



Bamboo- The ‘Timber’ of Mao-Naga Community

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Research

Abstract

Background: Bamboos are group of plants of wide ranging cultural and economic values to local communities. The present study was carried out to understand the importance of bamboos for the Mao-Naga community of Manipur, India, and the associated Traditional Knowledge.

Methods: Ten artisans (two females and eight males) were selected purposively for the study. Open-ended interviews conducted in person, and telephonic interviews were used to collect data. Prior Informed Consent (PIC) was taken from the knowledge partners prior to the interview. Voucher specimens have been deposited in Central National Herbarium (CAL), India.

Results: Our study records the uses and associated traditional knowledge on six bamboo species. The Mao-Naga are capable of distinguishing species from their taste, texture and physical appearance. Except *Bambusa pallida*, all other species are consumed. In addition, the Mao-Naga also consume bamboo borers (*Omphisa fuscidentalis*) infesting bamboos. Bamboos are used in traditional soil conservation techniques. Bamboos also play an important role in the community's calendric system, as seasonal indicators.

Conclusions: The traditional knowledge recorded in this study would be of help to the community in planning bamboo harvesting, mitigating soil erosion, soil conservation and maintain agricultural productivity. We recommend that value addition in bamboo crafts, bamboo shoots and bamboo borers should be promoted for enhancing livelihood security.

Key words: Bamboo, Traditional Knowledge, Mao-Naga, Folk taxonomy, conservation, agriculture.

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Okoko kodzū

Okoko mostii khru: Kovo hi oprobu omu kali koe, ea hihi no pfo chüheli vo pajü solowe ea kovo hino kasha-e molobowo nekolo obo bue. Kovo vahino amodo sokowo hiwoli oprobu hinahi chongho amazhü pajü bue tikocho hi Ememei yi mosülo koru dunoe.

Dado khru: Kovo vano larü rüpu koru duno pfootomei chacha ye netomei kahei hi kodoloe. Pfole heno vu kovo vahino mapra no ano kocho ea chükrei kakrü bvü leno kakrüwo, oko hi süpulo. Kovo pa, onghu ye solukhe khramei hi oprodzü no somothu lowo (voucher specimen to kowe) Central National Herbarium li hi thokhio tie.

Phoprakolo: Larü hina lihi kovo ota choro vano rükhi hithoe ea hikhrumei hi kovo vano ovo koso ea kostümei lapro khramei hi-e riikhithoe. Ota krükrü-o kobu kovo khramei hi kovoba koto, oke ea onga khruno mashü lowe. *Bambusa pallida* (Mataba) hi to chomoe. Kovokho tikocho (*Omphisa fuscidentalis*) hiwoli towe. Mostü shuwo kovo hi omei no shu kocho hi osü omi khupilo koru duno ea okhro chülü mocho kapi hi-e sopiwe.

Mochokowo chii: Kovo vano amodo hi moso duno sülo moli kashü süwoli, opha chülü no kovo va kolo, osü omi khu amo pilo koru duno, chüjü ota oni sokokhro ea ovo otali le sokhro kapi hi dunoe. Nilemei no kovo hipfo oshe mara, tolo kashü kovoba

ea kovokho hikhru hi sūlowo kovo hi kolei chūku mazhū pulo molishūe. Adeitili hihino nelimei kohrū li amzhū pajū pfovū pilo zhūe.

Ochūbi: Kovo, kostūmei lapro, Ememei, Kostūmei do ye olu, ojū ota, otakata

Background

A meal should have meat, but a house must have a bamboo. Without meat we become thin, without bamboo we lose serenity and culture itself- Pou Sou-Tung (Stiles 1994).

Bamboos are an important group of plants with wide cultural, economic and ecological values (Liese & Kohl 2015, Kumari & Singh 2014). Owing to their multiple importance, they are also known as 'green gold', 'poor man's timber', 'child's cradle to the dead man's bier', etc. (Kaushik et al. 2015). They are known to be durable and fast-growing with short harvest periods. Besides, they are also sustainable in yield, cheap and have supported livelihood through ages. These factors make bamboos a reliable resource for meeting the needs of increasing population, markets and development (Honfo et al. 2015; Cm & Seethalakshmi 2009). Bamboos are also a versatile group, known to survive in a wide range of climatic and edaphic conditions (Tewari et al. 2015).

