FIELD FORESTER

VOICES FROM THE FIELD

VOLUME 1 • ISSUE 8 JUNE 2016

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From the Chief Editor's Desk

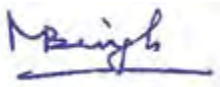
"Forests give life to life." While water and oxygen are the two most intangible benefits from our forests which directly nurture life, a very important and very visible benefit which literally gives life through livelihoods to a huge population throughout the country are Non Timber Forest Produce also referred to as NTFPs.

A large and diverse basket of Non Timber Forest Produce is sourced from our forests ranging from the humble *phool jharoo*, *Thysanolaena maxima*, to the very pricey chilgoza nut, *Pinus gerardiana*. These NTFPs touch our lives everyday in various ways and manners through a wide array of products of daily use – food, cosmetics, health supplements, medicines to mention just a few. The market for NTFPs thus exists but is far from organised. The collectors get a pittance compared to the market value of the product. Many a times, post harvest handling is abysmal and the quality of the product plummets by the time it reaches the final seller. Sporadic efforts have been taken by various State Forest Departments as well as few non-governmental organisations to streamline the process of value addition and marketing of NTFPs. However, much work is still left to be done.

It has been widely acknowledged that NTFPs are an important source of alternate employment right from the stage of collection, primary and secondary processing, value addition and marketing, especially for rural women. It can serve as a powerful tool to empower women – especially rural poor, tribals and other marginalised communities. It also can be used to create sustainable employment opportunities and wean away people from activities that degrade forests and harm wildlife.

However, caution needs to be exercised by managers while promoting the utilisation of NTFPs and organisation of their marketing and trade. Along with poor economic management is coupled an appalling gap in the knowledge regarding scientific management of most of the NTFP species – propagation, cultivation, sustainable harvesting, conservation strategies, etc. It is the need of the hour as we move towards multiple use forestry so that detailed attention is paid to the conservation and utilisation of NTFPs in a sustainable manner backed soundly by scientific knowledge.

As a result, for this issue of Field Forester, the State Forest Service Officer Trainees of 2015-17 batch in CASFOS, Dehradun were given assignments to cover successful stories on the conservation and management of Non Timber Forest Produce from all over the country. While bringing to our notice the wonderful work done by various agencies – government and non-government, I also hope that this exercise left a strong imprint in the impressionable young minds of the trainees and inspired them to emulate such work in the future in their respective workplaces.



MP Singh

UDAIPUR / RAJASTHAN

Myths, traditions and ethno-conservation of *Bombax ceiba*

About 1,500-2,000 trees or branches of B. ceiba are cut and burnt during the Holi festival around Udaipur city. There is thus an urgent need to develop sustainable conservation strategies to preserve the species.

Bikram Singh Rongpi

Plants form an integral part of many rites, rituals, folk tales, customs and traditions. Silk cotton tree (*Bombax ceiba* L.), locally known as *Semal,* is one such tree species quite popular among various tribal communities. The plant is being exploited largely for medicinal and commercial purposes, but traditional burning of this tree in *Holika-dahan*, an important festival of North India, is jeopardising its survival in the tribal-dominated Udaipur district of Rajasthan. An ethno-botanical survey carried out revealed that about 1,500-2,000 trees or branches of *B. ceiba* were cut and burnt during *Holi* festival in the villages around the city. Therefore, there is an urgent need to develop some sustainable conservation strategies and create awareness among rural and urban communities in order to preserve such a tree of immense medicinal value.

Bombax ceiba Linn.
Synonymous: *Bombax malabaricum* DC.
Salmalia malabarica (DC.) Schott & Endl.)
Local name: *Semal*
Sanskrit name: *Salmali*
Common Name: Silk cotton tree, red silk cotton tree, *Semal*
Trade Name: *Semal*

Growth Habit

Semal is called 'king of the forest' due to its massive size and showy flowers. It is a large deciduous tree with a straight cylindrical stem and horizontally spreading branches in whorls. This horizontally branching system in whorls, large size and the buttress at the base are the first seen characteristics to distinguish the species in the forest. The tree reaches up to 40 metre in height and 2 metre in diametre with the clear bole of 24-30 metre. Large trees are invariably buttressed at the base. Stem buttresses at the base and goes up to 5-6 metre in height.

Morphology

The young stem and branches are covered with sharp, straight, stout

SFS 2015-17 Batch, CASFOS, Dehradun

Young stem of B. ceiba

Bark of *B. ceiba*

prickles up to 1.2 cm long with woody conical bases.

Bark

Bark of *Semal* looks pale ashy to silver grey, 1.8-2.5 cm thick, smooth up to middle age, becoming rough with irregular vertical cracks on older trees.

Leaves

Semal tree has compound leaves palmate in appearance. The leaf is digitate, large, spreading, glabrous, which has common petiole, and 15-30 cm long. One leaf is composed of several leaflets. Five leaflets are common in one leaf, but sometimes up to seven leaflets can be found. The size of leaflets varies from 10 to 20 cm. Generally leaflets found at the centre are longer as in fingers of a palm. The leaflets are lanceolate, acuminate, more or less coriaceous and entirely glabrous.

Flowers

The bright red flowers, which appear January to March, are large and conspicuous on leafless trees. It presents a strikingly remarkable sight in winter and spring when the usually bare branches are covered with large, fleshy, red flowers. Birds are attracted to them and are probably responsible for their pollination. These flowers form a scarlet carpet on the ground for few weeks (2-3 weeks) after dropping.

The flowers of *Semal* are very attractive and visible from long distances. Because of its beautiful and attractive flowers, people like to plant it as an ornamental plant in botanical gardens, gardens or as an

Leave of *B. ceiba*

Capsule of *B. ceiba*

avenue species**.** Flowers are numerous, large, 10-12.5 cm across. It is clustered towards the ends of branches at the time of flowering. It has the thick, fleshy and cup-shaped sepals. It bears generally 5 petals in one flower which are 7.5-15 cm long oblong, re-curved above, fleshy and of bright crimson (rarely yellow or orange) colour.

Capsule

The pods are about 10-18 cm in length, oblong-oval in shape, locucidally 5 valved. Valves are woody, downy outside and lined with silky hair within.

Flowers of *B. ceiba*

Floss of *B.ceiba*

Seeds

Within the capsule, it has many seeds which are obovoid, smooth and 6-9 mm long in size. These seeds are oily and surrounded by a thick mass of long silky hair or floss, hence easily blown about by wind.

Distribution

Bombax ceiba Linn. (family Bombacaceae), the large, beautiful and deciduous tree is found throughout India and other parts of tropical and sub-tropical Asia, Australia and Africa, ascending the hills up to 1,500 m. It is known by different names such as Red Silk Cotton tree, Indian Kapok tree (English), *Shalmali* (Sanskrit), *Semal*

(Hindi), *Shimul* (Bengali), *Mullilavu* (Malayalam) and *Kondaburuga* (Telugu). The plant is even mentioned in *Mahabharata* proving its presence since a long time. Raj Nighantu describes this plant and its medicinal value.

According to Ayurveda, it has stimulant, astringent, haemostatic, aphrodisiac, diuretic, anti-diarrhoeal, cardio-tonic, emetic, demulcent, anti-dysenteric, alterative and anti-pyretic properties. Besides having immense medicinal potential, it has also been used for other commercial and industrial purposes. Many customs, myths and traditions are related to this old tree. Some of them reflect intelligent approaches for its sustainable use and preservation while some are seriously causing harm to this beneficial tree species. The paper concentrates on some deep-rooted traditions and myths related with *B. ceiba* and, in particular, the tradition of burning of the tree in *Holi*, a religious festival, which is causing immense damage to the survival of the plant in Udaipur district of Rajasthan. In this context, it is important to note that Udaipur district has the highest percentage of tribal population in terms of its share to the total tribal population of Rajasthan. Bhil, Garasia and Kathodiare are major tribes of this region, besides Meena and Damor tribes. Furthermore, the study also suggests some sustainable conservation strategies to protect the multipurpose tree species.

Methodology

Besides compiling information from literature about indigenous and commercial uses of *B. ceiba* and various myths and traditions related with the tree, an ethno-botanical survey during January to March 2007 was also carried out in Udaipur city and nearby villages to get information regarding the tradition of burning the tree in *Holika dahan*. After taking informed consent, informal interviews were conducted with tribal people, their medicine men and women, knowledgeable elderly individuals and village headman. Respondents were selected randomly, representing both sexes and age groups.

Table 1: **Population data at a glance**

Level	Gross population	Urban population	Rural population	Scheduled population	% Literacy rate
India	1,02,70,15,247	2,853,54,954	74,16,60,293	8,43,26,240	64.8
Rajasthan	5,65,07,188	1,32,14,375	4,32,92,813	70,97,706	60.4
Division Udaipur					
Udaipur district	2,633,312	4,90,317	21,42,995	12,60,432	58.62
Banswara district	15,00,420	1,07,316	13,93,104	10,85,272	44.22
Dungarpur district	11,07,037	80,143	10,26,894	7,21,487	48.32
Chittorgarh district	18,03,524	89,269	15,14,255	3,88,311	54.37
Rajsamand district	9,87,024	1,28,723	8,58,301	1,29,198	55.65

Fig. 1: **Location map of the study area**

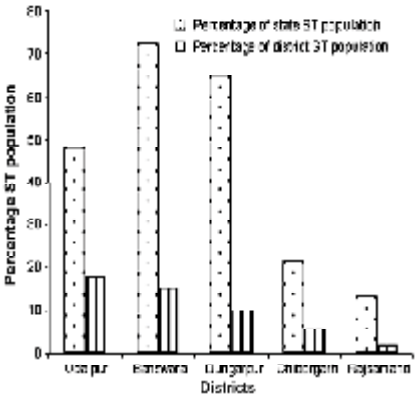


Fig. 2: **Percentage of ST population distribution**

Besides this, other methods were also used, such as observations, enquiries and participation in tribal ceremonies. Further, the information was also collected from forest officials, school teachers, government physicians, veterinary doctors, who have accrued enough knowledge about tribal customs due to their long association with them and long stay in the rural and tribal areas.

