvesting is done at the end of the season – just prior to the on-set of monsoon. This is considered most efficient as most of the bee brood is converted into honey – therefore the quantity of honey is maximum.
2. Honey collectors observe the change in shape of the comb from the beginning of the season to the harvesting time. As honey is stored the shape of the comb changes. From a long comb as the bees come in swarms – they form a shorter comb in length and a larger base at the top. The cell size at the top is increased to store excess honey.
3. Honey collectors survey familiar territories during the season for honey collection. These are sometimes their ancestral domains. They estimate the height of the comb from ground and decide on the number of steps required to make the ladder out of forest vines. Few specific species of forest vines found close to honey nests are selected for ladder making. Specific species are used for smokers. Apart from a vessel brought from outside all are forest species.
4. To regulate the honey harvesting and optimize number of bee colonies with substantial honey to amount harvested. We do not purchase honey if moisture content is more than 23%. This allows a waiting period and avoids to some extent a competition for honey hunting – with colonies having less amount of honey. Bees after they store the honey – start the process of natural pasteurizing through evaporation by high RPM through wing movement. This allows the moisture in the honey to evaporate. Then the cell is capped and sealed. With time and good ambient temperature – the honey is mature.
5. If honey is squeezed – Keystone does not purchase. Training on cutting of midriff of the comb for honey to ooze out of cells has been given. This allows hygienic filtration and prevents fermentation through mixture of dirty / foreign particles in honey.
6. Data collection on wild honey is done every year. Name of honey hunter, amount of honey brought, amount of bees wax, number of combs harvested number of combs not harvested, name of cliff, equipment and technology used, number of people in the honey hunting team, number of days spent. Data is available since 1995.

Apis cerana

1. Beekeeping is done with *Apis cerana* bees. Wild honey collection is also done in wild *Apis cerana* bees by indigenous people.
2. Training and promotion of beekeeping is an on-going activity in Keystone. Colony management, biology, capturing, management of diseases are part of the training schedule.
3. With *Apis cerana* as it is domesticated – there are no serious issues of ecological monitoring. Nevertheless monitoring of wild colonies is a priority as wild populations seem to come down.

Apis florea

1. Wild and migratory bee. Not much known of its population and honey harvesting details. Prefers hot, humid and shady climate.

Sting less Bees – Dammar

1. Smallest bees – nesting in cavities. Domesticated by tribals in bamboo. Wild harvesting quite common.

Responses to the Questions discussed at the workshop wrt honey harvests:

Types of harvesters – in some parts societies themselves bring people from outside to collect, but the honey doesn't come to the society at all… it's a dirty game but its done. Societies being instituted have actually created a level of disconnect between the harvesters and the landscape.

Central India – on institutions, in various villages the names of the honey hunters are recorded. Recently there are group insurance schemes for those who climb cliffs for the honey, being done through the JFM committeees by the FD (via the MFP federation). Ladders and sting-proof clothing is being provided- casualties have been reduced as a result. Buyer and seller meets with a couple of thousand people attending are being organized and this is where the prices are being set with a more equal negotiating platform…better prices are possible.

