ASEAN Guidelines for Sustainable Harvest and Resource Management Protocols for Selected Non-Timber Forest Products (NTFPs)

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ASEAN Guidelines For Sustainable Harvest and Resource Management Protocols For Selected Non-Timber Forest Products (NTFPs)

The ASEAN Secretariat
Jakarta

The Association of Southeast Asian Nations (ASEAN) was established on 8 August 1967. The Member States are Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Viet Nam.

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The guidelines are based on a socio- ecological framework and looks at aspects that affect the sustainability of NTFPs. It incorporates scientific as well as experiential knowledge, which indigenous peoples and forest managers have expressed in the form of thumb rules.

These guidelines serve as a primary reference for NTFP management protocols in the region to further guarantee sustainable management of NTFP resources for relevant stakeholders.

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List of Acronyms and Abbreviations

ACCSQ	ASEAN Consultative Committee on Standards and Quality
ASEAN	Association of Southeast Asian Nations
AMAF	ASEAN Ministers on Agriculture and Forestry
AMS	ASEAN Member States
ASOF	ASEAN Senior Officials on Forestry
AWGSF	ASEAN Working Group on Social Forestry
ASFCC	ASEAN-Swiss Partnership on Social Forestry and Climate Change
CCA	Chromated Copper Arsenate
CFE	Community Forestry Enterprise
CoV	Certificate of Verification
CS	Certification Systems
CBHE	Cambodia Federation for Bee Conservation and Community-Based Honey Enterprises
DENR	Department of Environment and Natural Resources (Philippines)
DOST–FPRDI	Department of Science and Technology – Forest Products Research and Development Institute
FAO	Food and Agriculture Organization
FIPI	Forest Inventory and Planning Institute
FPRDC	Forest Products Research Development Centre
FRIM	Forest Research Institute Malaysia
FSCRC–NAFRI	Forest Science Research Center, National Agriculture and Forestry Research Institute
GI	Geographic Indication
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
IP	Indigenous Peoples
IPLC	Indigenous peoples and Local Communities
ISO	International Organization for Standardization
ITTO	International Timber Trade Organization
IUCN	International Union for Conservation of Nature
JMHI	Jaringan Madu Hutan Indonesia
Lao PDR	Lao People's Democratic Republic
MBDC	Mountainous Bee Development Centre
NTFPRC	Non-Timber Forest Products Research Centre
NTFP	Non-Timber Forest Products

NTFP–EP	Non-Timber Forest Products – Exchange Programme
PFHN	Philippine Forest Honey Network
PGS	Participatory Guarantee Systems
RCB–LIPI	Research Center for Biology – Lembaga Ilmu Pengetahuan Indonesia (Indonesian Institute of Sciences)
SPABP	Samahan ng mga Palawano sa Amas Brooke's Point
SIE	Southern Institute of Ecology – Vietnam Academy of Science and Technology
SSNC	Swedish Society for Nature Conservation
SDC	Swiss Agency for Development and Cooperation
UNEP–WCMC	United Nations Environment Programme World Conservation Monitoring Centre
UPLB	University of the Philippines, Los Baños
WATALA	Friends for Nature & Environment, Lampung (Indonesia)
YBL	Yayasan Bambu Lestari

Glossary

cambium	the thin inner layer of a tree from which new bark is produced
clumps	cluster of standing culms taken as one individual bamboo plant
culms	the aerial stems of bamboo, usually hollow between nodes or rings
eusocial	a high level of social organization characterized by cooperation in caring for juveniles, division of labor, and overlapping generations
exudate	a substance secreted by a plant (for example, resin from an almaciga tree)
rhizomes	bamboo stems below the ground

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I. Rationale and Scope

The ASEAN Economic Community (AEC) foresees a future where its companies and community enterprises are competitive across the region and across the globe. This can only be possible if these companies, from small to large, meet the minimum standards for product requirements of buyers and consumers. Standardization is a necessary step in the aspiration of the AEC towards global competitiveness.

The ASEAN is going through a process of harmonization of standards for various products, including forestry products. However, standards for non-timber forest products (NTFPs) are still in their early stages in many countries. Protocols for sustainable harvest and management of NTFPs are crucial in order to meet quality standards.

In 2019, the Non-Timber Forest Products Exchange Programme (NTFP–EP) completed a gap analysis on NTFP standards in the ASEAN region. The study was meant to inform standard development strategies for regional and global competitiveness of ASEAN in the NTFP sector. This study revealed the important connection among sustainable harvest, quality of NTFP products, and their contribution to the overall sustainable management of NTFPs. With this realization, NTFP–EP was tasked by the ASEAN Senior Officials on Forestry (ASOF), specifically the AWG-FPD (ASEAN Working Group on Forest Products Development) to lead a consultative process to develop guidelines on sustainable harvest and resource management protocols for important NTFPs.

There is growing market demand for proof of sustainability and conservation of natural resources (HBR, 2019). For community forestry, small holders, family farmers, and producers to capture that market, they need to be able to meet the standards of quality and sustainability as important purchasing criteria. In 1992, the ASEAN Consultative Committee on Standards and Quality (ACCSQ) was created to facilitate the implementation of the ASEAN Free Trade Agreement. The committee has 12 working groups that are developing certain product standards, but none are related specifically to NTFPs, or for sustainable resource management.

These guidelines will serve as a primary reference for NTFP management protocols in the region to further guarantee sustainable management of NTFP resources for markets and relevant stakeholders. These guidelines incorporate scientific as well as experiential knowledge, which indigenous peoples and forest managers have expressed in the form of simple rules

of thumb (also known as thumb rules.) They are also based on a socio-ecological framework, looking at aspects that affect the sustainability of NTFPs: whether they are threats to the species and population of NTFPs from within the local geographical region, such as poachers or unsustainable harvesting, or whether they come from greater land use changes, such as plantation expansion, resulting in forest decline. Policies and institutions are examined to see how they support or hinder the capacity of forest users to implement sustainable practices.

As a starting point, examples of sustainable resource management protocols are presented for five important NTFPs: forest honey, resin, fruits, rattan, and bamboo.

II. Objectives

The guidelines on NTFP sustainable resource management protocols aim to achieve the following:

1. To promote awareness on the value of sustainable resource management practices and the importance of sustainable harvest protocols
2. To inform and guide the formulation of policies and programs by ASEAN Member States and other related institutions in ASEAN countries with regards to the sustainable management of NTFPs
3. To enhance partnerships and cooperation among stakeholders in the ASEAN community through the establishment of a common reference for the sustainable management of NTFPs

III. Methodology

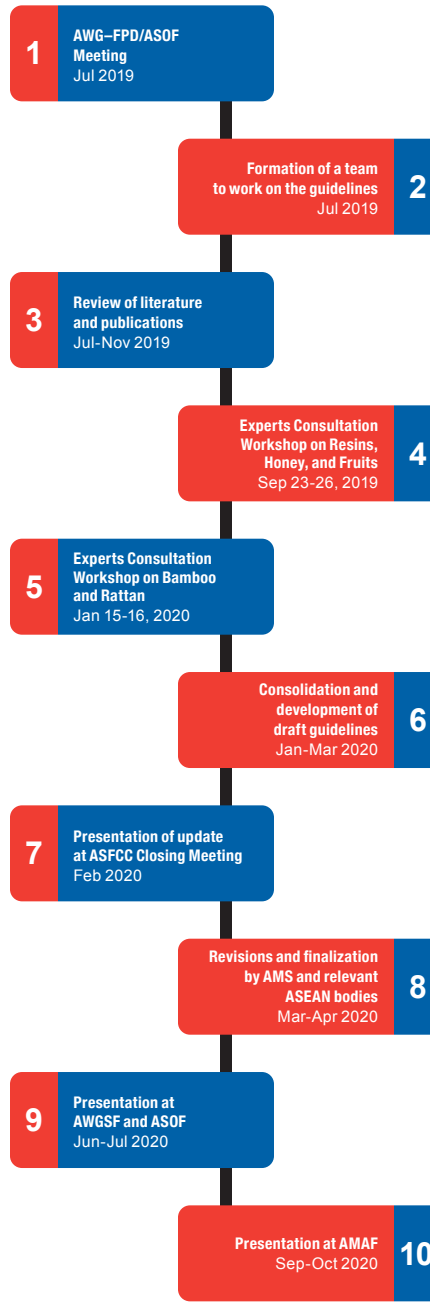
To develop these initial guidelines, key activities were undertaken including:

- Literature review, consisting of publications and related documents on existing protocols and guidelines on NTFPs;
- Meetings and workshops with participants from the academe, government, and forest communities; and
- Series of consultations with experts on five economically important NTFPs in the ASEAN region namely: honey, resin, fruits, rattan, and bamboo. Consultations included participants from government institutions, the academe, researchers, non-government organizations, and community leaders harvesting these NTFPs.

During the workshops, sessions on understanding the socio-ecological framework of the five selected NTFPs were conducted. This activity includes a review of ecological factors, trade and market considerations, institutional and organizational arrangements, and policies and regulations that affect the sustainability of the harvest. Thumb rules and indicators, along with practical monitoring methods and ideas for monitoring indicators for change and adaptation, were discussed and documented.

These guidelines were developed in collaboration with various stakeholders such as the policy makers of ASEAN Member States (AMS), scientists, community practitioners, and civil society support groups.

***Figure 1**. Timeline and Process for Developing the Guidelines*



IV. Target Audience

These guidelines are primarily intended to assist ASEAN Member States in developing NTFP protocols with various stakeholders in consideration of the following:

- The socio-ecological framework for sustainable harvest and resource management of NTFPs;
- Thumb rules developed by communities from traditional ecological knowledge;
- Indicators generated through conventional scientific investigation;
- Understanding changes over time and adaptation measures;
- Practical monitoring methods.

These guidelines may also be used by program managers at the national and sub-national levels, research and academic institutions, community enterprises, traders, and civil society groups that are working on projects involving management of NTFP resources, as well as for advocacy purposes.

In many sites across Asia, community stakeholders have already been observing thumb rules and monitoring locally identified indicators. In some cases, the youth and volunteers of the community also assist in monitoring and recording information (Box 4. Community Harvest Protocols and Monitoring of Resin). In other cases, university students have assisted in monitoring.

Through these guidelines, ASEAN Member States and local partners may be best advised on formulating NTFP protocols and monitoring activities to achieve sustainable NTFP management.

V. Definition of Terms

Plant products from the wild are harvested extensively by some of the most marginalized communities in the world. They contribute to many natural resource-based industries like medicinal plants, handicrafts and furniture making, and health food. These items are called **non-timber forest products (NTFP)** and are “defined as goods, other than timber and firewood, of plant origin and derived from forests which may be used directly—such as food, fiber, medicine, and construction materials—or processed further to yield oils, soap substitutes, and other commodities. These products may be traded for money or bartered for other goods and services (De Beer and McDermott, 1996).”

Management through localized value addition gathered momentum as a means of poverty alleviation, through initiatives catalyzed by research from the Peruvian Amazon (Peters et.al 1989). The study showed that income from sustainable NTFP collection was higher than the returns from timber harvesting or any other land use. When these value addition efforts were scaled up, the ecological sustainability of harvesting from the forests and impact on plant populations became a matter of concern, which needed to be understood better.

Sustainability requires that NTFP plant populations are able to persist over the long term, and not negatively affect ecosystem composition and functions. NTFP harvest systems can have ecological impacts at multiple scales, from individuals to ecosystems. The impacts of harvesting depend on many factors, including parts of the plant utilized, survival and reproduction at the level of population or species, and the nature and intensity of the activity (Ticktin, 2004). The life history of the species, defined as the life cycle of plants and understanding how they allocate resources for growth, also need to be studied.

Questions have been raised about the social and economic benefits to the harvesters—have NTFPs been able to address poverty alleviation as they were supposed to do? Management practices and the larger socioeconomic, political and ecological context need to be considered when assessing the impacts of NTFP harvest (Cunningham, 2001; Ticktin and Shackleton, 2011).

Sustainable NTFP management is a process to achieve continuous flow of products and services with none or minimum negative impacts on species populations, yields, and habitat in the long term (Ticktin and Shackleton, 2011).

Research shows that many NTFPs can be harvested sustainably especially if methods based on science, local knowledge, and policy are integrated into the protocol for management.

A **protocol** is a set of rules that allows stakeholders in an NTFP management and production system to communicate with each other about harvesting practices, value addition processes, quality and volume of harvest, ecology, pricing, and policy. An effective protocol is specific to site, plant, and product.

