

NTPF Sustainable Harvesting and Resource Management Protocol

Bamboo



NTFP Protocols Series

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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 – 1000 species belonging to 70 genera (Zhu & Wei 2018), from 1642 species in the world (Vorontsova et al., 2016). In Vietnam, 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, overexploiting 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 quadrangularis* 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 industry 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 to metal skewers.

Thumb Rules for Bamboo in Traditional Forest Communities



Harvest

- ✓ Do not harvest 3-4 days after full moon (Malaysia and some other countries).
- ✓ Do not harvest on Tuesday / Saturday; 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 (Vietnam).
- ✓ 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 Indonesia, from the ground: 3.5 meters, 5–6 meters, 5–6 meters.
 - b. In Malaysia, from the ground: 4 meters, 4 meters, 4 meters.
 - c. In Cambodia, from the ground: 3.5 meters, 5 meters, 5 meters.
 - d. In Vietnam, 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 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.



Bamboo flowering

Photo: Mogens Englund

Socio-Ecological Indicators to Ensure the Sustainability and Quality of Bamboo



01 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.

02 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 10–20cm 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) (Vietnam).
- ▶ 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.

03 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)

04 Institutions

- Strong organizations at various levels with effective coordination from the farmers, distributors and processors up to the wholesalers and re-sellers 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)

05 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.

06 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 lead 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.



Bamboo garden

Photo: Arief Robik and Dr. Elizabeth Widjaja

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.

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