Ethno-medicinal and commercial uses

B. ceiba is used in various indigenous systems of medicine in India, China and South-East Asian countries. Almost every part of the plant is used as medicine and its roots and flowers are used for curing maximum number of ailments. Its young roots are roasted in the fire and eaten like roasted sweet potato, while some tribes eat even raw roots during famine or otherwise. Some of the ethno-medicinal uses of *B. ceiba* prevalent among different tribes of India have been tabulated (Table 2). The plant has been found to possess strong anti-inflammatory, anti-bacterial, anti-viral, analgesic, hepatoprotective, anti-oxidant, oxytocic, hypotensive, hypoglycaemic, anti-angiogenic, anti-mutagenic as well as fibrinolysis enhancing activities. Besides the ethno-medicinal uses, *B. ceiba* is also used for various commercial purposes.

It is an important multipurpose tree used for agro-forestry, providing food, fodder, fuel and fiber. Due to high protein content in the leaves, the plant is the most preferred fodder species. It is widely used in silvipastoral system of agro-forestry to meet the feed requirements of livestock during the fodder deficit period in winter. Wood of this plant is strong, elastic and durable, which is best suited for ship, boat and catamaran building. It

Table 2: **Ethno-medicinal uses of *Bombax ceiba***

Plant parts	Uses
Root	Diarrhoea, dysentery, boils & burns, diabetes, impotence and as aphrodisiac, night pollution, scorpion sting and snake bite, sex tonic, urinary troubles, brain tonic, gonorrhoea, syphilis, bed-wetting, leucorrhoea and spermatorrhoea.
Stem & bark	Bacterial, viral, protozoal infection and digestive disturbances. Boils, heartburn, heart tonic, kidney stone, spermatorrhoea and weakness, headache, dislocated bones, easy delivery, snake bite, scorpion, centipede and spider stings.
Gum	Asthma, giardiasis, bleeding piles, diarrhoea and dysentery, dental caries, aphrodisiac and in scabies.
Leaf	Glandular swellings, rheumatism, anti-dysenteric, haematinic, menorrhagia, leucorrhoea, anaemia and infertility.
Flower	Haematuria, anaemia, lecucorrhoea, haemorrhoids, hydrocoele, gonorrhoea, menstrual disorders and leucorrhoea, boils and sores, splenomegaly, internal bleeding and cancer, colitis, premature ejaculation, snake bite, permanent sterilisation, diuretic and laxative.
Fruit	Anti-fertility agent, uterus protrusion, leucorrhoea.
Fruit & heartwood	Anti-diabetic, anti-diarrhoeal, snake bite.
Seed	Chicken pox and small pox.
Spines	Skin troubles, acne and headache.

is most widely used in match industry and for planking ceilings, canoes, shingles, toys, scabbards, coffins, well curbs, brush-handles and artifact production. Kathodi tribe of Rajasthan uses its wood for preparing musical instruments such as a membranophonic *dholak* and *tambura* while the Bhil tribe uses wood to make spoons for their kitchen. Oil isolated from its seeds is comparable to true Kapok plant and can be used as an edible oil substitute for cottonseed oil, for soap making and to illuminate. Floss isolated from its fruits is an excellent material for making padded surgical dressings, insulating material for refrigerators, soundproof covers and walls and as vermin-proof; it is suitable for making cushions, pillows and upholstery. The plant is best matchwood resource and useful for reclamation of wastelands and mine spoils. So, it can also be utilised to improve the barren soil and gain economic benefits simultaneously.

Myths, traditions and ethno-conservation

There are many myths, legends, folk tales, songs, customs and traditions associated with this large deciduous tree among various tribes of India. Some of these are indirect projections of a mentality showing concern for its sustainable use and conservation, while some are seriously damaging its

existence in nature. Ethno-conservation practices prevalent among the tribes and dispersed in the urban areas are primarily based on either dreadful imposition, or God-hood concept. In the former case, *B. ceiba* is said to be the tree of infernal region and the thorny appearance (*kantakdruma*) has led it to be called as *Yamadruma*, the tree of *Yama,* the lord of hell. The fear is so much engraved that a myth prevails among tribes that if a healthy person even visualises it in a dream, he becomes ill, and if an ill person sees it in a dream, he will die soon. It is considered inauspicious in Dungarpur district of Udaipur division due to hooting of owls that make their home on it.

Bhil tribe of Udaipur division has another superstitious fear associated with the silk cotton obtained from its fruit. According to them, mattresses and pillows filled with its plumed seeds will paralyse the user. So, they do not use its cotton, thus indirectly protecting its natural dispersal source. Besides this, its wood is not used as fuel by tribals of Rajasthan as it is believed that it will bring bad luck. Even the ancient text, *Brahamavaivarta Purana,* prohibits use of the plant for brushing the teeth. These myths have indirectly led to the survival and preservation of the tree in nature.

Imparting the God-hood concept is another way for ethno-conservation of plants prevalent among tribes. This tree has been considered as God tree since Vedic times. It is said to be the *nakshatra* tree of people born in *Jyestha* constellation and therefore, plantation of *B. ceiba* is expected. Concept of God tree is that nobody can use that tree even as a medicine.

The tree was also called to be home of female tree spirits, *yakshis,* and it was worshipped by women for gift of children and thus preserved for a long time. Semlia clan among the Bhil tribe considers *B. ceiba* as a tree totem and hence respect, worship, guard and conserve the tree. Moreover, Garasia tribe, present in Bosa village near Sirohi district in Rajasthan, protects the tree in a sacred grove called *Maad Bavasi.* Khuman clan of Meetei community in Manipur does not use or consume *B. ceiba* in any form and conserve the tree by simply employing environmental ethics in consumption or harvesting of plants. Similarly, tribal communities of Madhya Pradesh and Chhattisgarh also use various strategies to protect the tree. For example, while employing it for medicine collection, a clock-wise selection of one group of tree is done. Also, using different group of trees or collecting plant parts on specific days of the week are some ethno-conservation practices used by these tribals. Folk songs also give an idea of plants growing in the surrounding environs of tribals and throw light on most popular plant-based practices in usage and in various spheres of their lives.

Garasia tribe identify *B. ceiba* tree so much with themselves that they sing a song *Hemlo ropalo re* (meaning *O, plant the hemlo; hemlo = semal*). In this song, moon and clouds have been given the status of its father and mother, respectively, and generally village chief and his wife are assigned the role of its brother and sister-in-law. Then a

request is made to plant the tree and take care of it by considering it as one's own relative. Shade of the tree is also praised in a song by Garasia tribals. In some songs, even a warning is given to the tribals who cut the tree. Among all the customs and traditions related to *B. ceiba*, the one which is most dangerous and widely prevalent even in urban masses of Udaipur city is the use of the tree as a pole for *Holika dahan*. This particular tradition is leading to the loss of the tree species in large quantities in a single day, every year.

Holika dahan – a traditional fatal axe

Holi, the festival of colours, is also the blooming time of *B. ceiba* tree and its flowers are used to prepare eco-friendly colour to play with. Besides this, a pole of debarked *B. ceiba* stem or a branch is used as the main pillar to be burnt in *Holika dahan* by Bhil, Garasia and Damor tribes. The tradition of burning of *B.ceiba* is followed in states of northern India, such as Rajasthan, Madhya Pradesh and Uttar Pradesh, where the tree is found in abundance. However, from east to west, the use of sacred cotton tree (*semal*) in Holi is a must.

In southern India, where *B. ceiba* is found but Holi festival is not celebrated, it has been protected. *B. ceiba* poles are considered as virtuous Prahlad and are planted nearly a month before Holi. Even an effigy of *Holika* and Prahlad is prepared and tied over the prepared Holi in circle. The tree is well known among tribal people as well as urban people as *Holi danda*. The whole silk cotton tree, or a large branch of the tree, with sacred thread, coconut and vermilion and dry grass tied over it, is fixed in the ground on *Magha Purnima* (full moon day of the preceding month of *Holika dahan*) after cleaning and worshiping the land. In different tribes, there prevails some variations in preparing poles for *Holika dahan*, but the use of *B. ceiba* is a must to perfectly perform the tradition. In Bhils, before cutting a *B. ceiba* pole, a coconut is tied on the bough, liquor trickled and vermillion is applied and tree is cut in such a manner so as to have a head and two arms. Generally the pole is removed from the burning pile. This traditional two-armed *Holi* is still prepared and planted. But in some Bhil villages of Banswara district, besides *Bombax,* bamboo is also planted with a red cloth tied on it, representing Prahlad. Here *Bombax* represents the wicked aunt Holika, therefore it is allowed to be burnt and bamboo is removed showing survival of Prahlad.