Bamboos belong to the sub-family Bambusoideae of Poaceae (grass family). They are grouped into three tribes: Arundinarieae (546 species), Bambuseae (812 species) and Olyreae (124 species) (Clark et al. 2015). There 75 genera and 1250 species of bamboos growing naturally in all continents except Europe and Antarctica (Liese & Kohl 2015). In the European continent, bamboos are introduced species (Liese & Kohl 2015). In Asia, there are 65 genera of bamboos with 900 species, out of which 23 genera with 128 species are found in India (Kumari & Singh 2014). Manipur - a part of North-east, India under which the study area falls, harbors 54 species belonging to nine genera.

Bamboo shoots are seasonal, perishable in nature and short-lived. They are consumed as a delicacy in countries such as Bhutan, China, Indonesia, Japan, Korea, Malaysia, Nepal, North-east India, United States, Australia, and New Zealand. In Asia, more than two million tonnes of bamboo shoots are consumed annually. These products are either consumed fresh, dried, canned, boiled, fermented or

as medicine (Choudhury et al. 2012, Liese et al. 2015). Fresh and fermented bamboo shoots are also an importance source of revenue for rural communities. Bamboo shoots are tapped, fermented and consumed as wine in Tanzania (Liese et al. 2015, Lobovikov et al. 2007). In Philippines, bamboo water from the young culm is consumed to quench thirst (Arthur 2015). In Korean folk medicines, bamboo salts (*jookyeom*) are roasted with normal salt, yellow clay and bamboo culms to treat chronic diseases (Hwang et al. 2016, Lee et al. 2016, Robinson & Scully 2014). The clean young bamboo leaves are dried, roasted and consumed as tea in most bamboo growing countries. It is a delicious and healthy drink (Liese et al. 2015).

Bamboo leaves provide effective mulch for moisture retention and are used as organic fertilizer for soil rejuvenation. The mulch also offers consistent temperature, high humidity and encourage the growth of microbes for faster decomposition (Liese & Kohl 2015). There are reports of using bamboo leaves due to during fuelwood scarcity. However, the use of bamboo leaves as fuel should not be encouraged as it depletes the soil biomass (Liese & Kohl 2015).

Bamboos are ideal plants for afforestation of grassland and degraded landscapes due to their fast growth, extensive rhizome, high yielding litter and dense canopy (Song et al. 2011; Acharya et al. 2016). In addition, they also serve as effective windbreaks against soil erosion (INBAR 2018, Song et al. 2011). The Government of Ghana successfully implemented the use of bamboo for closing the gap of vegetation cover (FAO & INBAR 2018); After the nuclear bombing of Hiroshima and Nagasaki, the bamboo shoots were the sighted plants (Lobovikov et al. 2007); a study by Cm and Seethalakshmi (2009) reports that the amount of biomass from *Bambusa bamboos* is almost twice as that of the widely planted Eucalyptus.

It is reported that 2.7 billion people worldwide rely on solid biomass for cooking, and bamboo can provide an alternative renewable source for them (INBAR 2018, Lucas 2013). The demand for such biofuel can also help elevate the economy of an individual or globally. For example, Southeast Asian nations contribute almost USD 400 million to the global trade in bamboo and rattan (INBAR 2017). Bamboo have enormous potential for mitigation of climate change. They are known to sequester 200-400 tonnes carbon per hectare and are believed to sequester more carbon than some tree plantations (van der Lugt et

al. 2018, INBAR 2018). According to INBAR (2017), the world's largest carbon sequestration by bamboo is found in the bamboo forest of China which is reported to store 727 million tonnes of carbon in 2010 and projected to 1018 million tonnes by 2050. Bamboos provide excellent materials for house construction. The Qing Dynasty of China in 221 B.C. – 206 B.C. built bamboo palaces (Yu 2007). Bamboo buildings are known to withstand earthquakes. During the 1999 earthquake of Colombia, houses built from bamboo survived (Asfura 1999, Liese & Kohl 2015). Bamboo architectural models are popular for their aesthetic properties (Lucas 2013). Some of the renowned bamboo architectures are: Handmade School in Bangladesh, Wind and Water Café, Starry bamboo Mandala, Asian Water Villa and Bar Phong Tra (Henrikson & Greenberg 2011). Bamboo groves are used by animals for shelter against predators and weather (Lucas 2013).