The protocol is strengthened when it incorporates practical **'rules of thumb'** that are based on experience and practice. Such rules make the protocol easier to implement and enlists broader participation. Rules of thumb are guidelines that can be applied broadly, are easy to learn and apply, and are based on practice. Often, local communities or NTFP gatherers who are managing resources do not have access to technology and capacity, and in this situation, thumb rules become more practical.

These guidelines include both thumb rules as well as **indicators**, defined as a trend that signifies the state of a given parameter. For example, in many NTFPs, color can be an indicator of the maturity of the product. Darker resin indicates that it is older, as light is unable to penetrate the substance. The color of honey can indicate the pollen and nectar source. Other indicators can be seasonal, such as a long dry season that can indicate increase in flowering and fruiting. When certain flowers bloom in the forest, it is an indicator the bees will arrive soon.

Once a protocol is established and rules of thumb and indicators have been set, then monitoring becomes important to ensure compliance. **Monitoring** is defined as "the systematic measurement of variables and processes over time and assumes that there is a specific reason for that collection of data, such as ensuring that standards are being met" (Spellerberg, 2005). Monitoring is one way for resource managers to establish partnerships with communities and ensure sustainable harvests. Due to the complexity of NTFP harvest systems, there are too many components to monitor; therefore, the question of 'what should be monitored?' becomes very important. When selecting indicators and thumb rules to be monitored, some criteria can be kept in mind: changes in practices, easily identifiable factors, widespread occurrence, and either quantitative or qualitative records.

VI. Threats to NTFPs

Guidelines to establish standardized protocols are necessary to address the primary threat to NTFPs—the loss of habitat due to deforestation, degradation, and fragmentation.

In 2010, forest cover in Southeast Asia was 49% of the land area or 214,064 million hectares, with national forest cover ranging from a low of 26% in the Philippines to a high of 68% in Lao PDR. Between 1990 to 2010, 42 million hectares, or 8% of the forest land area, was estimated to have been lost in the region. These figures do not reflect quality of forest, as even forests with 10% canopy cover is considered in the total. Another 16 million hectares is expected to be lost by 2020 if trends continue (FAO, 2010).

Entire populations or even species of NTFP plant and animal sources can get wiped out when their habitats are destroyed or converted to other uses through large-scale logging, mining, and monocrop plantations. Dams, roads, and other large infrastructure also affect the health and vitality of forests, as well as increasing urbanization and large-scale forest fires. Massive burning of the peat lands in Indonesia, for example, threaten the existence of rare rattan and pitcher plant species which are being used for indigenous tools and handicrafts.

The resulting loss of biodiversity exacerbates threats to NTFPs, as many of them thrive in niche habitats and depend on the integrity of these habitats or of the entire forest to exist. Honeybees, for one, need to forage on the nectar of flowering trees; therefore, the diversity and abundance of available nectar sources will greatly affect the quality and quantity of honey. Southeast Asia is a biodiversity hotspot, having the highest proportion of threatened species of vascular plants, reptiles, birds, and mammals than any other region in the world (UNEP–WCMC & IUCN, as cited in Sodhi, 2010).

Imbalances in the ecosystem create opportunities for invasive species and disease-causing pathogens that may either affect the NTFP source directly, or other species they are dependent on. Chemical pollution through pesticides and insecticides also pose a threat to the integrity of the soil and NTFP species which are susceptible to environmental changes. This includes flowers and fruits, which in turn affect bees and other frugivores and pollinators, which affect biodiversity of the area.

Illegal trade in ornamental plants such as orchids, rare cycads, and succulents also pose a species-specific threat to these plants. Commercialization of

NTFPs may result in their cultivation or domestication. There have been no long-term studies on the effects of domestication on wild populations, whose genetic diversity may be affected. The emergence of genetically modified organisms (GMO) poses an unseen threat, as no long-term effects have been studied or revealed.

Climate change also has detrimental impacts on forest species. Flowering patterns are changing, affecting fruits and honeybees and other forest food sources. Harvesting seasons have become increasingly unpredictable. Extinction of endemic species is highly likely, which will create a domino effect on habitats and even entire ecosystems.

Security of tenure is very important in forests where Indigenous Peoples and Local Communities (IPLC) live. Ownership of the land enables them to protect their territory from poachers and and manage their NTFP resources in their own traditional and sustainable ways. Indigenous peoples have a holistic body of knowledge that is not preoccupied with quantitative data, but is integral to their culture. Their beliefs provide an understanding of the environment that can deal with its complexity and interpret signs and relationships, including humans (Berkes, 2009). Cultural disintegration of indigenous communities leads to lack of control in NTFP resource management, as traditional systems are no longer followed. Increased commercial demand may also lead to the insufficiency of traditional management practices to sustain the resource base, as indigenous communities have been harvesting NTFPs only for subsistence use (Stockdale, 2005).

To determine the threat to a particular NTFP, its biology and ecology must first be studied. This includes growth rate, habitat requirement, and roles and relationships with other species. NTFP harvesting will have different implications on biological processes, possibly affecting physiology and vital rates of individuals and community and ecosystem level processes. It can also change the demographic and genetic patterns of populations (Ticktin, 2004). Excessive harvesting of fruits, for example, will impact fruit-eating birds and bats, and as their pollinators, the fruit tree will also be affected by the decline in population of its pollinators.

The lack of supportive policy and institutions to regulate trade that favors sustainable practices and IPLCs heighten the threats to NTFPs. The tedious and expensive process of certification schemes, for example, is very limiting to communities. Often, harvesting communities are not rewarded for their sustainable management systems. This may lead to a breakdown of traditional practices, non-compliance with rules, and over harvesting. A higher price given for NTFPs on the other hand, can incentivize sustainable harvest.

VII. Socio-Ecological Framework for Sustainable Management of NTFPs

Indigenous people in the ASEAN region have been collecting NTFPs for a long time. These consist of wild harvested plant parts such as leaves, fruit, seed, bark, and root that are used as food, craft and traditional healing. These products play an important role in the lives of local communities as part of their household consumption, cash incomes, and cultural practices. However, widespread and large-scale harvests have led to degradation of forest habitat and loss of species. Unregulated trade and local markets for these products have also led to social exploitation of local communities.

Several studies have shown that NTFPs play an important role in interventions that seek to balance the conservation and livelihood benefits that are key to a community-based conservation approach (Vedeld, et al, 2004; Belcher & Schreckenberg, 2007; Chao, 2012; Morsello, et al, 2012; Wunder, 2014.) The work of NTFP–EP and partners with harvesters of NTFP for the past 20 years, especially in promoting sustainable use of natural resources, has resulted in the development of protocols for harvesting wild products. These protocols integrate traditional knowledge and practices of the indigenous communities with scientific methods of harvest, value addition, and monitoring. Using a variety of methods, social and ecological, is ideal in monitoring compliance and measuring outcomes. In the case of a forest-based enterprise, the information required to assess the sustainability of the harvest is based on the following:

- Ecological parameters
- Harvest methods
- Raw produce quality
- Production and processing standards

There has been an increasing demand for NTFP products, especially from herbal and medicinal plant industries. These protocols can only be implemented if there are market incentives for non-destructive harvests, thereby contributing to sustainable management of natural resources. Monitoring plays an important role in ensuring that protocols are followed and implemented.

At the outset, it is important to understand the threats to the NTFPs that are being harvested. If a species is threatened due to harvesting and removal from the wild, then dealing in the product for trade and value addition would not be recommended. After understanding the threats to the conservation of the species, a set of simple rules of thumb can be established in consultation with local communities to reduce these threats. The next logical step would be to establish simple indicators that can be easily monitored, to ensure that thumb rules are followed.

Box 1. Why are Socio-Ecological Parameters Important?

Much of the natural landscapes today have been modified by human activity either directly or indirectly, in recent times and in the distant past. There is no denying the impact of human presence on the environment—land, soil, water, or air. Therefore, it is important to see the context of social and ecological systems when monitoring products gathered from the forest.

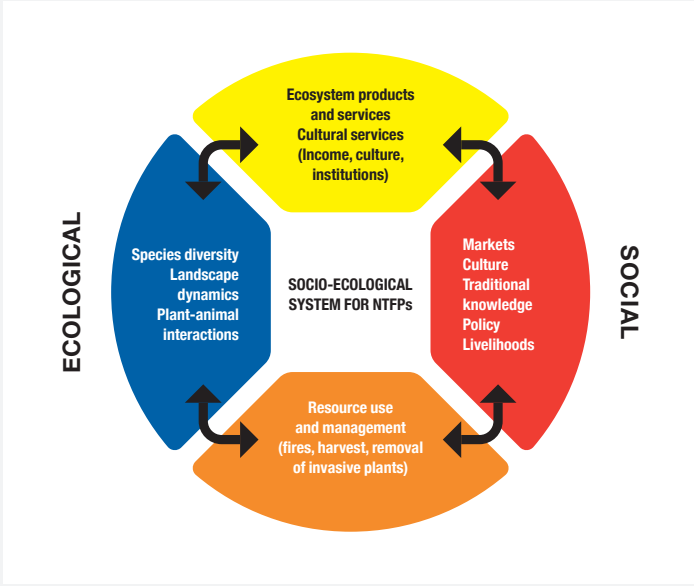


Figure 2. *Socio-ecological components of an NTFP harvest system which are constantly interacting with each other. This representation is based on NTFP–EP field experiences and was developed in consultation with Prof. Tamara Ticktin, University of Hawaii.*

Socio-ecological systems (Figure 2) look at the interrelated nature of human use and biodiversity richness. There is constant push and pull between social and ecological factors, forming a feedback loop. Human activity, such as removal of a plant part or whole plant, has impacts at several levels—individual, species, community, and genetic. The impacts spread out to other interdependent species. For example, the removal of fruits for trade reduces the amount of fruit available for wildlife. The forest where the product is gathered is an important space for biodiversity richness to thrive. Invasive species in the understory of the forest may prevent saplings of the fruit-bearing tree from growing to juvenile stage, so the community and forest managers need to address this ecological condition to maintain a healthy forest. One example of social factors influencing ecology is that some harvesters use fire to manage invasive species, but this may damage flowers and affect fruit production in the next season.

In a socio-ecological system, conservation of resources rests on three important principles:

1. **Sustainable harvest limits.** Essentially a method to harvest the surplus while ensuring the population remains stable.
2. **Resilience.** Capacity of a system to change and adapt without collapsing, and remaining within critical thresholds (Folke, et al. 2010).
3. **Adaptive Capacity.** Resource users in a socio-ecological system retain the ability to influence and manage resilience. These principles evolve from an understanding of the dynamic nature of any ecosystem—living with change and managing it to more desirable directions is the goal of these principles. Resilience does not mean the ability to return to the first stage, but rather to a point from where populations are able to bounce back. “Dynamic and complex social-ecological systems require strategies that build resilience rather than attempting to control for optimal production and short-term gain in environments assumed to be relatively stable.” (Folke, et al 2011). The complex web of interactions between social and ecological systems span time scales, making it important to study slow, sudden, and fast changes while also understanding the spatial linkages between production in one landscape and demand in another.

Listed below are some indicators of a resilient system:

- Conservation and development have multiple objectives and stakeholders.
- Long-term intergenerational institutions are in place to provide good governance.
- Culture is dynamic and shapes resource use.
- Environment is dynamic and shapes landscapes.
- Partnerships are prioritized.
- World views are respected.

MONITORING INDICATORS

For the socio-ecological framework, five indicators are proposed for monitoring the sustainable management of NTFPs. Each set of indicators has a bearing on how well a sustainable NTFP management system functions, as described below.

A. Ecological

Research on the ecological function of NTFP species is still very much needed. Very often, studies are conducted to understand the yield and quality of the produce, and not so much to understand the role of the plant in its habitat. For example, a resin tree in the forest may be a nesting site for an arboreal animal, its fruits an important part of a rare bird's diet, its resin used by insects for building nests. Unless the ecological role of the NTFP species is understood, especially how its population density influences the community composition in its natural habitat, whatever prescriptions given for sustainable harvest limits will never be accurate. The species is not only impacted by harvests. The role of pollinators, seed dispersers, and climate all play a part in determining the long-term survival of NTFPs in the forests. Though there are indices that exist to measure ecological stability, it is important that users of the protocol identify ecological indicators which can be monitored to ensure ecosystem services and functions remain intact.

B. Harvest and Resource Management

For NTFPs that are growing in natural forests, one of the factors that affects quality and sustainability is the harvest practice. For example, harvesting only the head or the honey part of the *Apis dorsata* comb means that majority of

the brood will be left. This method ensures that the colony of bees thrive; if much or the brood was taken in the harvesting process, the colony would have less chances of survival. For plants, harvesting improperly could lead to the death of an individual plant. For example, cutting too deep into the bark of a resin tree, piercing its vascular cambium, may destroy the ability of the tree to heal injury. Cutting the rhizome of turmeric, or yellow ginger, could affect its capacity to sprout back. Harvesting the rhizome of turmeric could reduce its capacity to produce shoots.