In Kathodi tribe, five poles of five different plant species are planted, one of them being *B. Ceiba,* and they keep length of each pole to the level of a person's head. Before planting the pole, a coin and *Areca catechu* nut is placed at the spot and all the poles are allowed to be burnt. Whatever may be the tradition, the fatal axe always falls on the *Semal* tree. This irrational tradition of cutting the tree for the purpose of *Holika dahan* is damaging the environment, disturbing the eco-system and proving devastating for human health.

Results and discussion

A survey in forest areas near Udaipur city just before Holi festival has revealed

many illegal attempts for felling the tree. Local tribes and people said that in 2007, around 1,500-2,000 trees or twigs of *B. ceiba* were cut for *Holika dahan*. There was hardly any concern about the sacrifice of such a large tree among people. The gravity of the situation can be further assessed as there are 2,351 villages in Udaipur district and on an average more than 2,300 young *Semal* trees or twigs were sacrificed. The observation also revealed that the number of trees has declined so much that people are now selling other plant species such as *Ailanthusexcelsa*, *Lannea coromandelica* and *Nyctanthesarbor tristis* in the name of *Holi danda*. Younger generation, that is ignorant about the identification of *Semal* tree, usually buys these debarked trees assuming them to be the traditional Holi poles.

Udaipur division, a tribal-dominated region has Meena, Bhil, Garasia, Damor and Kathodi as the main tribes. Udaipur district has the highest percentage (17.75%) of Scheduled Tribe population, followed by Banswara (15.29%) and Dungarpur (10.16%) districts (Table 2). Moreover, Banswara district has lowest literacy rate in the State, while Garasia, as compared to other tribes, has the lowest literacy rate in the State. With the rise in literacy levels, practicing of the old ethno-conservation customs have gone down but the adherence to this particular devastating tradition has continued. By mere conservation of one tradition, thousands of *Semal* trees or their branches are sacrificed on one single day, every year. Loss of an important ethno-medicinal tree can lead to simultaneous loss of many other important species surviving on the plant.

Conservation strategies

Various ethno-conservation practices, in the form of traditions, customs, myths and folk tales have made survival of *B. ceiba* for so many years. Now there is a need to revive these beneficial traditions for conservation while discarding all other traditional practices that destroy the plant. The most important part of the conservation strategy is to make people aware about its various beneficial medicinal properties. It should be a joint venture of NGOs, forest officials, local environmentalists, village heads and teachers at the local school level. There should also be a complete involvement of all tribal communities for replanting the tree as a customary practice. For conserving the tradition, only a small twig of *B. ceiba* can be used symbolically. In this regard, it is suggested that an iron pole wrapped with dried grass and hay material, instead of the wooden pole of *Bombax* can be used for burning in Holi. Moreover, increasing numbers of Holi burning events at short distance should be checked. This tree should be used for social forestry schemes and awareness among people and forest officials should be created. As natural propagation through seeds is low, largescale production of this plant is difficult. Efforts have been initiated for *ex situ* conservation of medicinal plant species.

For preserving the plant, largescale *in situ* and *ex situ* conservation techniques should be employed. Applications of biotechnology can be used as a major

tool to propagate and conserve the species in a short time period. One should strictly discard or modify all illogical traditions having a devastating impact on ecosystem, while re-establish those ethno-conservation practices and traditions, which are not causing harm to the environment. To maintain the grace of both – the tradition of *Holika dahan* and the multipurpose *Bombax ceiba* – we should initiate implementation of conservation strategies.

Acknowledgement

My thanks to Dr Surabhi Rai, IFS, Faculty CASFOS, for giving me the opportunity to prepare this case study for *Field Forester*.

ZIRO / ARUNACHAL PRADESH

Conservation and management of chestnut tree by Apatani tribe

Clan forests are usually located far inside dense forests and are visited for wood only during festive occasions

Hibu Tana

Castanopsis indica, of the family Fagaceae, is of great importance to the Apatani community of Ziro, in Lower Subhansiri district of Arunachal Pradesh. The Lower Subansiri district is located in the central western part of Arunachal Pradesh and lies between 26° 55′ to 28°21′ N and 92° 40′ to 94° 21′ E. Locally, the tree is called '*kiira*'. It is also called Chestnut tree. It can be found in a wide variety of forest types, mixed-deciduous forest and evergreen forest. The flowering period is April-May while the fruiting time is October-December. The sub-tropical tree species is found in association with various other tree spices of *castanopsis, Alnusnepalensis* and *Pinuswallchina* in Ziro, Arunachal Pradesh.

Utility of *Castanopsis indica*

Utility of the tree is manifold. It has edible fruit, its leaves and trunks are used in rituals and also as timber for

Leaves and fruits of *Castanopsis indica*

SFS, Batch 2015-17

Leaves of the spp being used in rituals

construction of traditional houses. The branches are used for fuelwood and poles for demarcation of boundaries as well as for stabilisation of stream banks that pass through adjacent paddy field. It is because of its religious importance for the tribe that the tree is managed and conserved in a systematic manner by the tribe.

Land use system of the tribe

In Arunachal Pradesh, Apatani tribe has its own system of land use classification – '*Aji*' which means agricultural land; '*Bije*' is individual bamboo forest, mixed with pine and *castanopsis spp*; '*Sansung*' is also individual forest dominated by *castanopsis spp* or *pine spp* and mostly managed as monoculture; '*UruMoreh*' is basically a sub-clan forest mixed forest; '*Hallumorey*' is clan forest comprising monoculture of pine orcastanopsis or mixed of both; '*Lemba booth*', village forest of mixed vegetation; '*Supung booth*' is community forest; '*Polung*' is also a community forest but mainly used for grazing; and lastly, '*Rantee*', which is a sacred grove where extraction is restricted except for the purpose of rituals. It is potential seed bank for various tree species.

Management and conservation

The tree species is conserved both *in situ* as well as *ex situ*. *In situ* conservation includes conservation in sub-clan forest, clan forest, village forest and in community forests which are basically wild dense forests and usually located far from the villages. Ownership of such forests belongs to respective clan of a village. The member from other clan and village can't fell tree in this demarcated area. There is a strict penalty for disobeying this law. In case the tree is felled from the other side of the boundary, then it is settled in terms of same volume of timber or Mithun (*Bos frontalis*). *Ex situ* conservation includes conservation of such tree species in private forest areas like *Bije* or Bamboo groves with *Castanopsis spp*, and '*Sansung*' denotes private forests other than bamboo groves that are

Mixed cultivation of bamboo and castanopsis indica

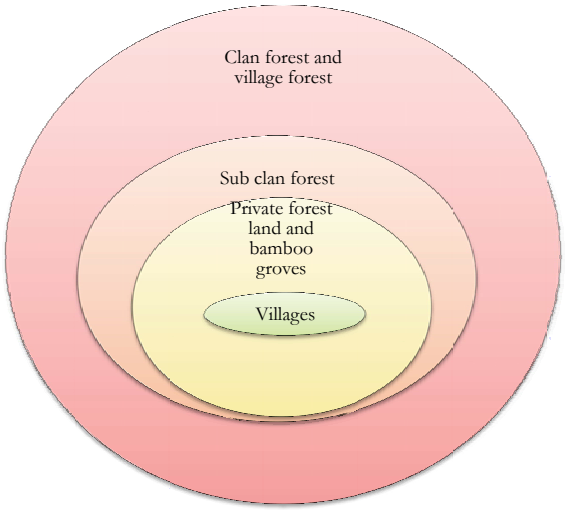


Diagram showing general set-up of land-use system with relative distance of forest type from villages (diagram is not to scale).

predominantly pine and *Castanopsis spp* in such land.

Generally, private forests are at proximity to a village and so the trees are planted deliberately in such private forest; logic behind being that in case a family member is unable to collect firewood due to ill health or so from clan forest, which is usually far, then it could be collected from the nearby private forest. The frequencies of conducting such rituals are also one factor that leads to conservation of the tree species. The tree species are usually obtained by natural regeneration. They grow in plenty in the plateau. The management

Stump of the spp being used in erecting structure

practices are mainly confined to cleaning of undergrowth and thinning in private forest lands. Cleaning is usually carried in and around the tree in the months of December and January. Thinning operation is carried out in the months of March and April and it is then planted after proper spacing. Old trees are cut in such a way that it gives space for regeneration. Only dead and old trees are selected for firewood. Sometimes trees are felled for opening the canopy.

Clan forests are usually located far inside dense forests. It's a pristine forest and kept as such. These forests are visited for demarcation of boundary (renewal) during festive occasions. Pole, stump and leaves are harvested at the same time for meeting ritualistic requirements.

No plantation activity is carried out in these forests. Numbers of poles or stumps harvested depend upon the number of male members in the family. Priority for felling is given to straight stumps then others, like opening of canopy, space felling, etc. As festival (Myoko) is repeated after three years for a group of villages, it gets time to rejuvenate by the time next felling operation is carried out in the same village.

The tree felling was restricted in the sense that commercial harvest of timber in such forests was discouraged. Timber was extracted mostly for construction of houses in the village. During days gone by, village elders were consulted for felling and hunting in these areas. Peer pressure was also an important factor that controlled illegal felling. However, time will tell as to how long the integrity of forest could be preserved by the community but, as of now, the forest is intact with rich wildlife and plant diversity.