The study was carried out with the following objectives: i) to document the uses, practice and knowledge of bamboo, and ii) to understand the cultural relationship of people with bamboos and evaluate the changing scenario.

Materials and Methods

Study Area

Ethnographic fieldwork was carried out from December 2018 to January 2019. Ten knowledgeable people (two females and eight males) were selected for the study. We refer to them as 'knowledge partners'; we find the term more appropriate than terms such as 'participants' or 'respondents' in the context of traditional knowledge (TK). The knowledge partners were identified by their knowledge on the bamboo weaving and handicrafts. Two of the men knowledge partners are artisans who sell baskets during the favorable season, while others weave for household use. Open-ended interviews were used for the study and the data collected was supported by observation of the participants by the first author who is also a member of the same community. In addition to the primary data, additional details were collected through telephonic conversation when required.

Voucher specimens were collected with the help of knowledge partners and were identified using Floras and reports including Kumari and Singh (2014), Seethalakshmi (2011), Kumar (2002) and e-floras of China, Nepal, and Thailand (www.efloras.org). Identifications were confirmed with the experts and

nomenclature was updated by referring to www.ars-grin.gov, www.efloras.org, www.theplantlist.org, www.tropicos.org, and www.worldfloraonline.org. Voucher specimens have been deposited in Central National Herbarium (CAL), Kolkata. Madras Christian College where the research was conducted does not have an ethics board. Hence, the code of ethics of the International Society of Ethnobiology (ISE) (2006) was used as a reference, and utmost care was taken to ensure that the study conforms to the code. Written prior informed consent was taken from the knowledge partners prior to the interview.

Results and Discussion

Species of Bamboos and their uses

Bamboos are commonly referred to as 'Kovo' and the young shoots are called as 'Kovoba'. The artisans undertake bamboo weaving and furniture as hobbies during their free time after paddy cultivation or harvest. Bamboo crafts and weaving are mostly carried out by men. Women help in repairs or weave bamboo baskets called *tubo siihru*. From our interviews, we understand that these labor intensive and time-consuming bamboo products are gradually replaced by plastic wares. We recorded six species of bamboos that are listed below with their uses.

a) *Dendrocalamus giganteus* Munro in Linn. Soc. London. 26: 150. 1868; Bor, Fl. Assam 5:11.1940; Dransfield & Widlaja 1995; Koshy Bamboo TBGRI 51. 2010, [Local name: *Kovopre*] Collection no. 12396 (CAL)

- Bamboos are split in half, diaphragm removed using a chisel, arranged upward and downward at regular intervals forming like a tin sheet which is then used as roofing for cattle sheds. Manicured bamboo is also used as roof gutter and substitute as pipes for irrigation (Schröder 2010).
- Young shoots edible (Kumari & Singh 2014).

b) *Chimonobambusa callosa* (Munro) Nakai in Bor, Fl. Assam 5:46, 1940; Seethalakshmi & Kumar, Bamboo India 96, t. 25 1998; Barooah & Borthakur, Bamboos Assam 106. 203 [Local name: *Chüte*] Collection no. 12385 (CAL)

- Culms are used for ceiling.
- Splits culms are used for basket making locally called as *ofro*.
- Young shoots edible (Seethalakshmi & Kumar 2002) and fetches high price in local market.

c) *Bambusa balcooa* Roxb. In Munro, Trans. Linn. Soc. London 26: 100.1868; Seethalakshmi & Kumar,

Bamboo India 37. 1998 [Local name: *Mosoba*] Collection no. 12743 (CAL)

- The most harvested bamboo shoot because of its abundance.
- Planted along river banks to control soil erosion.
- Split culms are used for making beds in agriculture huts.
- Used as rafters in thatched house construction.