For bamboo stands, harvesting is very crucial. Only mature culms should be harvested and clumps should never be clear cut. Clumps with just a few culms remaining should be left to recover for another 4 years.

Rituals or cultural beliefs are also important in resource management. In Indonesia for example, the Dayak people plant rattan in rattan gardens. Some regard the rattan garden as their “bank” and they only “withdraw” rattan for very special occasions. This belief helps maintain the sustainability of the rattan garden.

The timing of harvest is also crucial in ensuring the survival of NTFP species. When harvesting a whole plant, it is essential to know if the plant has flowered and produced seeds before it is uprooted. In the case of fruits, if these are harvested before they are mature, the viability of the seeds to contribute to the population will have to be taken into account.

C. Trade and Markets

Although some ASEAN countries and international institutions such as ISO already have quality standards for certain NTFP species like bamboo, many quality standards for NTFPs have not been developed for ASEAN countries. This is because quality standards are largely dependent on market demand, particularly for food products like honey. These standards can be met through proper harvesting, handling, and processing protocols.

The volume of harvest has a significant impact on the sustainability of an NTFP system. For ecological sustainability, there is a need to check that NTFP harvest has no negative impact on the population or its productivity and capacity to regenerate. For bamboo for example, a thumb rule is to harvest ¼ of the total culms, so that ¼ can be collected every year. But this also depends on other factors such as the ecological environment and soil characters. For economic sustainability, the quantity has to be enough to tide over long periods, so storage facilities have to be in place. Many NTFPs are seasonal, and have to be harvested and stored for the whole year.

Strong partnerships in the supply chain such as fair trade organizations, access to clean food grade containers and storage facilities can help ensure the quality of NTFPs. It would be a huge waste if NTFP producers ensure proper harvesting, only to lose quality points in processing and transport during the marketing of their goods.

Participatory Guarantee Systems (PGS) and Certification Systems (CS) are also market mechanisms that can add value to sustainably harvested NTFPs.

D. Institutions

Cooperatives, producer associations, and companies can assist in bringing economies of scale to a large number of NTFP harvesters who are working individually. These institutions can help also maintain and enhance the value that Community Forestry Enterprises (CFEs) make, so that there is more incentive to sustainable harvest and management.

Traditional institutions like a council of elders and the tribe itself may associate certain norms around NTFP harvest and management with a belief system. Social practice around belief systems can also strengthen protocol implementation.

E. Policy and Regulation

Understanding NTFP policies is important because it affects access to the resource by the primary gatherers. Government regulations can either promote or hinder NTFP trade. Often, policies that are not supportive of NTFP protocols result in a disincentive for producers to continue with NTFP businesses. For example, permitting systems and documentary requirements increase transaction costs that may not make sustainable harvest desirable and even viable. There is a need to review policies that are internal to an organization or indigenous community, as well as formal regulations at the local, national, regional and even international levels.

As ensuring sustainable NTFP management requires action from various stakeholders, these guidelines present various indicators to be observed and acted upon by various actors. In the collaboration of these actors does the potential for sustainable NTFP management increase.

Prioritizing which indicators to monitor at site level is agreed upon by local stakeholders after taking into account the local situation and various factors such as time availability, resources, knowledge, and frequency of observations, among other aspects.

VIII. Guiding Principles for Socio-Ecological Monitoring of NTFP Management Protocols

HARNESSING TRADITIONAL ECOLOGICAL KNOWLEDGE

Indigenous users of natural resources are guided by traditional ecological knowledge, which deals with the complexity of harvesting practices through rules of thumb and indicators. This body of knowledge has been handed over many generations through oral tradition. This knowledge is experiential and learnt by observation and practice. It helps communities live with nature based on their cultural beliefs and practices, and guides them in making decisions on harvesting products from the wild (Berkes 2009, Turner 2006, Gadgil 1992).

Often disregarded for not being “scientific” in some circles, traditional ecological knowledge has, in fact, demonstrated the sustainability of some NTFP management systems. One such example is the resin management system of the Pala’wan community in Brooke’s Point, in the Philippines. (See Box 4: Community Harvest Protocols for Resin in Palawan, Philippines). In this example, the traditional governance system plays a key role in ensuring the application of sustainable resin management practices. There is a need to advocate for the use of local or traditional ecological knowledge in community-based monitoring programs, and integrating elements of local knowledge in scientific methods.

The tolerance of an NTFP species to harvest methods varies according to the life history, the part of the plant that is harvested, the management practices, and the environmental conditions over space and time (Ticktin, 2004). There is currently lack of research, particularly long-term monitoring of harvesting practices and sustainability, not just of the NTFP species but of other species it is related to in its niche or ecosystem (Belcher & Schreckenberg, 2007). This is why traditional knowledge becomes all the more important, as this has been in existence and has proven to work through generations. Indigenous knowledge is a good source of long-term information on species behavior, interactions, and long-term monitoring on survival based on time-tested harvesting practices. For example, many indigenous

communities are knowledgeable with the behavior of forest bees including honeybee migration, nesting preferences, and floral choices.

COMMUNITY ENGAGEMENT AND INFORMATION SHARING

Working with communities is imperative in the implementation of NTFP protocols. Understanding their perspectives, challenges, and needs over the entire period of interaction must be strengthened. Data sharing has to be sensitive to the community's wishes. The need to disseminate knowledge that can benefit the overall monitoring effort has to be balanced with the sentiments of the local community.

PARTICIPATORY DATA COLLECTION

Sectors that have studied NTFPs from a strictly scientific forestry lens usually prefer to use common methods of inventory and quantitative assessments to arrive at sustainable harvest limits. However, these methods take time, expert input, and funding. Often, there are not enough resources (human and financial) to make these assessments. Given this reality, using local qualitative indicators and monitoring can be done, bringing in partnerships among academicians, researchers, and forest users to collect and manage data. Both qualitative and quantitative data can be part of the protocol. In some cases, technologies like Global Positioning System (GPS) and cameras may be used.

ESTABLISHING MULTI-STAKEHOLDER PARTNERSHIPS

To achieve the full potential of these guidelines, successful partnerships have to be established among academicians, policy makers, managers, and other local players. Long term sustainability of the monitoring effort depends on the willingness of the community and other stakeholders. The investment into this partnership will be critical in implementing protocols for sustainable NTFP management.

ADAPTIVE MONITORING

The environment is not static, and the unpredictability of weather patterns has become a reality among forest communities. Local natural resource users experience the changes more rapidly, and are adapting their traditional practices and knowledge based on the changes they observe in the environment. The protocols have to evolve and make room for such calibration, in order to avoid getting stagnant.

IX. Examples of Socio-Ecological Protocols

Across South and Southeast Asia, forest-dependent communities and indigenous peoples have established protocols on harvest and resource management in response to increasing demand for NTFP products. Forest honey gatherers in Cambodia (CBHE, 2010), Indonesia (JMHI, 2009) and the Philippines (PHN, 2013, NTFP–EP, 2014) have all developed forest honey standards and protocols which guide their harvest and quality control practice. Resin gatherers in Cambodia have also worked to consolidate their guide to sustainable oleoresin harvest (NTFP–EP, 2011), while community members and civil society organizations led by Keystone Foundation have also provided information to develop protocols on a wider range of NTFPs in India (Keystone Foundation, 2009).

Due to the diversity of NTFPs, their protocols are naturally varied. Different aspects of harvest techniques are important for different species such as timing, maturity, length, and depth of incisions.

Some important considerations for the sustainable harvest of NTFPs based on the plant part harvested are found in Box 2.

Box 2. Important Harvesting Considerations for Different Resource Categories

For harvesting leaves

- How to reduce damage to reproductive structures, growing points, branches, bark, and trunk?

For harvesting exudates

- How to avoid over girdling the tree or damaging stem wood too much?
- If making incisions in the tree, their minimum and maximum height on the tree, or the pattern, length, and depth of the incision.
- If tapping the tree, the height, and depth of the tap.
- If cutting holes in the tree, the size, and depth of cut.

For harvesting bark

- How to avoid over girdling the tree or damaging the cambium (the thin inner layer from which new bark is produced) too much?
- The minimum and maximum height on the tree to cut, the depth of cut, the % of total girth cut, the equipment used, and treatment of wound after the cut.

For harvesting below ground plant parts

- Which part of the root, rhizome, culm, or bulb to remove (i.e. lateral rather than taproot), and how to remove it?

For harvesting stems/apical buds

- How to reduce damage to the root base or to immature stems and shoots?

For harvesting fruit

- How to reduce damage to reproductive structures, growing points, branches, bark, and trunk?
- How to minimize harvesting of unripe fruit?

For harvesting fungi

- How to minimize any trampling of soil or disturbance of leaf litter layer, as this may damage underground mycelial colony?

For harvesting honey

- How to avoid harvesting immature honey, killing the larvae, or flaming the hives?

Reference: *Steps to sustainable and community-based NTFP management: A manual written with special reference to South and Southeast Asia (Stockdale, 2005)*

Protocols are important to ensure sustainability and conservation. Through the years, NTFP gatherers and their science and civil society partners have developed practical monitoring tools to measure compliance and outcomes. In this section, examples of socio-ecological protocols for five selected NTFP are featured. These protocols were identified through a participatory process using the guide questions in the Annex. It is envisioned that guidelines and protocols for other important NTFPs will also be established in the near future.

HONEY

Understanding the social structure of bees and the architecture of their hives is very important in establishing protocols for sustainable harvest of wild honey. Honeybees produce honey by collecting nectar, pollen, and dew from plants. They bring back the honey to their hive to store as food to keep them nourished when they are unable to forage outside. Stored honey also feeds their brood in the hive, making honey harvesting a potentially disastrous activity for future generations of bees if not managed properly.

Honeybees are susceptible to pesticides and to changes in the weather, particularly when flowering patterns change. Poachers that engage in unsustainable harvesting also threaten the survival of the honey industry.

Indigenous peoples in Southeast Asia have been harvesting honey observing linked sacred rituals and sustainable traditional methods. They usually collect honey from the species *Apis dorsata*, a eusocial honeybee which has four sub-species. *A. dorsata* build a large nest as a single comb, or as congregations that can have more than 100 colonies on trees and cliffs. They migrate long distances and return to the same nesting site every season. Other common honey sources are *A. cerana*, which nest in cavities and has ten sub-species, *A. florea*, and *A. adreniformis*.

Below are the thumb rules for honey in traditional forest communities:

- Define colony or area ownership.
- Do not destroy the habitat of the bees, including nesting sites and foraging areas.
- Ensure that colonies are a certain distance away from inorganic farms or sources of pollutants such as haze.
- Use appropriate sustainable harvesting tools and methods.
- Harvest only mature colonies for honey.
- Harvest only the honey part of the comb, leaving the brood intact.
- Brood collection is only for community consumption and not for sale. The brood is very nutritious and is a traditional food for some indigenous groups, therefore the harvest of this should strictly be for subsistence only. To ensure sustainability, a percentage of broods should always be left behind.
- Harvest honey only on dry days so as to reduce water content.
- Do not harm the bees while collecting honey from the hive.
- Cut honey combs and drain the harvested honey; never squeeze the combs. Honey should be pre-filtered in the forest if it cannot reach the processing center in a few hours.

- Honey should be clean and meet the standards for food and health.
- Respect local customs and rituals related to honey harvesting.
- Advocate for supportive policies and programs for sustainable forest honey management and trade.

The following socio-ecological indicators ensure the sustainability and quality of forest honey:

Ecological

- The forest has an abundance of nesting trees and nectar sources.
- There is a stable or increasing number of colonies in a particular area.
- Sacred sites are secured.
- There is regular flowering of pollen and nectar sources.
- There is occurrence of pollination.
- Climate patterns such as rainfall and humidity are stable.

Harvest

- Only mature colonies are harvested (wide, thick and visible comb; capped or sealed honey).
- Only the honey part is removed from the comb.
- Harvesting is done on dry days.
- Appropriate harvesting methods, tools, and equipment are used.

Trade and Markets

- Honey is clean and meets health and food standards.
- There is no brood for sale.
- Honey can be traced to its source.
- Honey properties indicate it has been harvested properly.

Institutions

- Local or traditional organizations are engaged in collective trade.
- There is an effective community institution that manages honey resources.
- Community discussions are done during honey collecting season.
- Social networks or partnerships exist between harvesters and other actors in the value chain.