UTTARAKHAND

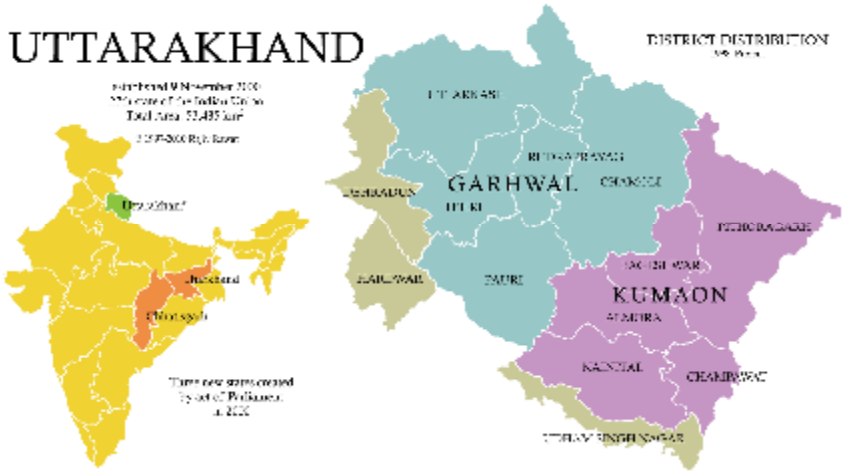
Indigenous uses of Chir Pine

Chir pine, being the dominant tree species, in Uttarakhand is well known to the local people, who have discovered several uses of it over time

D John Sha

Forests play a vital role in sustaining the human population, and also enhances the quality of life of human societies all over the world. Among the various types of forest vegetation, coniferous forests play a particularly important role in human culture and are represented in folklore and mythology. Many conifers have also served as religious symbols and have played a prominent role in art and various traditions. *Pinus roxburghii*, commonly known as long-leaved pine or chir pine, is one of the most important conifers in the Himalayan region and moulds the life of communities of the region. Chir pine is one of the most useful and commonly used tree species among all the pines in the Himalayan region. Chir pine is distributed in mountainous areas between 600-2300 m elevation over Bhutan, North India, Kashmir, Nepal, Pakistan, Sikkim and the southern part of Tibet. The Uttarakhand hills in northern India are one of the best habitats of chir pine forests.

This case study was undertaken



Garhwal and Kumaon regions of Uttarakhand state.

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in the newly created Himalayan state of Uttarakhand in India. The state consists of two regions, i.e. Kumaon and Garhwal. Uttarakhand state covers an area of about 53,485 sq. km. and has a population of 84,79,562 out of which 78 per cent fall under rural category. The state is well known for its rich biodiversity, ethnic communities, traditional resource use pattern and indigenous knowledge systems.

Apart from that, the state is also well known for the origin of various sacred rivers such as the Ganga and various temples. The state covers wide altitudinal range with diverse landscapes that has resulted into greater climatic variations and due to which there are several micro-climatic zones. Even in a single gradient, there are vast differences in climate such as temperature, humidity, snowfall, wind, etc., and therefore variation in vegetation patterns. Chir pine being the dominant tree species is well known to the local people, who have discovered several uses of it over time.

Broadly, one can say there are about 10 significant uses. One of the most important products is the resin from the chir pine. Apart from resin, the other parts used by the indigenous communities of the state are the cone, bark, leaves, stem and wood.

The tapping of resin in Uttarakhand began in 1890 and by 1896, it was commercialised. Tapping operations were extended to Jammu and Kashmir and Himachal Pradesh in 1940 and 1945, respectively. The old method followed for resin tapping was the faulty French "cup and lip" method, which was replaced by the "rill" method.

The use of chir pine as timber and fuelwood are among the major indigenous uses of this species in Uttarakhand. The daily life of middle Himalayan communities has revolved around the chir pine forests right from birth. Chir pine is a major fuel required for cooking in this region. Livestock also feed on the understorey plant species inside the chir forest. The chir pine seeds are edible and also a source of edible oil extraction. In Kumaon region, the needle-like leaves of the chir pine

Chir pine forest. (Photo: Vikas Chaudhury)

are used for livestock bedding, mostly during the rainy season to prevent livestock from contaminated water and resultant diseases. Blacksmiths, who are basically low-caste communities, use the bark of the chir pine for melting metals and designing various kinds of utensils. The small chips of resinous wood of chir pine are called *chhilla* in Garhwal and were used in place of kerosene oil in the past and also for lighting purposes. About 80 per cent of the chir pine in Kumaon and Garhwal region is twisted pine and thus provides varieties of shapes for decorative items. The cones of chir pine are generally collected for two purposes, collection of seed for reforestation and for decoration. Traditionally, the cones of chir pine have also been used as firecrackers during the occasion of Deepavali, the festival of light. Cones can also be used as a fire starter in fireplaces or crushed and moulded into presto-log shapes.

Chir pine plays a significant role in the folklore and mythology of indigenous cultures in Uttarakhand. In Garhwal, there is a festival known as Pandaw, in which the local people celebrate the occasion with dance and songs and worship various deities and gods. The festival continues for several days and in the closing ceremony, a chir pine is uprooted and brought to the village, which is adorned with various local fruits. Once the celebration is over the fruits are distributed among the audience, which are considered holy fruits. The twigs of chir pine are also used for religious purpose during marriage ceremony of Hindus. Besides, chir pine is used for the treatment of certain ailments. The traditional herbal healers prescribe the asthma patients to stay inside the chir pine forest.

Table 1. **Ten major uses of chir pine.**

	Major Indigenous uses	Part used
1	Timber	Wood
2	Fuel	Wood, bark
3	Edible and source of oils	Seeds
4	Religious purpose	Twigs
5	Decoration	Cones
6	Treatment of asthma	Forest
7	Pandaw festival	Tree
8	Livestock bedding	Leaves
9	Resin	Resin
10	Lighting	Resinous wood

Plants growing inside the pine forests are a source of valuable non-wood products, several of which are important in local and regional economies. Others are important traditional products. For example, various types of edible mushrooms like *Agaricus campestris, Cantharellus cibrosius, Collybia maculata, Morchella esculenta, Polyporus sulphureusand, Sparassis crispa,* etc., grow inside the pine forests along with varieties of lichens. Apart from this, many wild animals inhabit the pine forest. Many other tree and shrub species grow inside pine forests such as *Rubus ellipticus, Fragaria vesca, Myrica esculenta, Berberis spp., Carissa carandus, Carissa opeca*, etc., that have multiple uses.

Conservationists are more concerned

about the damaging of pine forests due to largescale tapping of resin. However, if the tapping operation is conducted properly, involving the removal of only the bark, then there is no damage to the trees and they may be tapped for up to 20 years or more. Even the more traditional methods of tapping which involve some removal of woody tissue may not affect tree survival and trees can seen in the wild with old tapping scars otherwise seem quite vigorous. The risk of damage is heightened if excessive wood tissue is removed. If the chir pines are managed in a sustainable manner, it can provide many benefits and also conserve other forest plant species effectively.

NFTP DEVELOPMENT

Conservation and management of wild bee honey

Sustainable honey harvest has a positive impact on the environment by increasing the number of colonies in the forest ecosystem and thereby giving pollination benefits to wild and domesticated flora as well.

Laishram Gitla

Honey is a sweet substance produced by honey bees from the nectar in flowers which they collect and transform with the help of enzymes they produce. Due to variation in the sources, honey harvested from combs of honey bees is unique every time it is harvested and also there is great diversity in flavor and aroma of honey of different parts of the world. Nonetheless, major constituents (glucose and fructose) remain more or less similar constituting about 70% of the honey. Honey has more than 20 aroma constituents, 19 organic acids, 5 enzymes, 28 minerals, 13 vitamins apart from 22 types of sugars. Honey has varied uses; as flavouring agent in foods and drinks, confectionery industry, alcoholic drinks; in medicine and pharmacy and in preservation of biological materials. Not only honey, but also wax, an important bee product, is used as a component in cosmetic and pharmaceutical industry. India is endowed with 3 species of native honey bees namely *Apis dorsata, Apis cerena* and *Apis florea.* Amongst the three, *A. dorsata* (giant bee) is known for its aggressiveness, higher honey yield and are distributed throughout the country. India in one of the leading honey producers in the world and produces about 70 thousand tons of honey annually. The major part of this comes from *Apis dorsata.*

Tribals living in the fringes of forests, hunt for bee colonies in the forest. Due to their unsustainable mode of harvesting, there is loss of colonies and valuable pollinators. Moreover, they are paid very less by the big traders. Furthermore, their mode of harvesting is very crude and unhygienic. A safe and eco-friendly harvest of wild bee honey, hygienic processing, packing, value addition of honey and reduction in price spread is very necessary for sustainable harvesting and livelihood generation of the local villagers.

Case study areas

1. Yellapur Taluk of Karnataka
2. Satyamangalam areas of Tamil Nadu
3. Sundarbans of West Bengal

Here in these areas, tribals both young and old are involved in

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harvesting of honey. However, their methods of collection are crude and not sustainable, clean and hygienic. Moreover, they are illiterate, trapped in by petty honey traders and are not capable of marketing their product for the right price.