d) *Bambusa nutans* Wall. ex Munro, Trans. Linn. Soc. London 26: 92. 1868; Seethalakshmi & Kumar, Bamboo India 67. 1998 [Local Name: *Vodzūba*] Collection no. 12424 (CAL)

- Highly preferred bamboo shoots because of its sweet taste and soft texture.
- Used in agricultural fields for fencing; less abundant.

e) *Bambusa pallida* Munro, Trans. Linn. Soc. London 26: 97. 1868; Seethalakshmi & Kumar, Bamboo India 67. 1998; Kumari & Singh Bamboo Meghal 52. 2014 [Local name: *Erū kova*] Collection no. 12396 (CAL)

- Culms are thinned and used for making shields, harvested during the waning of moon.
- Culms are thinned out using a knife, sharpened like double edged sword for clearing weeds and grasses in agricultural fields.

f) *Schizostachyum dullooa* (Gamble) Majumdar, in Karthikeyan et al., Fl. Ind. Enum. Monocot. 281. 1989; Kumari & Singh Bamboo Meghal 240. 2014 [Local name: *Mataba*] Collection no. 12440 (CAL)

- Split culms are used for weaving baskets, handloom, cordage and gumming sticks for trapping birds.
- Splits culms are made circular (7–9 cm in diameter), attached to wood, and used for the pruning of paddy crops (removing old and yellow leaves).
- Used for house construction and scaffolding.
- Used for making barns.
- Culms are thinned out using a knife, sharpened on both edge for clearing weeds and grasses in agricultural fields.
- Used as rafters in thatched roofs.

Folk identification of edible bamboo

Of the six bamboo species studied, five are edible. They are either cooked as such or fermented. These five species are also the common ones consumed by the community except *Bambusa pallida*. The Mao-Naga community identifies edible bamboo based on three properties such as taste, texture and physical appearance. The bamboo shoots are easily identified by the community on the basis of

morphology (sheath). For instance, during the initial shooting stage (ca. 30-50cm), *Bambusa balcooa* sheaths are yellowish green with rough blades, *Bambusa nutans* sheaths are greenish with smooth blade, *Dendrocalamus giganteus* sheaths are purplish pink, *Schizostachyum dullooa* sheaths are reddish with dense black hairs.

According to our knowledge partners, identity of the species of bamboo shoots can be determined through taste (chemical identification), even when the physical attributes are non-identifiable. The taste of the bamboo shoots varies from species to species ranging from sweet, bitter and sweet with aroma. *B. balcooa*, *B. nutans* and *D. giganteus* shoots are sweet. *B. nutans* shoots texture are tenderer and sweeter when compared to *B. balcooa* and *D. giganteus*. *D. giganteus* shoots are bigger than the two and the boiling of *D. giganteus* shoots leach a pale golden yellow color which is absent in *B. balcooa* and *B. nutans*. *Schizostachyum dullooa* shoots are bitter, *Chimonobambusa callosa* shoots are small, sweet and aromatic. These unique identifications of bamboo help us understand that the community has a rich knowledge about plant attributes such as taste and morphological features which in turn could be helping them in classifying the bamboos. Usage of taste and culinary attributes have also been reported from elsewhere. For instance, in their study with the Kanekes people of Indonesia, Hidayati et al. (2017) record terms such as *huwi kelapa* (plant that tastes good when cooked with coconut), and *kokosan* (fruits to be eaten by sucking). The Mao-Naga ways of identifying bamboos from morphology and taste adds to existing knowledge on folk taxonomy (Franco 2015). However, our study is unable to provide a complete picture of the folk taxonomic system as it only focuses on bamboos.

Bamboo as food

Consumption of bamboo shoots and its products are widely popular in many Asian countries (Kaushik et al. 2015, Liese & Kohl 2015, Choudhury et al. 2012). They also form an important part of Mao-Naga cuisine. The shoots sprout during mid-monsoon and provide food security for the community. The shoots are collected when they are about 30-60 cm in height. Bamboo shoots are harvested after the completion of paddy planting. In the recent years, there are early sighting of bamboo shoots before or during the paddy cultivation. Our knowledge partners attribute this to climate change. *Chimonobambusa callosa* shoots are tender, aromatic, sweet and fetch a good price in the local market. The reason

attributed to the high price is the difficulty involved in collection. The plant is locally rare, and grows in higher elevations (above 2000m) that are difficult to access due to lack of road network. No attempts have been made so far to cultivate the bamboo ex situ.