Policies and Regulations

- Policies for harvest and harvest areas exist.
- The ownership of colonies is defined.
- Harvesters have permits or licenses to harvest and transport honey.
- Policies for protecting the forest exist.
- There are enabling local, national, and international policies for Asian honeybees in such areas as taxes, partnerships, and honey standards.
- Local, national, and international platforms such as trade certification bodies advocate for favorable policies.

Monitoring Methods

- Resource mapping, including identification of nesting trees.
- Number of colonies observed versus number of colonies harvested.
- Community permanent plots recording number of colonies, number of trees with colonies, flowering trees before, during, and after each harvest season.
- Pre- and post-harvest monitoring through inspection of peer groups of non-collecting hunter group within three days after each harvest.
- Community-level associations assess the quality of the honey.
- Records of where the honey is from, what the nectar sources are, who collected, and other relevant information.
- Observance of adherence to harvest protocols.
- Community discussions during honey collecting season.
- Internal control systems and participatory certification processes checking traceability and sustainability.
- Reports on progress on enabling policies for harvest and trade of honey.
- Maintain observation records about animals and birds that are dependent on the bees, honey and combs.

Climate Adaptation

- Monitor if climate-related factors such as warmer temperature and stronger typhoons affect the flowering patterns of nectar sources and the migration and foraging patterns of bees.
- Ensure that traditional practices are still sustainable in light of changes in climate.
- Monitor if bee populations are declining.
- Monitor the use of chemicals in the vicinity, particularly pesticides.
- Record if honey has higher water content than previous years despite use of proper harvesting methods.

Box 3. Community-Based Monitoring of Honey and Honeybee Populations in the Nilgiris, India

Since 1993, the Keystone Foundation has been actively engaged with honey collectors of the Nilgiris region to support their sustainable harvesting techniques. Alongside trainings, an enterprise was set up to give a higher price as an incentive for sustainably harvested honey. A simple method was introduced to record ecological conditions of the wild honey in comparison to the number of combs harvested, the condition of the forest, and other factors. Information was collected primarily through interviews with honey collectors when they brought the honey to the enterprise.

After 10 years, the monitoring information was analyzed to understand the nature of the harvest. The findings for honey harvested from *Apis dorsata* combs indicated a marginal difference between volume of honey per comb of cliff and tree colonies (See Figure 3). Combs of bees nesting on cliffs yielded up to 15 kgs of honey, while those from trees had a volume of around 20 kgs.

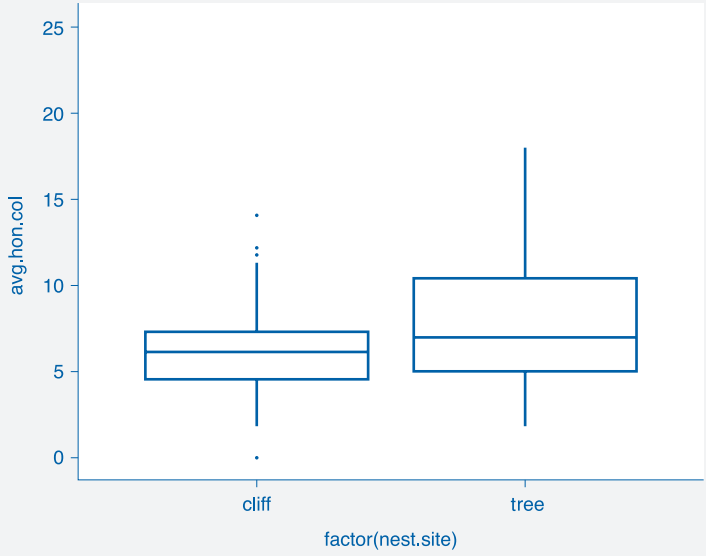


Figure 3. *Comparison of Honey Yield (in kgs) per Colony of Apis dorsata (Keystone Foundation Honey Monitoring Data 1994–2004)*

There was a wide range of age groups that participated in the honey collection (See Figure 4). Ages ranged from 19 to 65, with a majority of harvesters around 24 and 45 years old.

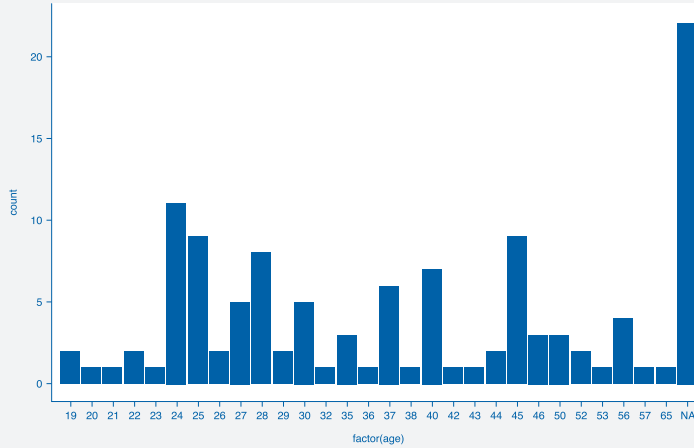


Figure 4. *Age of Honey Collectors (Keystone Foundation Honey Monitoring Data 1994–2004)*

From 2007 to 2009, research done in the forests of the Nilgiris contributed greatly to the development of a reliable method for counting bee nests, and nests, and providing a baseline on the number of bee colonies. Bees were counted along transects, which was efficient for large congregations and colonies like those of *Apis dorsata*, and in smaller plots for smaller bees like *Apis cerana*, *Apis florea* and stingless bees that nest in crevices and tree cavities. More than 60% of the transects and plots were revisited in 2019 to undertake an assessment of the bee nests and primary data collection.

The survey showed that habitats have changed drastically in 10 years, with more invasive species and reduced access for people to enter the forests.

Since 2008, local indigenous community members were trained to become Barefoot Ecologists who have been regularly monitoring the forests and agriculture lands that they use for collection of NTFP and growing of food. In one region, they monitored selected cliffs where the *Apis dorsata* nests regularly and observed them at

15-day intervals. Information gathered threw light on peak season for collection and percentage of combs that were harvested (See Figure 5). On average, even in the peak season it was observed that not more than 40% of the combs were removed, indicating that harvest never means complete removal. This was attributed to the fact that because the cliffs are inaccessible and it was humanly possible only to do a certain amount of collection, more than 50% of the colonies are not harvested.

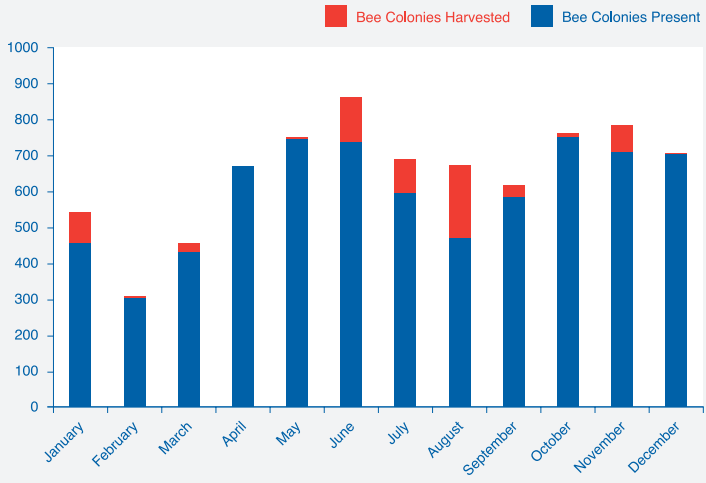


Figure 5. *Total Number of Apis dorsata Colonies Nesting on Cliffs and Percentage Harvested for Honey*

RESIN

Resins are exudates from certain kinds of trees that are used in various products. The material is not water-soluble, and its extraction necessitates cutting the bark of trees.

There are two kinds of resin: the solid resin which often comes from the bark of the genera Shorea, Hopea, and Parashorea, and the liquid resin which often comes from the phloem of the genus *Dipterocarpus*. For certain resin species such as *Agathis philippinensis*, resin emerges first as liquid and then hardens. There is also a stone resin in Indonesia and the Philippines that comes from the roots of *Pinus merkusii*, among other pine species. Liquid resin, also known as oleoresin or balsam, contains a mixture of essential oils, one example is Manila elemi or *Canarium luzonicum*. If harvested sustainably, liquid resin-producing trees will live for 50-60 years. In Mekong countries and in Indonesia, the resin from the trunk of *Styrax tonkinensis* is considered highly valuable especially in Viet Nam and Laos. Some countries such as Viet Nam and the Philippines ban the harvesting of liquid resin.

There are many threats to the resin industry. Resin trees are harmed by the use of unsustainable harvest methods such as resin hole mismanagement, improper tools, fire, chemicals, and girdling. In many countries, the habitat of resin trees has been destroyed due to conversion of forests to other land uses such as plantations and extractive industries. Hunting, cutting of trees, and forest fires have also been detrimental to resin trees. At the institutional level, lack of clear policies to secure tenure or regulate trade that favors sustainable practices and local communities also pose threats to the future of resin. In some cases, prices are very low for resin and this necessitates large volumes to be collected leading to overharvesting.

Below are the thumb rules for resin in traditional forest communities:

- Do not harm the forest ecosystem within the resin collection zone.
- Do not cause forest fires.
- Conserve biodiversity by not cutting trees or hunting animals that may be nesting in these trees.
- Define tree or area ownership and zones (do not tap in disallowed areas).
- Tap only mature trees.
- Do not use chemicals when harvesting resin.
- Use appropriate sustainable harvesting tools and methods.
- Make the right size and shape of incision.
- Follow local wisdom.
- Advocate for supportive policies.

These socio-ecological indicators ensure the sustainability and quality of resin:

Ecological

- There is an increasing number and good distribution of resin trees (saplings, juvenile, adults).
- The forest is healthy with a diverse population of plants and animals.

Harvest

- Proper harvesting methods are used (correct size and shape of cuts, proper use of fire for liquid resin) with the proper tools and equipment
- Resin is harvested at the right season.
- Trees continuously provide resin after repeated harvesting.
- Size of resin hole and number of holes are in proportion with the size of the resin tree.
- Resin hole is not getting larger due to unsustainable technique and uncontrolled fire.
- Leaves are not yellowing or falling off.
- No termites or other insects are attacking the resin trees through the cuts.
- Local wisdom is practiced.

Trade and Markets

- Visual indicators of good quality resin are observed (color, size, purity).
- Resin products can be traced to its source.
- Price of product is favorable to the harvester.
- There is value addition by harvesters or the community.

Institutions

- Local or traditional organization is engaged in collective trade.
- Social networks or partnerships exist between harvesters and other actors in the value chain.

Policies and Regulations

- Policies for collection and collection areas exist.
- Harvesters have permits or licenses to collect resin.
- Policies for protecting resin trees exist.

Monitoring Methods

- Field monitoring is done to check forest conditions.
- There are permanent plots where the number of trees is checked annually.
- Harvested trees are checked for new cuts or holes, and condition of trees is checked once a month or every other month.
- The amount of resin in holes or cuts is checked.
- The amount of charcoal attached to the hole for liquid resin (indicates use of fire) is checked.

- Harvest records are maintained.
- Quality and quantity of resin at collection area (indicates immature tree tapping, overtapping, improper tapping methods) are recorded.
- Records showing who is the harvester, where, when, volume, price, quality, etc. from every collection at processing center or storage area for enterprise groups or trader is consolidated.
- Observation records about animals and birds that are dependent on resin trees for nesting, seeds/fruit or resin are maintained.

Climate Adaptation

- Climate-related factors (e.g., warmer temperature, stronger typhoons) affecting the health of resin trees are regularly recorded.
- Impact of irregular rainfall on the quantity of resin harvest is monitored.
- Factors that cause changes in harvesting patterns (e.g., socio-economic issues, poachers) are recorded.

Box 4. Community Harvest Protocols for Resin in Palawan, Philippines

Resin from *Agathis philippinensis*, or almaciga, is a culturally and economically important NTFP harvested by the Palaw'an indigenous community in Amas, Brooke's Point, Palawan in the Philippines. In their ancestral land, there are traditional laws which the community follows pertaining to almaciga. These include tree ownership, harvesting practices, and traditional governance system whereby a group of elders, in consultation with the community members, sets the rules and metes out fines or punishments for offenders.

The community formed an enterprise group so that they could consolidate their produce to command a higher market price, as well as secure their harvest concession. The group manages the business, markets the product, and monitors tappers' compliance to sustainable harvest protocols, as follows:

- All harvesters must tap only the trees that belong to their family.
- A tree only becomes harvestable when a single person can no longer hug the entire trunk by himself.
- An untapped tree must first be tested before making numerous incisions. After the first incision, a harvester should wait 3–5

seconds to see if resin will come out. If no resin comes out, the tree is left alone. If resin trickles out quickly, the incision is repeated after 15 days, then again after 30 days, to determine if the tree will produce good quality resin. If the tree shows productivity, then it is tapped at maximum twice a month. A healthy tree can yield 5–10kgs of resin per tapping session.