Owing to the importance of wild honey bees as pollinators and their population decline due to unsustainable practices of honey harvest, this case study was carried out by University of Agricultural Sciences, Department of Apiculture, Bangalore, during February 2009 to March 2014. The work was taken up with the sole purpose of striking a balance between conservation of wild bees and livelihood needs of the honey gathering tribals.

Honey harvest method in case study areas

The tribals follow a crude method for collection – exposing the nest to smoldering fire to chase the bees away from the comb area, then the comb is cut and honey is squeezed out of the honey comb. The larvae and egg stages contained in the honey comb are thus damaged and hence resulting in the loss of huge number of bees.

Sustainable honey harvest protocol introduced to tribals

The tribals were taught how to collect honey sustainably. They were willing to understand the aforementioned issues and wish to conserve bees in nature. Sustainable honey harvest method encompasses the following points:

- Before removal of honey comb, chasing of bees using thick smoke
- During honey collection the part (chamber) of comb containing eggs and/or larvae are left uncut
- Care is taken not to harm the Queen bee
- Only mature hives, that are indicated by capping (with wax) of the cells, are harvested; but not all the hives in a cluster
- If about 90% of the hive is capped, then it is ready to harvest
- The honey portion is indicated by the bulge which is to be cut
- Some honey should be left on the hive for use of the bees. This allows the nest to recoup to its earlier form. Not only this prevents the colony from being destroyed but also facilitates more than one harvest per colony.

The tribals were taught to collect honey by cutting and draining it through a filter. By doing so, they fetched 1.5 to 2 times more price than earlier. However, the method requires skilled handling to avoid stinging. In order to solve this problem, plant species which have repellent/calming ability against wild honey bees were identified. Of these, *Amomum maximum* has highest calming ability. The fresh stem extracts are smeared on the hands of the person while handling the bee colony. *Mimosa* is now used by the tribals in smoke generation to induce calming in bees.

Impact of sustainable honey harvest method

The gaps in the traditional method of honey harvest were worked out in the new method. The model is being

followed by Forest Department and Horticulture Department as well. Direct/indirect impacts of the new method are summarised as follows:

- Use of certain repellent plant material helped to becalm the bees .
- Jumbo smoker supplied, helped easy chasing of bees from the comb area without any harm to the bees and is no threat to forest. Traditional honey harvest using fire torches could be a serious cause of concern.
- Use of bee suit gave confidence in bee handling during daytime. It reduces the drudgery of night work and enhances the safety of honey gatherer.
- Removal of only honey area from the comb helped to save the colony along with brood and helped repeated harvest of honey from the same colony 2-4 times (depending upon the floral availability). Per tree colony density also increased (23 per cent).
- Cutting combs into pieces at the midrib and allowing draining out of honey helped to obtain clean honey. Quantity of honey harvested increased.
- Filtering cloth in the collection bowl facilitated collection of clean honey; this fetched a higher price for the honey, nearly 1.7 times of what they used to get earlier.
- Honey processing plant set up in the area facilitated not only clean marketable honey production but also honey procurement, testing, packing and sale.
- The processing helped in enhancement of price of raw honey by 50-70 per cent ie., from Rs 140 to 225 at Yellapur. As a result, tribals have slowly come out of the debt trap of small time honey traders who offer them low price for their honey at Yellapur. In Coimbatore, the price after processing of honey was Rs 250 and was directly delivered to the tribals. The price of honey procured at Ulon was Rs 110 while it was sold at Rs 220. In West Bengal, the forest department restricts the tribals selling their honey only to the forest department. The forest department procures honey from them by paying only Rs 60 per kg of honey.
- Overall, the earning per person increased (2 times).
- They influenced the neighbors to harvest honey in sustainable way; their service is solicited by neighboring taluks and districts to harvest honey in a sustainable manner.
- All in all, the case study helped tribal wellness and wellness of wild bees.
- It has high scope for expansion into other states to enjoy the eternal success.

Other achievements

(i) Organic certification: Authentic Organic Certification by an international certification agency helped the Village Forest Committees to sell their honey as organic and at a higher price.

(ii) Wild bee nesting tree species: Wild bee flora was recorded for Yellapur, Satyamangalam and Sundarbans. In Yellapur, two species viz., *Adina cordifolia and Trivia nudiflora* were

found most important to support wild bee colonies and constituted about 62 and 13 percent of total nest bearing trees, respectively. In an effort to conserve wild bee colonies the Forest Department declared a 3 acre forest area having rich number of *Adina* as undisturbed area.

(iii) Honey analysis: Wild honey is sometimes adulterated with sugar syrup or corn syrup by few traders and unscrupulous honey gatherers. In order to save the brand image of forest honey from being sullied, trainings were imparted in honey analysis, processing and packing at Central Bee Research And Training Institute, Pune.

(iv) Value added products: Training was imparted to a large number of beneficiaries and prospective entrepreneurs in value addition activities: bakery, dairy and *amla* (fruit) products with honey. This helped them in acquiring certain skill-sets which help them in sustaining themselves in a secured way.

(v) New technology developed: A new method to hive little bee colonies with cardboard boxes helped to partially domesticate the wild bees. The hived colonies can remain inside the hives at least for 4-5 months during which the colonies can be used for sustainable harvesting of honey and planned pollination of crops in the farm. In addition to this, it will facilitate the researchers to make *in-situ* observations about the bees.

Status of dissemination and extent of adoption and success

This system had become popular among tribal honey collectors so much so that tribals of other three villages also came forward to adopt the new technology. They were ready to purchase the safety gadgets using their personal funds. The new technology is widely practised by tribal beneficiaries in six other selected villages.

Conclusion

Sustainable honey harvest has a positive impact on the environment by increasing the number of colonies in the forest ecosystem and thereby giving pollination benefits to wild and domesticated flora as well. Furthermore, there is no environmental issue/concern as regards honey processing since it does not yield any unwanted and dangerous by products. Living standards of the tribals have improved as result of better income generated due to proper market linkage for forest honey.

TRIPURA

Jhumia rehabilitation through rubber

The Tripura Forest Development and Plantation Corporation Ltd has played a key role in tribal livelihood generation and conservation initiatives

Rajiv Engti

Forests are an integral part of the tribal culture and tradition of Tripura. The forests in Tripura are mainly tropical evergreen, semi-evergreen and moist-deciduous. The state has a geographical area of 10,492 sq. km of which 6,293 sq.km (about 60 per cent) is the forest area as per legal classification in the state. As per the report of the Forest Survey - 2003 of India, only 52.2 per cent forested areas are well stocked, the remaining areas are degraded. Rubber plantation has become a much talked about phenomenon in the state of Tripura. The State Forest Department, aiming to target soil and moisture conservation, first introduced rubber in Tripura in 1963.

India ranks third in terms of production of natural rubber in the world after Thailand and Malaysia. Kerala is the largest and Tripura is the second largest producer of natural rubber in the country. Rubber (*Heveabrasiliensis*) is a tropical crop and the species has proved excellent for permanent settlement of tribal *Jhumias* or shifting cultivators. The present study is based on secondary sources and secondary data collected through available literature in form of books, journals, reports and websites.

Tribal livelihood

In the pre-independence period, Tripura was a princely state and nearly 53 per cent of the state's population were tribals. With partition and the influx of a large number of Bengali refugees into the area, the tribals soon became a minority in the state. By 1971-81 (after the Bangladesh war) this percentage reduced to 28.4 per cent. By 1991, this percentage had gone up marginally to about 30.9 per cent. In the 2001 census, the tribals formed 31.1 per cent of the population in the state. It is estimated that over 80 per cent of these tribal people live in the forested areas and because of their migratory patterns of slash and burn cultivation since pre-independence period,most of the land in the plains area was dominated by the non-tribal population. Almost 10 per cent of the area under forests is under *jhum* or shifting cultivation. The tribals mostly practicing shifting or jhum cultivation are termed as Jhumias. The term 'Jhumia' is not the name of a specific community but a generic term used for tribals

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dependent upon shifting cultivation as a primary source of livelihood. The nature of *jhum* cultivation is such that it primarily depends on an interface with forestry for its survival.*Jhum* is a precarious system of cultivation that yields barely enough to survive. Most of the *jhum* farming is for subsistence and the situation is even worse in cases where people are not doing *jhum* and only have to depend on wage labour for their employment. This means that they have to buy almost all their necessities from outside, thus increasing their cost of living. In fact *jhum* has always had an intimate relationship with casual labour and collection of forest produce. Apart from this, sale of firewood is the other source of income for the tribal people; the other major contribution of the forests to tribal livelihood also comes from labour employed by forest department and the collections of forest produce made by the tribals and sold to marketing societies or to the traders. The nature of employment depends on the types of employment generated in the forestry sector.

Rubber Plantations and Jhumia Rehabilitation

After Independence, a number of attempts were made to set up programmes to settle the *jhumias* into occupations that were acceptable in the mainstream peasant economy. Most of the measures initiated by government failed to curb *jhum* cultivation in the forested areas. By the 1980s, 122,837 acres was occupied by the tribals in reserved, proposed reserved and protected forest areas. Of these more than 1 lakh acres were being utilised for cultivation alone and the rest was being used for homestead and other purposes. The challenge of rehabilitation was thus of a huge scale and had to be implemented in accordance with the Forest (Conservation) Act 1980. Since land for rehabilitation was scarce outside the forested areas, it was soon realised that non-agricultural forest based options have to be pursued. It is for this reason that the Government of Tripura was forced to adopt innovative approaches towards the development of tribal livelihood systems.