We observed that the community does not harvest the bamboo shoots in bulk. According to the knowledge partners, prolonged storing of bamboo shoots results in formation of fibers which is tasteless and difficult to swallow. Therefore, bamboo shoots are harvested as: i) shoots without sheaths and ii) shoots with sheath. Shoot without sheath are consumed on the same day or the next to avoid desiccation and wastage. The shoots with sheath can be stored four to five days with less wastage. However, they are heavier due to the presence of sheath. Fermented bamboo shoots are widely used by the community. For long duration storing of fermented bamboo, the shoots are stored in a cold environment and handled with clean plastic tableware to increase the shelf life. Contact with bare hands or contamination of salt results in browning of the fermented shoots which in turn affects the aroma and taste. *Schizostachyum dullooa* is locally known as *mataba*. *Mata* means to ferment/rot and *ba* refers to soft tissue of the bamboo. The nomenclature was given to acknowledge the use of bamboo shoots in fermentation. It is interesting to note that although the name signifies its potential use, the practice has been abandoned by the community.

Bamboo borers as food

The bamboo borers (*Omphisa fuscidentalis*) drawn from the wild are either consumed or sold at a good price. The borers first attack the young shoots, complete their larval cycle inside the shoots, bore a hole in the internode and escape as adult. The host bamboo species are *Schizostachyum dullooa*, *Bambusa balcooa* and *Dendrocalamus giganteus*. The infestation of bamboo borers can be easily identified by the shortened internodes. The ideal time for harvesting the borers is after the paddy harvest. In Thailand, bamboo borer is a well-known food, cultivated and promoted by the Thai Department of Forestry (van Huis et al. 2013, Singtripop et al. 2009). In China, borers are given as 'titbit' for guest (YI 2010, Mei-ling et al. 2006). We feel that community based small-scale farming of bamboo borers could be a lucrative occupation for the Mao-Naga.

Seasonal knowledge in bamboo harvesting

The production of starch in bamboo is season dependent and reduction of starch increases the durability and resistance against pest. Bleaching, drying, smoking and chemical treatment are the major techniques used for reducing starch content (Schröder 2012). Bamboos are harvested in two seasons:

i. Warm monsoon bamboo

First harvest is carried out during the onset of monsoon months (May-June). Sprouting of new leaves indicates the time for bamboo harvest. The harvested bamboos are mostly used for construction or fencing purposes.

ii. Cold winter bamboo

Second harvest is during the cold winter months (November-February). Harvested bamboos are usually used for households such as scaffolding, weaving of baskets, mats, barn, cordage, and house construction.

Harvesting of bamboo at the right season or time increases the durability, tensile strength, longevity and minimize pest and borers. *Bambusa pallida* which is used for making shields harvested during the new moon or no moon day, is believed to have reduced infestation of pests. This knowledge is supported by the findings of Grubisic et al. (2018) that nocturnal insects depend on natural light of the moon and stars for orientation and movement.

Bamboos used for handicrafts are harvested during November and December. *Zhaso* are split bamboo measuring approximately about 1.5–2cm in diameter, 4ft in length and made of two internodes. For pest repellent, longevity and sturdiness, they are dried and smoked for about 5–6 months. After smoking, the splits are immersed in water for 10-15 days for easy splitting and less breakage. Fine strip of bamboo splits from *zhaso* are prepared by using a knife called *mopro*. *Mopro* are used for making mats (*ozha*) and baskets (*pisii*). *Zhaso* are also used as ropes. The preparation of *zhaso* is common to all the Mao-Naga and Poumai – an ethnic community of Naga. *Schizostachyum dullooa* and *Bambusa pallida* are preferred species for making bamboo mats and baskets because of its minimum wastage and durability. *Chimonobambusa callosa* is used for making baskets call *oro*. The *zhaso* and *mopro* for making *oro* are prepared on the same day without smoking.