- New incisions can only be made after three months and should not be more than three inches wide in the shape of an inverted triangle.
- To maintain the quality of resin, the harvester must remove dead or old bark from the part where resin will flow.
- Resin that splatters to the ground is not removed as it is believed this protects the tree from termites.
- Urinating and spitting near the tree are strictly prohibited.
- No fires should be set anywhere near the tapping areas.

The community monitors compliance to these protocols through two methods:

1. One is actual observation of tapped trees in the forest. This is done by volunteer members who are engaged in other forest activities, or by cluster leaders among tappers. They check to see if the surrounding area of the tree is clean, if the cuts are done properly, and if the tree is healthy. They check for presence of pine bark weevils, termites, and disease as well as wildlings emerging from mother trees. The leaves should be a healthy green; if it turns yellowish, then there could be termites attacking the roots.

2. The other method is simply by looking at the almaciga harvest per tapper. If the quality of the resin is good, this is an indication that the trees of that tapper are healthy. Almaciga is classified into class A or tipak, class B, and class C depending on size, color, and purity. Tipak is a large white lump, class B are white broken pieces not less than two inches long, and class C are small broken pieces with some impurities such as bark or soil. Dark colored resin in powder form are classified as rejects. Harvesters bringing in class C almaciga get paid a lower price, and this also indicates there could be problems with his or her harvesting methods. The consolidator of the enterprise group records the amount and class of almaciga that the harvesters bring to the sorting and storage facility, and reports any findings to the group.

FRUITS

There are many different kinds of fruits from the forest that are consumed by humans and animals. These wild edible fruits may come from trees or plants, and may be eaten at various stages of ripeness. They are an important source of nutrition and income. A study of forest-based communities in Viet Nam revealed that fruits make up 29% of the plant part used for food. However, there are many threats to the survival of the forest fruit industry. Destructive methods such as cutting trees or big branches to harvest fruit, and harvesting immature fruits, are some of them. Others are loss of forest and the reduction in the number of fruit trees and plants. Protected area rules may also restrict local harvesting, even when communities are using sustainable harvest practices.

The thumb rules for fruits in traditional forest communities include the following:

- Keep fruit-bearing trees and plants healthy.
- Ensure that the tree is not killed or damaged in order to harvest the fruit tree.
- Harvest only at the right age and height of the tree.
- Harvest at the right season when fruits are mature (except when they are eaten unripe).
- Use appropriate tools when harvesting.
- Always leave enough fruits on the tree for the animals to eat and for seeds to germinate.
- Respect the mother tree or spirit tree.
- Respect tree or area ownership.
- Organize a farmer or harvester association.
- Ensure fair trade practices.

The following socio-ecological indicators ensure the sustainability and quality of forest fruits:

Ecological

- There is an abundance of fruit-bearing trees.
- There is a wide range of ages of fruit trees—seedlings, saplings, juveniles, and adult trees.
- Mother trees are identified and protected.
- There is a healthy population of animals that are feeding on fruits and serve as pollinators or seed dispersers.
- The forest is healthy with a diverse population of plants and animals.

Harvest

- Fruits are harvested ripe as indicated by color, size, taste, and odor (except when eaten as unripe fruits or immature fruits are cooked as vegetable).
- Harvest protocols exist and are followed.

- Protocols are disseminated in the local language.
- Rituals are practiced.

Trade and Markets

- Quality of fruits sold is good.
- Traceability of fruits
- Prices are favorable to the harvesters.
- There are direct markets.
- There is value addition by harvesters or the community.
- There is continuous supply and no wastage.

Institutions

- Local or traditional organization is formed, running and functional for collective trade, with a diverse membership coming from different age groups and gender.
- Social networks or partnerships exist between harvesters and other actors in the value chain.
- Fair trade and Participatory Guarantee Systems (PGS) are in place.
- Geographic Indication (GI) exists.

Policies and Regulations

- There are policies for collection and collection areas.
- There are policies for protecting fruit trees, such as incentives for non-destruction.

Monitoring Methods

- Assessments and baseline studies are done in partnership with the community, government, and the academe.
- Resource mapping, including identification of mother trees, with the community decisions is recognized by government.
- Harvest protocols are observed.
- Records of increase or decrease in demand are kept.
- Trade certification bodies exist.
- Quantity and quality of fruits sold are recorded.

Climate Adaptation

- Repeat assessments every five years.
- Monitor if climate-related factors (e.g., warmer temperature, stronger typhoons, rainfall pattern) affect the health of fruit trees.
- Ensure that traditional practices are still sustainable in light of changing climate and market demand.
- Monitor changes in quality of fruits, particularly its taste, size, shape and color.

Box 5. Studying NTFP Populations in the Wild – The Case of Amla (*Phyllanthus Spp*) Fruits in India

Amla is the local name for the fruit of the Phyllanthus species, found in India. It is widely consumed and traded as an NTFP, with many uses ranging from food to medicine to cosmetic products. Local communities harvest fruit from three main species of trees.

From 2004 to 2007, the Keystone Foundation conducted a study in the Nilgiris region to estimate the density and distribution of Amla trees in the wild. The area covered a landscape of 1500 sq. kms, and measurements were done through 41 one-hectare plots. The Amla trees were found in forests ranging from mid-elevation dry forests to mid-elevation savannah woodlands to low elevation dry forests. Each forest type had a unique species composition and community structure coupled with varying degrees of fire frequency and intensity, invasive plants, parasitic plants, and human use (grazing cattle, firewood collection, and NTFP collection).

The study showed that Amla tree density per hectare in the forest varied according to species and habitat. While there were some plots with 30 individuals, there were also plots that had 300 standing adult stems. Regeneration was found to be good in most of the populations studied, which means there were enough young individuals which could be recruited to the adult size classes, ensuring the long-term survival of the population. This can be taken as an indicator that harvest levels are at sustainable limits. The only factor that seemed to be influencing the population of Amla trees was the vegetation or forest type.

Fruit harvest was not a significant predictor of recruitment in Amla trees in the wild. Studies on the Brazil nut tree harvest systems also show similar results, and in many cases, fruit harvest up to 80–90% had no negative impact on populations of trees. Another study on Amla trees in the Western Ghats showed that high levels of harvest did not affect the regeneration status, unless there were additional factors like parasitic and invasive plants that caused mortality and blocked recruitment.

Studying an NTFP's population status in the wild is important to gain full understanding of the factors at play in the system. A combination

of study methods is needed. The ecological studies in this case were supported by knowledge from the people, which helped to understand history of management and frequency of disturbances. A good understanding of the population dynamics of species is vital to making effective management plans and conservation strategies.

Reference: *Varghese, A., Ticktin, T., Mandle, L., Nath, S. (2015). Assessing the Effects of Multiple Stressors on the Recruitment of Fruit Harvested Trees in a Tropical Dry Forest, Western Ghats, India.*

RATTAN

Rattan is typically a climbing palm that grows in tropical regions, including Southeast Asia. An important renewable NTFP, it is found in forests and also cultivated in rattan gardens for use in making handicrafts and furniture, and as construction material. Rattan has been cultivated by local communities from generation to generation for local use and income generation (Matius, 1981). Rattan is often categorized as those that have solitary stems like manau (*Calamus manan* Miq.), and those that have clustering stems like sega (*Calamus caesius* Blume), batang (*Calamus zollingeri* Becc.) and batang merah (*Daemonorops robusta* Warb).

It is found in the tropical rainforest of Africa, mainland India, Sri Lanka, foothills of the Himalayas, South China, Malaysia, Australia, and the West Pacific (Figure 6).

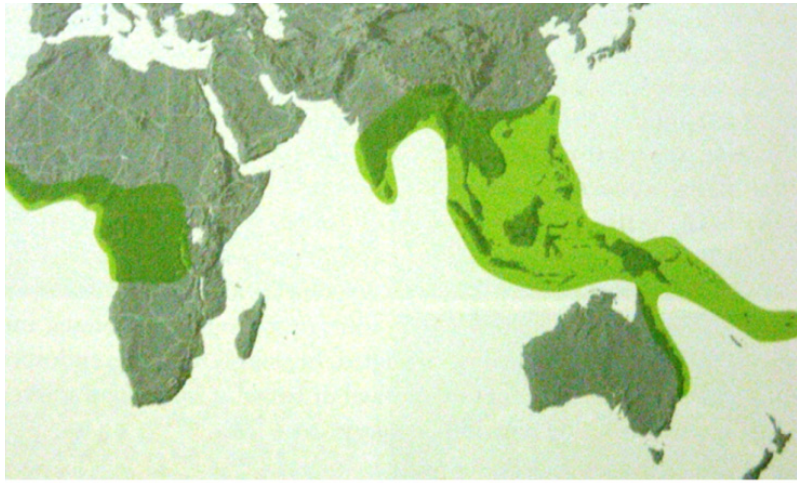


Figure 6. *Distribution of Rattan in the World (Rustiami, 2011).*

Rattan fall into eight genera: *Calamus*, *Ceratolobus*, *Cornera*, *Daemonorops*, *Korthalsia*, *Myrialepis*, *Plectocomia*, *and Plectocomiopsis. Calamus* is currently the largest genus of palms. Govaerts and Dransfield (2005) recognized 374 species, and more have been added since, making a total of about 400. The genus is classified in the subtribe *Calaminae*, tribe *Calameae*, subfamily *Calamoideae* (Dransfield et al., 2008). Currently in 2019, seven new species were found in Sumatra (Henderson & Rustiami, 2019) bringing the total number in Indonesia to at least 100 species (Rustiami, pers.comm. 2020).

In Indonesia, the commonly cultivated rattan species are sega (*Calamus caesius*), jahab (*Calamus trachycoleus*), jepukng (*Daemonorops crinita*), semambu (*Calamus scipionum*), and pelas (*Calamus penicillatus*).

Most rattan species inhabit wet tropical rainforests (evergreen forests). Rattan can be found in both drylands (*Calamus caesius* (sega/taman), *Calamus optimus* (seletup), *Calamus manan* (manau) and wetlands/alluvial areas (*Calamus trachycoleus* (jahab, irit), *Daemonorops crinite* (pulut merah, jepung). Some rattan species are found in both drylands and wetlands. In sandy clay and periodically flooded areas balubuk (*Calamus burchianus*) and sega air (*Calamus axillaris*) are found. In limestone rocky mountain areas manau padi (*Calamus marginatus*) grows and in peat swamp areas only dahan/andung grows (*Kortalsia flagellaris*) (Rachman and Jasni, 2013).

Many of the species found in Indonesia are wild rattan, which have a bigger diameter than cultivated rattan. In Sulawesi, the most commonly traded species are seuti (*Calamus ornatus* BI.), lambang (*Calamus ornatus var celebius* Becc.), batang (*Calamus zollingeri* Becc.), noko (*Calamus koordersianus* Becc.), batang merah (*Daemonorops robusta* Warb.), sigisi (*Calamus orthostachys* Furtado) and tohiti (*Calamus inops*).

In Viet Nam, there are 56 species recorded: *Calamus* (41); *Daemonorops* (8); *Korthalsia* (2); *Myrialepis* (1); *Plectocomia* (2); and *Plectocomiopsis* (2). Of this number, 31 are endemic to Viet Nam. At least 32 species are popularly used, while four species are believed to be extinct. New species to science were also identified recently: *Calamus parvulus* (Henderson & N.Q. Dung) and *Calamus spiralis* (Henderson, N. K. Ban & N. Q. Dung)

In Laos, there are six genera of rattan: *Calamus*, *Deamonorops*, *Korthalsia*, *Merialepis paradoxa*, *Plectocomia*, and *Plectocomiopsis*. There are 32 species, with five new ones: *Calamus laoensis*, *Calamus bimaniferus*, *Calamus evansii*, *Calamus oligostachys*, and *Calamus solitaries*.

There are many threats to the rattan industry. Unsustainable harvest practices have led to forest degradation and problems in regeneration. Changes in

ecological conditions have resulted in habitat loss and affected variety, with some rattan species now included in the IUCN Red List of Threatened Species. Rattan farmers and gatherers face the threat of land speculation, land conversion into mining, oil palm plantation, coffee and cacao plantation, urbanization, and infrastructure. Loss of traditional knowledge has led to a general lack of knowledge and awareness about rattan. Less people are interested in harvesting rattan or maintaining rattan gardens due to low market prices, forcing farmers to sell or convert their land to other uses. The use of chemicals and trade in synthetic rattan are some of the causes for the unstable market. At the institutional level, lack of political will in crafting policies and enforcing regulations is a major concern.