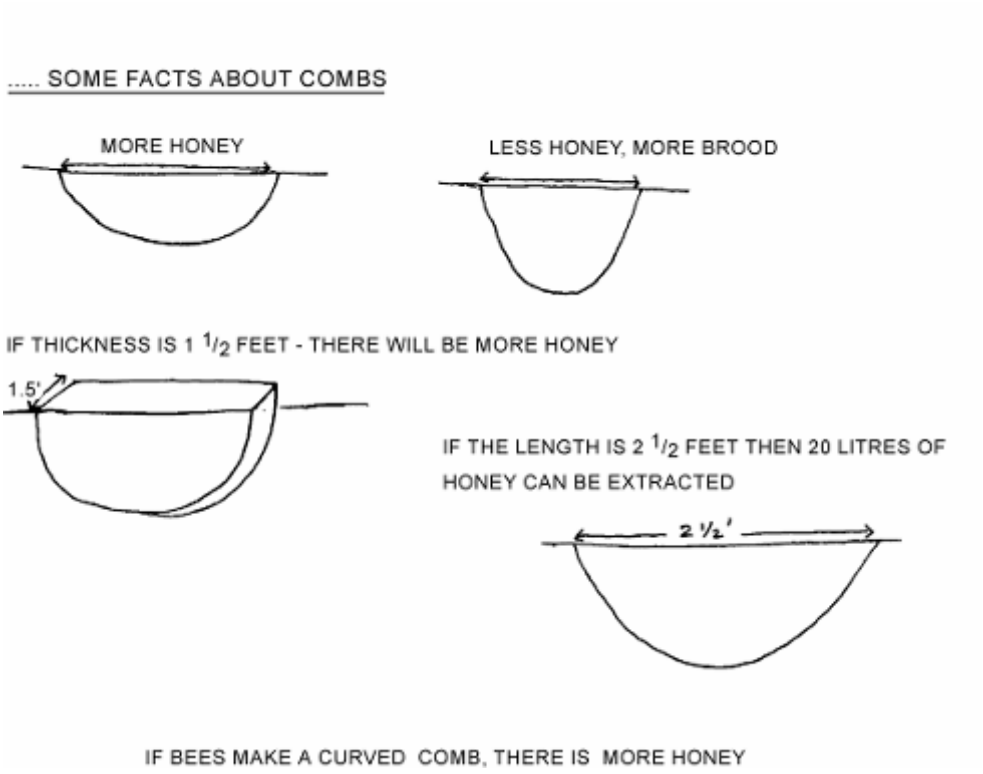
Re. technology upgradation, Keystone feel that this cultural traditional activity within which a lot of conservation ethics are embedded. If one tampers with ladders, masks, or phones for communication.. and if we tried to make these interventions, the whole attempt would take the shape of an enterprise purely, rather than an attempt for the honey hunting ***ecosystem****. If we gave a wire that never degraded, we would lose all the links to the kinds of vines that don't burn....everything.*

Fire and smoke for harvesting to some extent damages the hives. In one area, a repellent was developed from plant extracts that empties the hive for a few hours – maybe that technology can be shared. In Niligiris, at the time of smoking, all the larvae have developed into bees, and all are smoked out along with the bee. The hive is cut, but all the adult bees do go elsewhere. But its also true that when you go for collecting you cant wait for all the hives in your field to be mature – these practical considerations are there.

Landscape level variables must be kept in consideration – e.g. Strobilanthus, etc. have– mass flowering and explosive seed dispersal, only once every couple of years. With the populations becoming fragmented, etc., it makes a difference if there are not enough bees to pollinate in those years because of harvest. With all the tea plantations, and the use of pesticides, bee populations are affected. All these factors go into the populations of the bees, etc. Migration can be affected. We have also observed the migration of bees in BRT – along with the observation of the crop pesticides reducing the populations of bees – changes in the plains cropping patterns affects the livelihoods of the collectors up in the hills. Another reason for the decline of bee populations is the harvesting of neera from Coconut inflorescences, and bees drown in the pots that are attached.

PP Hegde - There is a balance between mortality and survival among bees, a self regulating mechanism of bee population, which helps prevent a situation of more bees than leaves!

These attempts at defining protocols are based on the experience that different people have gathered over the years from working on the issue. Ecological Monitoring has not yet confidently come out with a sustainable harvest limit for any species. But it hashelped to keep the pulse on the resource. There are many NTFP species which show a preference for disturbed habitats then the question that arises is at what point does destructive harvesting become detrimental. The overall objective of the manual is to emphasis for the need of practicing improved harvest practices and monitoring various aspects those are connected directly with the resource production, income generation and trade.



Honeyhunters & Beekeepers of Tamil Nadu – A Survey Document, 2001

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