In Tripura, rubber trees were initially introduced in 1963 by the State Forest Department for soil conservation initiatives. Of all the schemes thought up by the government to draw people away from slash-and-burn practices, rubber cultivation has been by far the most successful. It was one of the most important strategies adopted for rehabilitation of *jhumias* in Tripura. The rubber plantation project was conceived to provide a lucrative alternative to *jhum* cultivation. The rubber option looked attractive because it had the potential of providing *jhumias* with a substantial income along with cash crops like pineapple and pepper which were grown along with it. Apart from the income benefits, the *jhumia* rehabilitation schemes are also significant because they contribute to skill development in several ways.

In the 9th five-year plan, the raising of rubber plantations was made one of the main strategies for rehabilitation of *jhumias* through the World Bank

aided India Rubber Project. Here the Central Government, Rubber Board and Bank had come together to aid the Tripura government to raise rubber plantations and to develop itself as the "Second Rubber Capital of India". The Tripura experiment is modeled on the experiences of the Kerala rubber economy. Tripura is now the second largest producer of natural rubber after Kerala, with 33,000 hectares of plantations, and about 1500 hectares are added to this each year.

At present there are six types of rubber plantations in the state:

(a) The block plantation scheme implemented by the Rubber Board along with the Tribal Welfare and Schedule Caste Welfare departments, in 49 blocks.
(b) The plantations under the *Jhumia* Rehabilitation Plantation scheme started in 1992 by the Tribal Rehabilitation Plantation Corporation.
(c) Plantations started by the Tripura Forest Development and PlantationCorporation covering about 6,700 hectares of commercial plantation.
(d) Plantations raised through the Sub-Divisional Magistrates funds along with the co-operation of the tribal welfare department.
(e) Plantations done as a part of the *Jhumia* rehabilitation programme of the Tripura Tribal Areas Autonomous District Council.
(f) Private plantations and rubber growers who receive technical guidance from the Rubber Board.

Role of corporation

The Tripura Forest Development and Plantation Corporation Limited (TFDPC) is a public sector undertaking of Government of Tripura. It was established in 1976 under the Companies Act, 1956, by the Government of Tripura with equity participation from the Ministry of Environment, Forest and Climate Change, Govt. of India. The Corporation is working for re-vegetation of degraded forestland through rubber plantation and other forest resources to ensure development and upliftment of economically weaker sections of the society.

The first rubber based rehabilitation project was implemented at Warrangbari in West Tripura district. After 35 years of sustained efforts, TFDPC has emerged as the single largest rubber estate owner in India (over 11,600 hectares). TFDPC has since then played the following significant role for tribal livelihood generation and conservation initiative:

Presenting a successful model: The Corporation has presented a successful model for the permanent settlement of tribal shifting cultivators for other NE states to follow. It has been able to provide settlement to more than 2,700 tribal families so far and plans to cover another 1,000 families in the next five years.

Direct and indirect employment opportunities: It has created employment opportunities for nearly 6,500 people directly and for an equal number of people indirectly. It has become one of the most important social

sector organisations in the state. Each tribal family involved in rubber tapping operations is earning between Rs 10-15,000 every month from sale of rubber from one hectare of rubber plantation. The Corporation has been earning profit over the years and distributing dividends to shareholders, thus playing an important part in strengthening rural economy by creating permanent jobs.

Promoting rubber based industries: The Corporation has also been successful in promoting rubber-based industries in the state of Tripura while generating around 10 lakh man-days every year.

Diversification to enhance tribal livelihood: It has taken initiatives to diversify its activities in the promotion and value addition of rubber along with rubber timber, bamboo and marketing of medicinal plants. At present, it runs a sophisticated furniture manufacturing unit that produces rubber wood furniture from seasoned and treated rubberwood at affordable prices. A rubberwood board unit has also started functioning and an export oriented door manufacturing factory is also in the pipeline.

Thrust on degraded land: It has given a thrust to enhance the area of rubber plantations on degraded forest land. Rubber plantation in Tripura is generally taken up on uplands (locally called *tilla*). These lands are ideally suitable for rubber cultivation as they are unutilised and fallow in nature. The use of *tilla* or wastelands for cash crops would also lead to an increase in revenue potential by tapping the large industrial and export markets. The Corporation also intends to cover another 3,874 ha along the Indo-Bangla border to create sufficient resource base for rubber industries of the state.

Training and capacity building: Training the tribal youth in rubber tapping techniques along with other rubber industry related skills enhances their employability. This has allowed tribal youth to earn their livelihood beyond the scope of traditional means.

Suggestions and Conclusion

Successful management of rubber plantations shows that rubber can be a substitute *jhum* as a way of survival for the tribal people. However, the rubber management strategies of the government may take the following considerations to improve upon livelihood generation and conservation measures associated with it:

- Convergence of literacy, skilldevelopment and women's empowerment is necessary to achieve the desired result of social engineering process through rubber plantation.
- The TFDPC needs to ensure women representation in all its committees. The rights of women tappers should also be recognised in all labour and wage related decisions. There is an urgent need to carry out a gender sensitisation analysis of all rubber based projects.
- The basic amenities and infrastructural requirements of plantation based workers must be assessed and upgraded.
- Introduction of green energy like solar energy among the tribals

is imperative from the point of conservation.

- Intercropping should be given more emphasis during the gestation period of seven years before tapping starts to avoid monoculture and augment the income of tribals.
- Degraded and fallow land should be targeted for extension of plantations and clearing of pristine forest area should not be allowed at any cost which would be counter-productive from the environmental point of view.

This model of livelihood generation through rubber is very much applicable in other parts NE states particularly in Karbi Anglong, a hill district of Assam. Predominantly inhabited by tribals practicing *jhum*, rubber could play an important role in bringing about socio-economic changes in their lifestyle. Rubber has already been introduced there, but it lacks the institutional and policy level initiatives as seen in Tripura. Thus, rubber could also become an important means in other areas of in the north-east for generating livelihood options and afforestation of degraded lands after taking into account the environmental concerns associated with it.

NORTH-EAST

Broom grass: A potential livelihood generation source

As the cultivation of the broom grass needs minimum input and labour and generates a very attractive economic return it could become an effective instrument for rural development

Rajib Hazarika

Nature has blessed India with a number of economically important plant species that are directly useful to mankind and can form the basis of economic upliftment in rural areas. Prominent among them are the Non-Timber Forest Produce (NTFP) like bamboo, canes, thatch, broom grass, medicinal plants, etc. Some of the non-timber forest produce species have good potential for generating local employment and can be used for enhancing rural income. Their cultivation is site specific; therefore, selection of a suitable species is very important from an ecological and economic point of view.

The broom grass (*Phooljharoo*) is one of such species that can be harvested from wild as NTFP as well as cultivated as a cash crop for its inflorescences that are used for making brooms. Besides providing commercial broom, it also provides fuel and fodder during lean period. The brooms of this grass are more durable than those made from other plants such as *Cocos nucifera* and *Phragmites* species. Its cultivation can promote the sustainable use of fragile and degraded lands.

In India, it is distributed in the hills of the North Eastern region and Sikkim Himalayas. It is most abundantly found in the States of Meghalaya and Assam, along with Arunachal Pradesh, Mizoram, Nicobar Island, West Bengal (Darjeeling) and Tripura. In these States it is found to grow in wild in a very wide range of environmental conditions such as steep rocky mountain slopes, shallow soil, damp steep banks along ravines, on sandy banks of the rivers and drought and high rainfall conditions, showing that it has the comparative advantage to harsh tolerance. It is suitable to grow on wastelands, *jhum* fallow land, as well as in homesteads. It is a multi-purpose crop. The inflorescence is used as broom and stems are used as wall building material in these States.

In the last two decades, the demand for broom has increased manifold which led to domestication of broom grass for cultivation in recent years and motivated many erstwhile shifting cultivators to take up cultivation of this plant, resulting in increased income. Broom grass is grown either

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in monoculture or as an intercrop with *Artocarpus intergrifolia,* Citrus spp., *Ananas comosus*, *Psidium guajava*, *Cinamomum tamala* and *Michelia champaca,* or as the major component of agro-forestry model. In degraded forests and wastelands, where the root stocks are available after slashing and burning the vegetation, broom grass naturally colonises the land within short periods, whereas in fallows and cultivated lands, natural regeneration does not occur and broom grass is thus planted. The rhizome of broom grass from wild habitat is collected and cultivated in cleared fields. Depending on the associated crop in intercropping, the spacing of plantations varies from 3m x 3m to 5m x 5m. In monoculture, the spacing is kept at 2m x 2m, so as to get a density of at least 16 tussocks per 10 sq m plot. Cleaning and weeding is essential one month after burning. Farmers remove weeds, shrubs, and climbers and leave only a few trees. Weeding is absolutely essential during the first two years of growth. Weeding is carried out twice a year for proper growth. The ratoon of this grass can be taken up to the 5th or 6th year of planting. Generally, the centre of tussock is devoid of new culms during the 4th and 5th year of planting as they arise from the periphery. To obtain high yield from broom grass, fields are burnt during April after harvesting the crop in the 5th or 6th year. The propagules are again planted in May-June.

A cattle-proof fence is required to protect the plantation area due to high palatability of the leaves. Adequate fire prevention measures need to be taken during the dry and winter months.