Thumb rules for rattan may differ per species and habitat in each country, although they generally consist of the following:

- Respect local customs and rituals related to rattan harvesting.
- Do not cut support trees; if needed, climb, or use other tools to cut and pull the rattan.
- After harvesting rattan, clean the leaf litter, twigs, or grass that cover the shoots so that these can be exposed to sunlight and are able to grow well.
- Rattan clumps are important for breeding, they should not be damaged. After harvest, leaves and sheaths should be chopped and put on clumps.
- Do not damage seedlings.
- Do not harvest rattan canes that are fruiting in low density areas.
- Rattan harvesting is recommended in the dry season, so that stems dry quickly. If rattan is harvested during the rainy season, longer drying time is required to avoid being attacked by rattan-damaging organisms. If the rainy season is longer than six months, however, often harvesting is done in the middle of the rainy season (Indonesia).
- Use appropriate tools and observe safety.
- Rattan is cut 1 to 1.5 meters from the ground and stems are left bent down to prevent fungus from damaging other stems (although in some countries, rattan is cut 20 cm from the ground; practices differ depending on the species).
- Select rattan that is mature enough i.e., at least 75% of the leaf sheath is dry and peeling.
- Length indicator depends on the market demand and according to the standard (Indonesia).
- Observe proper and sustainable processing and treatment methods for rattan.
- There should be transparency in supply chain information.
- Presence of national associations, community rules, and regulations are important in rattan harvesting and management.
- Advocate for supportive policies.

- Local groups or people's organizations ensure proper resource management and monitoring.

For the conservation and sustainable harvest of rattan, these socio-ecological indicators may be used:

Ecological

- 30%–50% ideal canopy for growth of rattan (Viet Nam).
- General growth of rattan at an altitude of 0–1500 meters above sea level with rainfall condition not less than 2000 mm/year, humidity around 40–60% and light intensity for growth of 20–50%. (Indonesia).
- Best elevation is 700 meters above sea level (Viet Nam), but generally there are more rattan species in evergreen and semi-evergreen forests with altitudes from just above sea level to around 1,000 masl.
- Observe the number of plant and animal species in rattan gardens (Indonesia).
- Observe the number of plant and animals (invasive species and herbivores) that damage rattan gardens (Indonesia).
- Rattan is usually found in forest areas that have high humidity (±60%), secondary forests, shrubs, and available support trees for climbing rattan.
- Proper soil and location of sites for cultivated rattan.

Harvest

- Identification of rattan reserves.
- Harvest less than 80% of harvestable rattan. Mature rattan is often at a length longer than 5 meters.
- Rattan that is ready to be harvested has several characteristics that can be observed. Some leaves are yellow and dried up. Most of the petals of the lower leaves have fallen off, are blackish brown, and are usually scattered under the stem. The part of stem which has been opened is dark green.
- Harvesting rattan during the dry season hastens the drying process. But care has to be taken that residual parts that fall when the stem is cut does not damage the young stems and saplings in rattan clumps.
- When harvesting during the rainy season, cover the stumps of cut stems to prevent water from entering the plant.
- Remaining cane after cutting should be shorter than 20 cm from the ground (Viet Nam).
- Lesser exploitation of rattan in steep areas or eroded riverbanks to be followed.
- Protect support trees for rattan to climb on when they start to grow longer.

- Leaf sheath is color brown, falling off, cane color yellow and shiny when dried, stem is shiny and does not easily break when bent, there is a "Tik-tik" sound when cane is bent or when silica falls off the cane (Indonesia).

Take note of stock density and length distribution; yield has size-specific growth per year (Laos).

Trade and Markets

- Standard system has been set and is available.
- There is available and transparent information sharing in the value chain.
- There are market or regulatory incentives for sustainable rattan management.

Institutions

- Participatory planning and assessment.
- Participatory regulation development.
- Monitor harvest records and rattan management plans to ensure feedback mechanism or synergies among stakeholders.

Policies and Regulations

- Policies are in place to protect rattan gardens and forests.
- Community participation is present in rattan harvesting.
- Ban on rattan export policy being reviewed.
- Monitor policies affecting rattan (trade and export, tenure, etc.).

Monitoring Methods

- Participatory mapping and inventory of rattan species in an area or site.
- Monitor before harvest and after harvest indicators of rattan annually.
- Monitor harvest methods.
- Maintain harvest records of species and volume harvested.
- Forest patrol and sample plots to monitor regeneration of rattan looking at length class distribution.
- Inventory of biodiversity in rattan gardens and rattan forests.
- Determine signals of ecological impact (logging, fire).
- Annual focus group discussions are conducted among producers, governments, and associations.
- Monitoring rattan product prices and the impact on harvests and harvest practices.
- Impact monitoring (Laos).

Climate Adaptation

- Monitor if climate-related factors (e.g., warmer temperature, stronger typhoons) affect the growth of rattan.

- Monitor if irregular rainfall affects quantity of rattan.
- Ensure that traditional practices are still sustainable in light of the changing climate.

Box 6. Participatory Guarantee System for Rattan in Indonesia

NTFP–EP Indonesia and rattan stakeholders started the process of developing a sustainability standard for rattan in 2012. This was sparked by the need to raise perceived values of Indonesian rattan. The prices had dropped as a result of certain policies at that time. The stakeholders knew there were certification mechanisms that catered to "green" markets and environmentally conscious buyers, but they were concerned that many of these third-party certification systems were expensive and not entirely appropriate for rattan systems where local people are often the experts and not external inspectors.

Thus, NTFP–EP and stakeholders embarked on installing a Participatory Guarantee Systems (PGS) for rattan in Indonesia. Participatory Guarantee Systems (PGS) are locally focused quality assurance systems. They certify producers based on active participation of stakeholders and are built on a foundation of trust, social networks and knowledge exchange.

The stakeholders involved were civil society partners supporting rattan farmers and gatherers, national and local government partners, local rattan associations, rattan weavers, and scientists. After three years of discussions and meetings with farmers, gatherers, government officials, rattan manufacturers, and other stakeholders, the PGS called ROLES Rotan Lestari Indonesia (Sustainable Rattan in the Indonesian language) was ready. Standards and procedures for sustainable rattan harvesting and management under ROLES are found in Table 1.

By the end of 2019, at least four rattan producer groups with 150 members in two islands covering three provinces were utilizing ROLES standards and engaging with national and international rattan buyers. The ROLES PGS system aims to contribute to the overall goal of increasing benefits for rattan producers and promoting sustainable forest management.

Table 1. PGS Rattan Standard (ROLES PGS Standards, 2015)

Criteria	Indicators
Legality	• Rattan is harvested from areas where rights over land and resources are clear. • Authorities have granted permission to harvest rattan in this area. Plans to harvest rattan in the area do not exceed limits granted. • No illegal activities related to natural resource management are found in the forest where rattan is harvested.
Production Sustainability	• Inventory, management planning and monitoring of the area is conducted periodically. • Harmful chemicals are not used in the process of harvesting/planting, handling, and processing rattan. • Rattan is harvested sustainably by considering the rules, science-based methods and local knowledge that cover aspects such as: securing rattan regeneration, sustainable harvesting, and biological diversity. • Income diversification of the area/forest is considered.
Ecological Sustainability	• Proper waste management is applied in the process of harvesting, planting, handling, and processing of rattan. • The process of harvesting rattan does not harm species and habitats of high conservation value. • The process of harvesting does not change the landscape and forest cover.
Socio-Cultural Factors	• Rattan harvesters' group have received approval from the larger community in the area. • Youth that may be involved in the process of harvesting, handling, and processing of rattan are not losing days in school nor sacrificing play hours.

Continued to next page

Criteria	Indicators
Socio-Cultural Factors	• Equal opportunities for men and women in the process of harvesting, planning, handling, processing rattan, and capacity development within the group/organization. • There are written rules about the group/organization. • The group/organization provides some of its profits to local community. • The group/organization has a mechanism for conflict resolution. • The group/organization is concerned about capacity building of its members.
Traceability	• Raw materials and processed rattan can be traced back to its origin.

BAMBOO

Botanically, bamboo represents a specialized group in the grass family. In Asia, bamboo has been intricately linked to both culture and even survival since ancient times. There are many traditional uses of bamboo ranging from handicrafts, bird cages, poultry coops, musical instruments, water pipes, and fishing contraptions to bridges and house construction (Kurz, 1876 and Wong, 1995b). The use of bamboo has since evolved to modern factory-based production of paper, bamboo blinds, clothing material, laminated bamboo, pillars using strand woven bamboo, sunglasses, bicycles, straws, and barbecue skewers. As timber becomes scarce, bamboo is being touted as the "timber of the future." Living bamboo provides edible shoots, fences, windbreaks, ornamentals, and a means to counter erosion in some areas. Indeed, bamboo is said to have 1,500 uses (Lancaster, 2012).

Bamboo is part of the grass family called Poaceae following the International Code of Botanical Nomenclature (ICBN), or traditionally known as Gramineae under the Linnaean System of Classification. They share certain characteristics that place them apart from other grasses: segmented, typically hollow stems (called culms) that are somewhat woody and sprout from the underground stem portions (or rhizomes); a complex system of branching; and flowers that typically have three perianth-like structures each (lodicules) and 3–6 stamens (Soderstrom, 1981).

It is suggested that there are three centers of bamboo distribution around the globe, one in the South and the South Western part of China, South East Asia and the Eastern part of South Asia, then the other is located in South America. Asia has 900–1,000 species belonging to 70 genera (Zhu & Wei 2018), from 1,642 species in the world (Vorontsova et al., 2016).

In Viet Nam, there are 216 bamboo species (Son & Thang, 2013).

For centuries, bamboo have been of great importance in rural communities in tropical Asia, where it is used intensively as a sustainable resource for numerous purposes. Often classified as minor or non-timber forest products, bamboo's value or potential value has been largely underestimated. However, growing commercialization of bamboo has seen increasing demand for the product, which may lead to pressure for unsustainable harvesting.

There are various threats to the sustainable production of bamboo. Infrastructure projects, landslides, forest fires, overexploitation and heavy flooding have resulted in the destruction of bamboo forests. The conversion of bamboo forest into monoculture plantations in some countries has also led to a decline of bamboo forests. Bad planning, in the case of the bamboo chopsticks industry in Indonesia, can also lead to the destruction of vast tracts of bamboo forests. In the Philippines, if unsustainable harvesting of bamboo shoots continues, such as one case in Pangasinan province, this may lead to decreasing culm production. In the same province, kawayan tinik bamboo clumps were also removed with the construction of irrigation systems (Razal R.A. et al., 2020). Introduced bamboo such as *Chimonobambusa quadralungaris* from Japan that are used as ornamental plants have turned out to be a highly dangerous, aggressive, and invasive alien species especially in Gede and Pangrango Nature Reserve. (Widjaja, 2019).

Less extreme are the threats that wildlife pose to bamboo. Rats from the family *Spalacidae* and the subfamily *Rhizomyinae* feed on underground parts of plants, and in particular, bamboo. Some bamboo rats also live in gardens and feed on a wide variety of vegetation. Insects such as mites, aphids, mealy bugs, and scale are also threats to bamboo; they remove plant fluid, cause defects and reduce strength, inject toxic compounds into the plant, and transmit diseases resulting in defoliation and wilting of young shoots, and even death of the culms. The wild elephant in Sumatra, Indonesia eats the young bamboo culm until its gums are bleeding. This is done to obtain the salt for the elephant's life. When the bamboo flowers many birds are collecting the seeds for their food. It is important to note that some of these animal and plant interactions are natural relationships which exist in the ecosystem.

In terms of institutional threats, it appears that stimulating the industry, is difficult if local community forest associations are weak. With private industries shifting to other raw materials, bamboo producers may have to search for other markets to maintain their incomes. In the Philippines for example, there is a restaurant chain selling barbecue which has substituted bamboo sticks for metal skewers.

Below are the thumb rules for forest bamboo in traditional forest communities:

General

Many communities believe that "more bamboo results in more water, cleaner air, and stable soil" and thus, it is important to keep and manage bamboo forests for forest conservation.