Agricultural practices

Bamboo grove which are deemed unfit or hindrance for the cultivators are usually burnt down during the months of January-March. It is observed that burning of bamboo grove results in faster regeneration of shoots. According to Vogl (1974), the fire residues create warmer surface temperature, activate soil organisms, and chemical reactions, resulting in stimulation of early growth. Ashes and charcoal are good absorbents, imbibing atmospheric moisture and acts as excellent water reservoirs for the growth of plants (Santalla et al. 2011). On the residues left by the fire, a local variety of *Capsicum frutescens* is planted. The practice is said to increase the spiciness of the chilies and yield. Although *Schizostachyum dullooa* shoots are not consumed due to its bitterness, first shoots that emerge after burning are fit for consumption.

Soil conservation

According to INBAR (2019), bamboos are the ideal species to reduce soil erosion due to their wide-spreading roots and extensive rhizome. The effective use of bamboo for controlling soil erosion has been proven worldwide (Gurung 1989, Rashford 1995, Singh et al. 2003, Tardío et al. 2018). The Mao-Naga community plant bamboos on the river banks to check soil erosions. Bamboos do not root deep. Therefore, they allow trees such as *Salix tetrasperma* to grow alongside with the grove. The combination of the two makes one of the finest bio-wall in riverbanks to check soil erosion. *Bambusa balcooa* and *Schizostachyum dullooa* are seen widely grown along the river banks of Chuherii River and Chiithukhe River. The bio-wall still stands tall along these river banks even after years and decades, and the success story is narrated in support of traditions by the elders. Bamboo culms are harvested and used to build retaining walls in landslide prone areas. The culms are usually split in two or four for building the walls. Usually, four or more wooden poles are hit firmly into the ground and the split bamboo is woven between the poles. The spaces between the retaining wall and river bank are joined by using stones, bushes and mud to minimize the flow of water current inside the weaved bamboo.

Culture and bamboo

According to Mao-Naga tradition, bamboo groves are retained as common property between the previous landowner and the new one when the land is sold. Likewise, any bamboo growing between two plots of land are shared as common. This age-old tradition laid by the ancestors allows mutual understanding between the owners. This is cited as

a reason for the lack of disputes or fights arising from sharing of bamboo resources and groves. According to Mao-Naga folktales, there are three brothers Asiipfo Alpha, Chiituwo and Khephio (believed to be descendants of Dziilliamosiia- the mother of mankind). Their father gave them a script each before the exodus. Asiipfo Alpha's script was written on the bark of a tree called *osiike*, Chiituwo on bamboo sheaths call *soluke*, and Khephio on the hide of an animal call as *osohei*. In the lapse of time, Khephio – the forefather of Nagas lost his script to the rats (Also see: Nepuni 2010). Another version of the story says that dogs consumed the script. Nevertheless, the scripture was lost, and the Nagas has no choice but to borrow it from others (Nepuni 2010). Thus, the Roman script is used today as a medium of communication.

Bamboos in religion and beliefs

On the first day of the Mao-Naga lunar month Chiithuni (January), menfolk go to village pond or spring for spiritual cleansing called as *phehrii mani*. To foresee the future of the village, rituals are performed by the village chief or an elder. Mao-Naga community does not have a dedicated shaman or priest for performing any community rituals.

Rituals for foreseeing the future are performed with the help of a bamboo stalk. The stalk is split into half and thin/flattened using a knife or a *dao* (long knife). Prior to this, the selection of the stalk is done using two criteria: i) Pebbles are thrown at bamboo, and the first stalk to be hit is chosen, ii) Intact tip (broken tip is considered unclean).

Planting of bamboo is time specific and limited to three days before the paddy plantation (month of May). Planting of bamboo before/after the recommended time is believed to be a bad omen and results in failure of monsoon rain, or drought. If this taboo is violated, the village chief or elders asked the community or the grower to uproot the plant. Planting of bamboo is a taboo for young people. It is believed that if the bamboo grows luxurious than the person, such persons have a bleak future. To break the omen, even the adults walk across the sapling to ward off the omen. In Kakani-Kathmandu area of Nepal too, planting of bamboo is a taboo; it is believed that the person would become sterile (Gurung 1989).