Harvesting of broom is done when the panicles become tough at maturity and the colour of panicles turn to light green or red. They are harvested in winter, from January to March. The harvesting should be done carefully when the panicles mature properly. The timing of the harvest is very important. If the plant is harvested prematurely (5-7 days) their production declines, while if it harvested late it will begin to wilt. At the time of harvesting one should make sure young sprouts are not damaged or the plants are not uprooted. The yield is lowest in the 1st and 5th year while in the 3rd year it is the highest. The leaves are harvested for fodder once in the middle of monsoon (August) from 2nd year onwards.

The quality of broom depends upon the time of harvesting. Shorter inflorescences, generally collected in the early stages of inflorescence development, are considered to be the best in quality. The product is classified under three categories:

Class I or best quality: Those types in which the flower has not yet opened and is collected in the months of January and February.

Class II or medium quality: Those types that are cut immediately after flowering and are collected in the months of (late) February and March.

Class III or inferior quality: Those types that have remained in the culms for longer periods and are collected in the months of April and May.

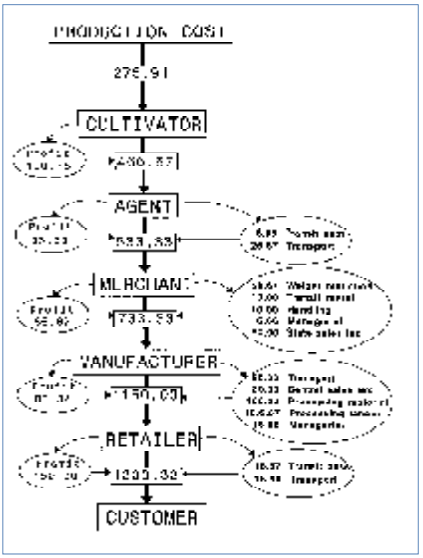
After harvesting, the product is transported to homestead for processing, which is usually a simple

process. A frame-like structure in the form of trays made of bamboo is used for drying the inflorescence. Sometimes, the inflorescences are tied in small bundles and hung over fixed bamboo poles. The drying operation is done over three to four days for hardening the stems in order to prevent rotting. The product is then packed in large bundles and transported to the market or stocked in one place in the villages to sell to middlemen or traders. At this level of processing, majority of the product enters the market and is transported to other places. Value addition, by making broom by bundling about 30-35 dried inflorescences, is done manually by very few households and for a small quantity of the total harvest.

The yield of broom in the 1st and 5th year is low. The highest yield is obtained in the 3rd year. The maximum growth takes place from 2nd year onwards when annual increment in number of culms per tussock is very high. The yield of broom mainly depends upon the quality of planting material, type of land and cultural practices adopted. The yield obtained on plain fertile land at Lathow Research Station of SFRI, Itanagar, Arunachal Pradesh, is given in Table1.

The demand for broom is very high throughout the country as well as abroad as the brooms are required in each household and marketing is not a problem. The majority of the production is from subsistence farming areas and dispersed collection from the forest, which are inaccessible to transport networks and markets. It is a high volume crop and there is glut in the market during the harvesting season which results reduction in price for the poor forest collector or the

Figure 1



Source: An illustration of broom grass in Eastern Himalaya by Uma Shankar *et.al.*

Table1

	1st Yr.	2nd Yr.	3rd Yr.	4th Yr.
Number of culms per tussock	13-25	54-78	213-275	170-205
Height of tussock (Av. m)	1.56	2.38	3.26	3.10
Inflorescence length (Av. m)	0.95	1.13	1.23	1.15
Dry matter production tonnes/ha.	5.41	8.9	10.4	9.2

Source - SFRI, Itanagar, Arunachal Pradesh

farmer. The wholesale market of broom trading is highly monopolised and, as a result, major portion of the income goes to traders and middlemen.

The farmer gets very meagre amount i.e., about 35 per cent of the retailer's price. Further, its demand in the area of production is very less as other alternatives of brooms are also available locally. Therefore, to improve the economy of people and region, the system of cooperative marketing needs to be developed. The Forest Corporation can play a good role in this venture.

Uma Shanka *et. al.* (2001) in his paper present the pathway (Figure 1) from field to customer depicting price appreciation during various stages of movement and processing. From his study it is seen that for each tonne of broomstick, the cultivator earns a profit of US$190.76 and sells to the agent at US$466.67. In the process, a huge profit of US$150 is earned by the retailer and finally costs to consumer at US$1333.33. So for each tonne of broomstick, the farmers get only 35 per cent of the final sale value.

Broom-grass cultivation can be a good profitable enterprise. Kaushik and Saha (2014) reported a net return of Rs 1,46,550 and Rs 1,90,600 in first and second year, respectively, from broom grass under agro-forestry model in Tripura. The estimates for cost of cultivation, yield and economic returns of cultivation has been worked out by Bisht and Ahlawat (1998) on the basis of experimental plantation raised at Lathow, Namsai, without taking in to account of the value of the fodder, fuel-wood, etc. (Table 2). This information gives a general idea about the economics of cultivation and can be helpful to the farmers and other growers who intend to take up its plantation as a cash crop. However, it varies according to labour efficiency, wages, soil fertility, cultural practices, market price and demand, etc. The plantation has a rotation of 6 years in which 5 crops are taken annually. The profit can be raised further if brooms (final saleable product) are processed by the cultivator themselves. The planting and establishment costs can be saved to great extent if the

Table 2

Yield and income from the cultivation of broom grass / ha.

Sl. No.	Yield			
	1st Yr	2nd Yr.	3rd Yr.	4th Yr.
Av. yield of culms/tussock	18	60	225	180
Total yield of culms (from 1600 tussock)	28,800	96000	360000	288000
Total No. of brooms or Jhadu (Av. 35 sticks Total income (@ Rs. 4 per jhadu)	822	2740	10285	8228
Total income (@ Rs. 4 per jhadu)	3288	10960	41140	32912

Source: Bisht and Ahlawat (1998)

individual/farmer and his family members take up the works themselves.

Broom grass is a multipurpose species which provides brooms, fuel, fodder and has high soil conservation value. It is usually available in large quantities from July to February and is used as cattle feed in the period of fodder scarcity. The decoction of roots of this plant is used as mouthwash during fever. The fibrous root system of the plant is very useful in checking soil erosion on steep slopes. After the harvest, the broom sticks (stem) are used as wall building material in Assam and other parts of this region. The sticks have also been tried by paper and pulp industries for the manufacture of paper. The cultivation of this grass can wean away the practice of shifting cultivation and reduce the dependence of people on forests.

The present challenges are:

- The lack of baseline data, unclear demand supply scenario.
- Volatile market.
- The sector is totally unorganised.
- Poor attention paid to the conservation.
- Absence of sustainable harvesting protocols from wild.
- Absence of proper infrastructure for post harvest handling.
- Lack of skill of the primary producer.

To optimise the use of broom grass in overall upliftment and development of livelihood, following measures can be taken:

- Enabling policy & institutionalisation – An autonomous organisation similar to that of similar to Coir Board or Rubber Board can be established.
- Creation of Awareness, Social Mobilisation and Capacity Development.
- Research and Development should be focused on creation of data base, documentation of all available know-how about broom grass, past and present. etc.
- Possible alternate use of broom

Broom Grass under Agroforestry

A success story at Depachhara village under Kanaachanpur Forest Division in North Tripura

Under the patronage of Mr. P.K. Kaushik, Scientist and Mr. A. Saha, Deputy Conservator of Forests, Centre for Forest based Livelihoods and Extention, Agartala, the people of Depachhara village started cultivation of broom grass under agroforestry model where broom grass is the primary product along with by products as fodder besides generating an additional income by intercropping perennial arahar, brinjal and chilli. The economics of the model is very encouraging with a net return of Rs. 1,46,550/- in the first year with a total expenditure of Rs. 57,700/- and a total return of Rs. 2,04,250/-. The net return amount increased to Rs. 1,90,600/- in the second year with the reduction of expenditure to Rs. 29,900/- and increase in total return to 2,20,500/-.

Although it was done on a test basis the economics show a tremendous potential of the cultivation of the grass in the model prescribed.

A complete plant of Broom Grass (*Thysanolaena maxima)*

Broom from Broom Grass

grass, other than as broom, can be explored.

- Market regulation can be done by implementing
  - ✓ Minimum support price (MSP) for broom grass harvest.
  - ✓ Mechanism for market intelligence and information system.
  - ✓ Creation of sufficient infrastructure system for storage at the production site.
  - ✓ Efficient certification system for improved trade.
  - ✓ Value chain development by primary processing, grading, branding and certification.
  - ✓ Explore for new market.

As the cultivation of the broom grass needs minimum input and labour and generates a very attractive economic return it could become an effective instrument for rural development. It may help the rural and poor people who primarily depend on forest, for the improvement of livelihood. As an immediate impact, it ultimately reduces the pressure on forest degradation by means of non-judicial extraction from forest. Availability of vast areas of wastelands in the country favours the adoption of largescale cultivation of broom grass in India, specially in the North Eastern States. Another positive aspect is the adaptability of the broom grass to grow in these degraded areas helps in checking encroachment in forest area. There is also a need to further evaluate the impact of largescale plantations of broom grass

on the environment and to develop a management system to ensure conservation of soil and water while enhancing the livelihood of the rural poor. Another major challenge is the non availability of proper marketing procedure which many a time leads to suffer the producers.