Harvest

- Do not harvest 3–4 days after full moon (Malaysia and some other countries).
- Do not harvest on Tuesdays and Saturdays; No harvesting during full moon (Javanese calendar in Indonesia).
- The harvest of bamboo shoots depends on the season and other factors. Such species as the Bambusa longissima should not be harvested from June to September (Viet Nam).
- For some bamboo species, old rhizomes should be removed for the new rhizomes to emerge; however, this is not advisable for clumping species such as D. asper, B. bamboos, and B. blumeana.
- Cut the culm in three pieces according to buyer specifications:
  a. In Cambodia, from the ground: 3.5 meters, 5 meters, 5 meters.
  b. In Indonesia, from the ground: 3.5 meters, 5–6 meters, 5–6 meters.
  c. In Malaysia, from the ground: 4 meters, 4 meters, 4 meters.
  d. In Viet Nam, from the ground: 2.5 meters, 3 meters, 4 meters, 5 meters.
- In general, culms harvested during the rainy season are suitable for biomass, handicraft, scaffolding, and other short-term uses. However, these are not suitable for pillars and buildings.
- Some farmers do not harvest 7-year-old culms to prevent soil erosion and provide protection to emerging shoots (Bukidnon, Philippines).

Post Harvest

- Sometimes bamboo is preserved by muddy river to prevent insect attacks by washing out starch. Bamboo has also been transported by river to lower transportation costs.

Bamboo should be treated before using traditional or conventional methods, but it can be treated chemically with borax. Use of arsenic based chemicals such as Chromated Copper Arsenate (CCA) should be avoided as some buyers find this treatment harmful.

Management

- To prevent gregarious flowering, which can occur when there is a long dry season and too much fertilizer, do culm cutting; hybridization can occur between several genera/species when they flower at the same time.
- Conduct bamboo inventory regularly.
- In the context of communally owned and managed bamboo areas, to avoid conflict, there should be consensus within the community regarding bamboo harvest.

The following socio-ecological indicators ensure the sustainability and quality of bamboo:

Ecological

- There is a symbiotic relationship between bamboo and other species in the ecosystem. Elephants and rodents in Cambodia are seen to naturally control the population of bamboo. The loss of elephant and rodent habitat means uncontrolled populations of bamboo. It is believed that selective cutting of bamboo will not affect overall species diversity and will not affect population growth of bamboo clumps.
- Regulation of bamboo harvest in the wildlife zone (Indonesia).
- Identification and mapping of areas where bamboo is needed to combat soil erosion.
- For rehabilitation of bamboo stands, it is necessary to do mulching with compost or other materials such as rice husk compost, loosening the soil in mature clumps, and mounding soil to cover uppermost rhizome.
- Some bamboo stands are overgrown when prices are low for bamboo and when bamboo is not used for crafts or other purposes.

Harvest

There are different protocols in harvesting bamboo culms for different purposes and in managing shoots for future growth:

Shoots

- Mulch clumps with leaves/litter during the rainy season (Cambodia, Indonesia).
- Harvest shoots during the early rainy season. Rainy season is when shoots emerge and grow.
- Cut shoot before it emerges from the mulch to obtain more sweet and tender shoots (Indonesia) or once it just emerges at 10–20 cm above the ground (Cambodia).
- Cover the cut shoot with soil after 1–2 days to avoid fungi and mold infection (Indonesia).
- Shoots produced during early rainy season should be used for shoot production (Indonesia).

- Shoots produced at the latter part of rainy season should be allowed to grow for culm production (Indonesia).
- Smaller bamboo shoots should be cut off and bigger shoots retained for bigger culm production (Malaysia).
- Keep only five bamboo shoots sparsely random within the clump; keep the healthy shoot for good culms (Cambodia).

Culms

- Mound up soil surrounding the clump before rainy season (Cambodia).
- Harvest culms during the dry season to avoid damage through fungal and beetle attack (Indonesia). This is also done to prevent the damage of young culms as well as bamboo shoots during the rainy season (Cambodia).
- For spiny bamboos, remove branches to facilitate access for culm collection (Cambodia).
- Cut culms close to the ground, just above the node, to stimulate growth of shoots and culms (Cambodia, Indonesia).
- Harvest only mature bamboo (>3 years old) at the right height (10–15 cm above the ground) for culm production such as for building structures.
- During harvesting, when total culms in one clump reach 10–15, stop harvesting and leave for 3 years to recover (Indonesia). The 10–15 remaining culms should be a mixture of young and mature culms to create healthy clumps. Remove old and unhealthy culms to improve growth (Cambodia, Indonesia).
- Only harvest maximum 30% total culms in one clump. From the harvest, 70% should be mature bamboo (>3 years old). Do not cut immature bamboo (<2 years old) (Viet Nam).
- Remove the witches' broom that affects the growth of the bamboo.
- Prevent bamboo clumps from catching fire by making tunnels within monoculture bamboo areas, or grow trees resistant to fire, and give clumps access to sunlight (Cambodia, Indonesia).
- In harvesting natural stand, there should be about 100–200 clumps per hectare for a healthy bamboo forest. Usually there are >40 or more culms per clump and 10–12 culms per clump can be harvested per season.
- For G. scortechinii, 70% of mature culms are harvested in one season. After harvest, the following composition is optimal: 1 year olds – 4 culms remain (45%), 2 year olds – 3 culms remain (35%), 3 year olds – 2 culms remain (20%).
- Harvest age is 3–4 years old for bamboo used for buildings and structures, and 1–2 years for biomass, crafts, and pulp and paper.

Trade and Markets

Check various criteria affecting production: species choice, product choice: shoot or culm, stock for planting such as rhizome, culm propagation/sprouting, tissue culture, soil characteristics, environment, rainfall, temperature.

Culms

- If during the production process machines are used, the species used should have a thick culm (more than 1 cm thickness).
- Free from defects, cracks, and pinholes.
- Straight bamboo culms.
- Bamboos are mature as shown by removal of sheath, white spots caused by lichens or fungus, resonance test (traditional way), and color of culms (dark green, reddish brown, or grey).
- Mature culms can be used for pillars. The light green colored bamboo can be used for handicrafts or pulp industries.
- Bamboo should be dried up to 12% moisture content (ISO TC 296) if it will be used for industrial purposes (laminated bamboo) to avoid fungus and powder post beetle attacks.
- For culms, check the quality using visual observation for 20% of total random harvest; if there are defects, then it is necessary to check 100% of the whole plot.

Shoots

- For shoot production, mulching is compulsory to get sweet and tender shoots.
- Shoot quality and quantity. Shoots of good quality are sweet and tender. Shoots should be directly brought to process and steamed to prevent browning. The quantity of shoots depends on the season. During the rainy season, shoot production increases.

Plantations

- For planting, it is necessary to know what finished products are planned. This will guide species selection.
- Soil characteristics for bamboo plantation: soil structure is not clay, not in an area that floods, should be granular. But irrigation or watering during the dry season in the nursery is necessary to grow bamboo stock.
- Monitor the following aspects regarding shoot quality:
  - No shoot production or shoots have not yet emerged
  - Length
  - Diameter
  - Shape
  - Which shoot should or should not be harvested
  - Taste of shoot (sweetness, tenderness indicates good quality)

Institutions

- Strong organizations at various levels with effective coordination from the farmers, distributors, and processors up to the wholesalers and resellers with fair trade agreements among them.
- Well organized bamboo plantations managed and owned by the local community are effective in implementing selective culm cutting and marketing operations.
- More organized flow of activities and easier loan acquisition (Philippines)

Policies and Regulations

- Local and national policies support sustainable bamboo harvesting.
- Some policies recognize that there is overharvesting of bamboo shoots, thus there is a ban on harvest of bamboo shoots in some towns in the Philippines. It is important to monitor policies that can protect endangered bamboo species.
- For bamboo with abundant stands, monitor the enforcement of government policies promoting the utilization of bamboo products (Philippines).
- Community-developed regulations and policies are important in sustainable bamboo management. Rules and protocols on coding bamboo stands assists in proper timing of harvest. Rules can be developed on how to bring bamboo out from the stands.
- Monitor illegal harvesting of bamboo.

Monitoring Methods

- Periodic assessments such as through transect observations or inventories are useful. More accurate results can be obtained in human-made plantations. Quadrat sampling design can be applied, and accuracy improved with the use of Global Navigation Satellite System (GNSS). This would be possible if communities are accompanied by technical persons, who can assist in generating maps and analyzing data from satellite images.
- If bamboo stands are growing in state-owned forests, monitoring should be led and done by the forest department (Indonesia). But when the bamboo stands belong to the community, it is in the best interest of the community to collect data on harvesting stems.
- Disturbance of bamboo-harvested area: forest fire, land encroachment, land conversion, and mixed use of bamboo shoot and culm.
- Monitor harvest method.
- Check shoot harvest: number of shoots per month per year, which month has the highest number of shoots. This is especially important for villages focused primarily on shoot production.
- Condition of clump: density of culm/clump and number of old bamboos, number of healthy shoots and dead shoots. This is important to determine suitable use, proper time of harvesting and bamboo productivity.

- A good chronology of records about the bamboo harvesting from selection, coding, harvesting, carrying, stripping, and manufacturing is important.

Box 7. Bamboo Age Markings towards Sustainable Harvest, Ngada, Flores, Indonesia

In 2012, Yayasan Bambu Lestari (YBL) or Sustainable Bamboo Foundation based in Bali Indonesia released a book called "Towards Resilient Bamboo Forestry" or "Menuju Perhutanan Bambu Resilien" (Rabik and Brown, 2012). The book highlights six steps in the sustainable management of bamboo clumps namely: 1. Improving the Bamboo Structure, 2. Management of Understory Plants, 3. Soil Management 4. Soil Nutrient Management, 5. Sustainable Harvesting, 6. Ecological Pest and Disease Management.

The step on sustainable harvest elaborates the age structure of the bamboo clumps. Once the age of the clumps has been determined, then the stems or culms are marked by age. Usually ages are classified as 1. Young Bamboo – (bamboo aged 1–2 years), 2. Adults – When bamboo is 3–4 years old, 3. Over aged bamboo – around 5–7 years old. There are several ways to know the age of the bamboo like the resonance test using a bamboo culm of 50–75 cm in length with a diameter of 6-8 cm. By placing one end of the bamboo on the culm being tested and then placing the other end on one's ear, one can hear the sound made after tapping on the bamboo. Older bamboo produces a sound that lasts longer in the ear.

An optimal cluster is one that has 4 culms that are 1 years old, 3 culms that are 2 years of age and 2 culms that are 3 years old. It is important to harvest the 3-year old mature bamboos first and the 1 year olds last.

In 2015 YBL, in collaboration with the company Indobamboo, led by the Ministry of Forestry and Environment and supported by ITTO, joined the government program on establishing 1,000 bamboo villages both to restore especially degraded ecosystems and to lead to improved local incomes.

One of the villages in the program is Ubedolumolo Village, Bajawa Subdistrict, Ngada District, Flores Island, East Nusa Tenggara Province. They were managing the Dendrocalamus asper species. The Ngada district is known for its close links with bamboo spanning generations. Their local wisdom also supports bamboo cultivation. They identified and marked the ages of the culms in each clump with the planned year of harvest to make sure that only mature culms were harvested, leaving shoots and young stems intact. Alongside this sustainable bamboo management practice (HBL), the local community organization was also strengthened for more efficient management of the initiative, post harvest treatment was implemented and local industries promoted. Since then Ngada district has been declared by the Ministry of Environment and Forestry as the center of excellence for the 1,000 bamboo villages program as a platform to develop and strengthen the use of bamboo in Indonesia through the community-based bamboo industry. Since then there are already 10 bamboo villages that have been used as centers of excellence and pilots for other regions, all in Ngada District. The sustainable bamboo program is also supported with a Community Learning Center, Bamboo Field School and Bamboo Music School in Wogo village, Golewa sub-district.

X. Conclusions and Recommendations

ASEAN is moving towards a more liberalized trade framework through the ASEAN Economic Community (AEC) with visions of a single market and single production base. Thus, ASEAN countries trading individually or as a block, should produce products of standard quality, even products from forests. This comes at a time when consciousness of green purchasing and sustainable lifestyle in the region and globally is growing. Thus, it is strategic for ASEAN to not only be able to ensure quality products, but products that are produced sustainably and those that do not harm the environment.

ASEAN's efforts to develop guidelines on protocols for sustainable management of NTFPs is thus timely as this will guide NTFP gatherers and small producers towards ensuring both quality products and those that are environmentally friendly.

These guidelines apply a socio-ecological framework to consider varied factors that impact a non-timber forest product management system, especially those managed by communities and small holders. Factors include ecological considerations, harvesting and resource management practice, trade and market requirements and practices, and institutions and policies on resource access and ownership.

There are several examples in these guidelines to assist AMS in the preparation of national and subnational protocols with their partners in the field. Concrete examples have also been shared. Some examples are taken from centuries old practice by indigenous communities that have already been implementing sustainable harvest protocols (Box 4). Others are taken from newly established protocols and practices to increase value to NTFP products and to be able to tap into the growing green market (Box 6).