Weaving and agriculture

Bamboo mats are used mostly for drying paddy, vegetables and as sleeping mats. It is said that drying on bamboo mats is faster when compared to

plastics/fabrics (International Rice Research Institute IRRI 2013). Bamboo weaving is observed as a hobby by the villagers. Due to necessity of bamboo mats during paddy harvest and post-harvest, villagers are compelled to weave bamboo mats but it is taboo to leave the mat incomplete and harvest paddy because it is believed to yield less harvest. Therefore, elders advise the artisans to complete the mat well ahead of harvest. The belief system acknowledges the dutifulness and diligence towards one's work to complete before indulging in another. At present, the art of weaving is known to few elders. Bamboos and infertility

According to Mao-Naga belief, the root of bamboo grows as much the height of the bamboo. Cultivators usually don't plant crops underneath the bamboo, as it would result in stunted growth or no yield. Similar observations have been reported in the communities of Terai, the midhills and Kerabari of Nepal (Das & Mitchel 2005). According to knowledge partners, the roots take 2-3 years to decay whereas the rhizomes take three or more years. Time taken for the root and rhizome to decay makes swidden farming difficult. Consequently, to ease up the process of decomposition, burning is practiced.

Bamboos and famine

The flowering of bamboo in Mao-Naga community is believed to have induced famine in the region. This belief is similar to that of the Mizos (people of Mizoram, India) because the Mizos suffered famines caused by rats. Initially, the rats feed on the bamboo seeds of *Bambusa tulda* and *Melocanna baccifera* and later target the standing crops (Nag 1999, Liese & Kohl 2015, Govindan et al. 2016). Knowledge partners acknowledge that they did not witness bamboo related famine in the past 60-70 years, keeping in mind that the average maximum life span of bamboos is 40 years (Kumari & Singh 2014). Mao-Naga hunt the rats and consume them which might have averted the rat induced famine.

Seasonal indicator

The Mao-Naga community depend on monsoon for paddy cultivation which usually arrives during the mid of May and continues till August. The turning of bamboo leaves to dark green indicates the precise time for paddy plantation. Young bamboo shoots sprout after paddy transplantation is over. It is said that the sprouting of bamboo indicates that it is time to end paddy transplantation. Plants can serve as seasonal indicators, setting up various moods of the community (Franco & Narasimhan 2012). Such seasonal indicators are also known to help

communities direct their individual as well as collective actions related to agriculture and ecosystem management (Franco 2015). The use of plants as seasonal indicators for agricultural activities has also been reported from Pnar community of Meghalaya (Samati & Begum 2006) and Mao-Naga of Manipur (Mao & Hynniewta 2011).

Conclusion

TK is a result of years of observation, experimentation, and understanding which remains dynamic with each passing generation. The 'timber' of Mao-Naga has supported the community in the past and the dependence is only likely to increase due to rapid depletion of resources. The TK recorded in this study would be of help to the younger generation of the community in planning bamboo harvesting, mitigating soil erosion, soil conservation, and maintain agricultural productivity by observing seasonal indicators. We recommend that value addition in bamboo crafts, bamboo shoots and bamboo borers should be promoted for enhancing livelihood security.

Declarations

List of abbreviations: FAO - Food and Agriculture Organization of the United Nations; INBAR - International Bamboo and Rattan Organisation; IRRI - International Rice Research Institute; PIC - Prior Informed Consent; ISE - International Society of Ethnobiology; TK - Traditional Knowledge.

Ethics approval and consent to participate: The study conforms to the code of Ethics of the International Society of Ethnobiology (ISE) which is in compliance with the Nagoya Protocol on Access and Benefit Sharing.

Consent for publication: Written Prior Informed Consent (PIC) is taken from all the knowledge partners for publishing the information.

Availability of data and materials: The data was not deposited in public repositories.

Competing interests: The authors do not have any competing interests.

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