NTFPs can be important indicators of the health of the ecosystem, and, since they are linked to people's livelihoods, can be easily monitored. Forest monitoring relies on 'apex' species or endangered wildlife. In adding more common species like NTFPs more frequent and widespread information is secured.

Observing and monitoring the thumb rules and indicators laid out in these guidelines requires cooperation. Community groups in Asia have worked closely with youth, volunteers and student assistants to implement their

monitoring systems. Sustainable management of NTFPs does not depend only on NTFP gatherers following rules. Rather, it requires that these systems work within an enabling environment of supportive policies, well-functioning institutions and ethical trade partnerships. Thus it is best that these guidelines are shared and protocols be formulated and implemented in collaboration with various stakeholders.

During the consultations in developing these guidelines, several recommendations were made for specific NTFPs as follows:

Honey

- More research is needed to increase perceived value to forest honey. This may increase the value of honey and thus incentivize the forest protection related to caring for honeybee colonies.
- Communities can be assisted in documenting and translating guidebooks on sustainable harvesting of honey.
- Honey gatherers need to be linked to green markets that understand the holistic values related to forest honey.
- Honeybees need more forests to survive, yet areas for foraging are shrinking. It may be wise to recognize and support communities with clear traditional ecological knowledge around honey and NTFPs in general.

Resins

- Recognizing more community-managed areas in resin producing territories and reducing permitting procedures to allow local communities to benefit from the gains from these NTFPs is key to sustainable NTFP management. This is especially true for NTFPs such as almaciga and benzoin.
- Continue research on fire control measures for dipterocarp oleoresins.

Fruits

- Planting more fruit trees is important to avoid depletion of resources, especially in cases where only the roots or specific parts of the plant are utilized for herbal and medicinal uses because the active components are only localized in this part of the plant.
- Price incentives and promotion of processing of wild fruits are factors to forest conservation (case of *Arenga pinnata*, *Scaphium macropodum*, and cardamom).

Rattan

- In order to increase incentives to farmers for sustainable harvest, shorter supply chains are needed, as well as local level rattan manufacturing industries.
- A strategy on rattan development would be helpful in guiding the development of the industry across sectors.

- Political support is important from the government (local/national) to stimulate local farmers to keep and manage their rattan gardens as well as village forests where natural rattan is growing and harvested by villagers for auto consumption and for trade.
- It is also imperative to remove or relax policies that effectively lower the farmgate prices of rattan harvest.
- Propose the rattan gardens for city green spaces and strengthen forest protection for rattan growing.

Bamboo

- Provide economic incentives and support for diversification and marketing of bamboo products.
- Bamboo harvested in own gardens should not incur in any royalty or tax.
- To stimulate bamboo production and trade, remove requirements that increase transaction time and costs (e.g., certification of verification) particularly for bamboo harvested from private plantations.
- Operationalize action plans to realize sustainable production towards potentially highly profitable bamboo industries.
- Support research studies about the potential of bamboo as a raw material in developing innovative products using latest technology.
- Encourage linkages with potential processors and bamboo producers that would benefit the community forestry sector.
- In order to more effectively capture market opportunities, develop an effective bamboo inventory system to update supply volume.
- Monitor the harvesting of a sampling of community forest stands and harvesting methods and bamboo stands to assess healthy bamboo populations and propose price and marketing strategies.

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XII. Annex: Guide Questions to Assess Sustainability and Identify Socio-Ecological Indicators

HONEY

Ecological

- How many hives/colonies are there in a particular area?
- What species are the nectar sources at particular times/seasons?
- Do these nectar sources flower regularly? How often?
- Are the flowers showing signs of being pollinated?
- What species are the nesting trees and how abundant are they?
- What is the habitat of nesting trees? Is the nesting site a tree, cliff, or other?
- Are there single or multiple combs in a tree, cliff or other nesting site?
- Do the bees remake a hive in the same spot or same tree?
- How many percent from the total hives are harvested in a particular area?
- Are sacred trees or areas protected?
- What are the natural threats to the bees? Are these present?
- What are the anthropogenic threats to the bees? Are these evident?
- Is the climate stable?

Harvest

- Who are the harvesters?
- When and how often do they harvest?
- Where do they harvest?
- Are there bounds to honey harvesting territories?
- From what species of bee is honey harvested from?
- When is the season/weather for harvesting?
- What are the indicators that the hive is ready for harvesting?
- What are the traditions and practices around harvesting? Are they being followed?
- What or what parts are being harvested?
- What methods or tools are used?

- How much honey is being harvested per hive?
- What is the water content of the harvested honey?

Trade and Markets

- How was the honey removed from the cut comb?
- Is there a balance between sucrose and fructose content?
- What is the quality of the honey?
- What is the quantity of honey harvest over the years?
- Is there brood for sale?
- Can honey be traced to the harvesting area or harvester?
- Who dictates the price?
- What are the market or government standards for honey?
- Who are the buyers? Do they influence the market, particularly the sustainability of harvest?

Institutions

- Is there a community organization for harvesters, processors and traders of honey?
- Is there a community organization that manages, governs, and/or enforces practices and traditions around honey harvesting?
- Are there links between harvesters and middlemen/traders/buyers?

Policies and Regulations

- What are the tenurial instruments in place/ available to them?
- What is the situation regarding their access rights?
- What are the government laws/policies around harvesting and management of this NTFP?
- What are the laws/policies/traditions around harvesting?

RESINS

Ecological

- What is the species being harvested?
- What is its habitat?
- Does it have a stable population?
- How fast does the tree grow to harvesting size?
- What are the natural threats to the trees? Are these present?
- What are the anthropogenic threats to the trees? Are these evident?

Harvest

- Who are the harvesters?
- Where do they harvest?
- Are there bounds to resin harvesting territories?

- What is the percentage of the trees being harvested to the total number of resin trees in a particular area?
- Do they have established harvesting practices?
- When is the season/weather for harvesting?
- What are the indicators that a tree is ready for harvesting?
- What methods or tools are used?
- How are the incisions made (size, shape)?
- How big are the incisions and how many per tree?
- How much resin is being harvested per tree?
- Do the trees being harvested appear healthy?
- For how long is one tree being harvested?
- How long after a cut is abandoned does it heal?
- Are methods being used to reduce impacts of harvest?

Trade and Markets

- Is the resin of good quality?
- Is there a big quantity of harvest?
- Are the products sorted according to color, size and purity?
- Who dictates the price?
- Who are the buyers?
- Who are involved in the supply chain?
- What are the market or government standards for resin?

Institutions

- Is there a community organization for harvesters, collectors and traders of resin?
- Are there links between harvesters and middlemen/traders/buyers?

Policies and Regulations

- What are policies that support the collection and management of resin?
- Is there an equitable permitting system?
- What are the tenurial instruments in place/available to the harvesters?
- What are the laws/policies/traditions around harvesting? Are they being practiced/enforced?

FRUITS

Ecological

- What is the species being harvested?
- What is its habitat?
- Does it have a stable population?
- What are its pollinators/seed dispersers? Are they abundant?

- How fast/often does the tree bear fruit?
- Are there mother trees that are not being harvested?
- What are the natural threats to the trees? Are these present?
- What are the anthropogenic threats to the trees? Are these evident?

Harvest

- Who are the harvesters?
- Where do they harvest?
- Do they have established harvesting practices?
- Are there bounds to fruit harvesting territories?
- What age does the tree start bearing fruit?
- When is the season/weather for harvesting?
- Is there a suitable time of day for harvesting?
- Is fruit always harvested from the same site?
- What or what parts are being harvested?
- What methods or tools are used?
- What are the indicators that it a fruit is ready for harvesting?
- What is the percentage of fruits being harvested per tree?
- How much percent of the total trees are being harvested in a particular area?
- For how long is one tree being harvested?
- Does the tree bear the same amount of fruit after harvest?
- How often does it fruit in a year?

Trade and Markets

- Are the fruits harvested of good quality?
- What are the indicators of good quality fruits?
- Is there a big quantity of harvest?
- Are the fruits sold in its raw form or have they been processed?
- Who dictates the price?
- Who are the buyers?
- Who are involved in the supply chain?

Institutions

- Is there a community organization for harvesters, collectors and traders of fruits? Do they regularly meet?
- Are there links between harvesters and middlemen/traders/buyers?
- Are there fair trade practices in place?
- Is there Geographic Indication on products?

Policies and Regulations

- What are the policies that support the collection of fruits and the management of fruit trees?
- What are the tenurial instruments in place/available to the harvesters?

- What are the laws/policies/traditions around harvesting? Are they being practiced/enforced?
- Are there regulatory bodies that set or enforce protocols?

RATTAN

Ecological

- What is/are the species being harvested?
- What is its habitat? (Physical environment and landscape dynamic)
- Does it have a stable population?
- What are the plant-animal interactions?
- What are the natural threats to the resource? (forest fire, bamboo shoot eaten by animal?) Are these present?
- What are the anthropogenic threats to the resource (including poachers, etc.)? Are these evident?
- Are there thumb rules (developed by communities/harvesters) in gathering rattan?

Harvest

- Who are the harvesters?
- Where do they harvest?
- Are there bounds to rattan harvesting territories?
- What is the species being harvested (and whether solitary or clump)?
- How many palms are in the area?
- How fast does the rattan grow to harvesting size?
- When is the season/weather for harvesting?
- What are the indicators that it is ready for harvesting?
- What methods or tools are used?
- What and what parts are being harvested?
- How many canes are harvested if in a clump?
- How much percent of the total clumps or solitary stems are being harvested in a particular area?
- How long after a cut is made does it grow back to harvesting size?
- Are methods being used to reduce impacts of harvest?

Trade and Markets

- What are the indicators of good quality rattan?
- What is the quantity of rattan harvest over the years?
- Can rattan be traced to the harvesting area or harvester?
- Who dictates the price?
- What are the market or government standards for rattan?
- Who are the buyers? Do they influence the market, particularly the sustainability of harvest?

Institutions

- Is there a community organization for harvesters, processors and traders of rattan?
- Is there a community organization that manages, governs, and/or enforces practices and traditions around rattan harvesting?
- Are there links between harvesters and middlemen/traders/buyers?
- What are the existing social networks/partnerships concerning rattan?

Policies and Regulations

- What are the tenurial instruments in place/available?
- What are the government laws/policies around access, harvesting, and management of rattan?
- What are the laws/policies/traditions around harvesting rattan?

BAMBOO

Ecological

- What is the species being harvested?
- What is its habitat? (Physical environment and landscape dynamic)
- Does it have a stable population?
- What are the plant-animal interactions?
- What are the natural threats to the resource? (forest fire, bamboo shoot eaten by animal?) Are these present?
- What are the anthropogenic threats to the resource (including poachers, etc.)? Are these evident?
- Are there thumb rules (developed by communities/harvesters) in gathering bamboo?

Harvest

- Who are the harvesters?
- When and how often do they harvest?
- Where do they harvest?
- What is (are) the species being harvested? Are these running or clumping?
- How many clumps are there in a given area?
- What is the habitat of the bamboo being harvested?
- When is the season/weather for harvesting? Is there a season for “shooting”?
- What are the indicators that the shoot/culm is ready for harvesting? How is the maturity of bamboo for harvesting determined?
- What methods or tools are used?
- What are the traditions and practices around harvesting? Are they being followed?

- What parts of the bamboo resource are being harvested?
- How much is being harvested?
- If shoots are harvested, what are ways to ensure regeneration? (to ensure that new shoots sprout?)
- If culms are being harvested, how many culms are harvested if in a clump?
- What percent of total clumps or solitary stems are being harvested in a particular area?
- Are there methods to ensure regeneration of stems?
- What are the methods of harvest that avoid damage to the mother plant?
- Are methods being used to reduce impacts of harvest?
- How do you harvest bamboo to ensure good quality bamboo?
- How is post-harvest handling of bamboo done to avoid/prevent insect attack or decay?

Trade and Markets

- How was the bamboo/shoot harvested?
- What is the quality of the bamboo?
- What is the quantity of bamboo harvest over the years?
- Can bamboo be traced to the harvesting area or harvester?
- Who dictates the price?
- What are the market or government standards for bamboo?
- Who are the buyers? Do they influence the market, particularly the sustainability of harvest?

Institutions

- Is there a community organization for harvesters, processors and traders of bamboo?
- Is there a community organization that manages, governs, and/or enforces practices and traditions around bamboo harvesting?
- Are there links between harvesters and middlemen/traders/buyers?

Policies and Regulations

- What are the tenurial instruments in place/available to them?
- Access rights?
- What are the government laws/policies around harvesting and management of this NTFP?
- What are the laws/policies/traditions around harvesting?

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