Broom grass, a special gift for Meghalaya

In recent years, Meghalaya emerges as one of the largest producers and exporters of broom grass in India. Ninety per cent of the brooms produced are exported outside the State. Broom grass cultivation is promoted and protected on wastelands, in degraded forests, and in erstwhile shifting cultivation areas of the State of Meghalaya. Its domestication in Meghalaya may be attributed to the plant adaptability to the climatic condition of the state, high profit from cultivation and to the high market demand due to decreasing production in natural forests. Tewari (2014), describe the production of brooms in Meghalaya from the years 2004 to 2009 and is given in Table 3. There is a trend of an increase in production, price, and grower's income. This may be attributed to the expanding market for the product. The steady increase in the price shows that the price was regulated by external demand. The drop in price during 2005-2006 may be due to the doubling in the production within a year, possibly causing a glut in the market. However, during the subsequent years, when production either increased moderately or stabled, the price continued to increase.

Marketing linkages

The brooms produced in Meghalaya find their way to local, national, and international markets. The brooms are brought to transit points through middlemen and wholesale dealers. In some cases, the farmers/producers themselves bring the product to the main market in Shillong where it is bought by wholesale dealers. The local demand is met by the petty retailers who buy brooms from wholesale dealers. The supply for other states and countries is transported by road or railway through the regional traders / wholesalers of Guwahati and Dhudhnoi

Table 3

Annual production of broom (dry inflorescence) and cash income to farmers in Meghalaya.

Year	2004–2005	2005–2006	2006–2007	2007–2008	2008–2009
Production (metric tonnes)	12,873	25,083	27,966	28,347	25,963
Price (INR per metric tonne)	20000	12000	20000	27000	45000
Total annual cash income to farmers (million INR)	257.46	300.99	559.32	765.37	1168.3

Source: Tewari (2014)

(Assam). The quantity of export depends mainly on the orders received from the various dealers across the country. A huge amount of broom is transported from Shillong to other parts of the country via Guwahati, through road and railways. The brooms are exported in raw and unprocessed form to various parts of India. According to the traders operating from Guwahati, the brooms are also exported to other countries like Pakistan, the Middle East, and European countries such as France, Italy, and Germany.

The leaves are used as fodder in areas where fodder is scarce and stems are used as raw material in paper industries and small-scale cottage industries for making mats. However, full utility potential of the broom stem in industries is yet to be realised. In addition, the farmers can effectively utilise the broom grass's potential to prevent soil erosion in the hill slopes.

Cultivation, processing, and marketing of broom grass are economically viable cropping practices in Meghalaya due to an ever-growing demand. The value chain has developed and the growers are receiving a good return for their investments. This trade benefits almost all sections of society, as the landowners benefit from the cultivation, the landless benefit by working as daily wage labour, and the traders and the transporters earn their livelihood by marketing the produce. As a result, broom grass plantation is gradually becoming popular in rural Meghalaya, particularly among the marginal and subsistence farmers. Even without any external intervention, the farmers are getting good returns because of low investment and quick production, as broom grass may begin to be harvested one year after planting.

ZIRO VALLEY / ARUNACHAL PRADESH

Bamboo conservation by Apatanis

The use and management of bijehh by Apatani tribe according to the traditional knowledge has scientific basis and is an example of successful resource utilisation

Hano Moda

Apatani is one of the major tribes of Arunachal Pradesh with a population of about 30,000, inhabiting in seven villages of Ziro Valley, the headquarter of Lower Subansiri district. They are known for sustainable and efficient management of natural resources. Also known as the rice-bowl of eastern Himalaya, the Ziro Valley is located at an altitude of 1524 m above sea level. The climate is humid sub-tropical to temperate with longer cold season. It receives annual rainfall of about 200 cm. The average annual temperature is about 16°C. As a result of variation in climate, topography and altitude, there are two major types of forests in this valley – sub-tropical forests and temperate forests. *Blue pine* and *Castanopsis* are the major species of tree found in the area. The blue pine forests and well-maintained bamboo (*Phyllostachys bambusoides*) garden are characteristic of this area and are not found anywhere else in the surrounding region. Agriculture is the main occupation for rural inhabitants. They practice settled wet-rice cultivation, with or without fish, in combination with the rice in the same field. They do not practice shifting cultivation.

Bamboo plantation/garden

The bamboo garden of *Phyllostachys bambusoides*, locally called *bijehh*, is one of the most striking feature and very

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important component of the villages of Apatani. This species of bamboo is grown in their individually owned bamboo garden. Other varieties of bamboo grow wild deeper in the surrounding forest but they are not valued and so are not managed. In fact, some species of bamboos are looked upon as nuisance when they grow in private forest.

Location: The bamboo garden/ plantation occurs on the side of the forest road or village road or just next to the wet-rice fields or dry vegetable garden and thus form the fringe of forest areas.

Composition: *Phyllostachys bambusoide*s (*bijehh*) are either monocultured or mixed with other vegetation, commonly blue pine (*piisa),* wild cherry (*sembo*), wild apple (*pecha*), etc.

Uses: These bamboos are extensively used by Apatani farmers primarily for house construction and repairing, crafts and fencing. Most families have their own plantation of this species. Young shoots (*byafuhh*) of this species are eaten.

Cost: The present local cost of one mature bamboo ranges from Rs 20 to Rs 25, depending on the distance of the

bamboo garden from the main road.

Preference/Popularity: Though several other species of bamboos (like *tabyoh, riizan,* etc) may be found further inside the forest, they don't find much application and are not valued much. So they are not tended and kept near villages. The only popular and much preferred species is the *bijehh/Phyllostachys* bamboo, which is individually owned, tended and strongly protected and fenced.

This bamboo is highly used and preferred for its special characters and ease in harvesting and working.

Characters: This species is only found in this valley and nowhere else in the region and it can tolerate the cold winter and frost. It grows straight and is of medium height free from curves, bumps and bending. The bamboo has an average outer diameter of 4-7cm, average wall thickness of 0.5-0.6cm and medium inter-node length of 26-27cm. The surface is smooth and toned, free from insect attack marks. This bamboo species is the strongest, most durable and resistant to insect attacks compared to other species of the area. The tensile strength of this bamboo was recorded to be higher than that of mild steel. The bamboo does not form clumps and grows in an isolated manner, unlike most other species.

Easy harvesting & excellent workability: The suitable height, weight, diameter, thickness and absence of clumping, straight length, free from top bending, etc., highly facilitates the process of cutting, gathering, transportation and ultimate uses for different purposes. Compared to this, many other species of bamboo which grow in clumps, bend down or are too tall or thick, etc., are not easy to work with. And because of all these reasons, *bijehh* is the only species of bamboo the Apatani tribe uses when it comes to building houses, fencing, etc.

Silvicultural practice: Maintenance and plantation of bamboo is done with great care. An established plantation regenerates on its own every year and to maintain the density/space

and increase the yield and growth, young shoots and matured bamboos are selectively harvested. Promising young shoots are retained and thinner or thick stunted ones are removed; more young shoots are removed from densely covered patches and limited or no shoots are removed from sparsely covered part of the plot of bamboo garden. Normally, mature bamboos are harvested after every third year during winter season to avoid insect damage. Propagation is done through vegetative rhizomes in the month of February or early March. An entire 1- or 2-year-old bamboo culm, along with the rhizome, is dug out and planted at a new place for multiplication. The planting of bamboo is done from the top of the slope downwards for better and quicker root growth. The root of the planted shoot should be long for larger diameter culm and faster overall growth; the longer the root length, the larger the diameter of the new culm. The new shoots are pruned and old culms are removed every year.

Conservation strategy

- Individual bamboo gardens are strongly protected by fencing to keep out humans, deers, mithun, stray cattle and for boundary demarcation to avoid dispute. This is repaired or rebuilt every winter to keep it strong enough to prevent entry of mithun which causes extensive damage and loss, especially during the monsoon when new shoots grow.
- Sustainable harvesting. Bamboos are not harvested beyond what can be sustainably harvested; only fully mature culms are harvested, no matter how high the demand is or how great the need is. Harvesting is done during winter season, taking care not to create gaps. Only about 1/5th to 1/4th of the total bamboo culms in the plot is harvested so as to make space for younger culms and

maintain the stocking density. The tops are used as fillers in fences and in spurs for river training. Dry old bamboos and tops from old fences are used as firewood.

- Shoots spared. Though there is high demand for the young shoots in market for eating, they are harvested very carefully so that adequate new shoots grow and replace the old culms which will be harvested.

Conclusion

The use and management of *Phyllostachys bambusoides (bijehh)* by Apatani tribe according to the traditional knowledge has scientific basis and this is an example of successful resource utilisation which shows how resources may be efficiently utilised in a sustainable way.

KOTDWARA / UTTARAKHAND

Briquetting units: Using pine needles as renewable energy resource

The importance of this technology lies in conserving wood, a commodity which leads to widespread destruction of forests

Mito Rumi

Pines are evergreen, coniferous resinous trees, growing 3-80 m (10-260 ft) tall, with the majority of species reaching 15-45 m (50-150 ft) in height. Fine pointed leaves of pine are known as pine needles, which are one of the forest residues from which millions of tonnes of biomass are generated. Pine needles have high calorific value. They are associated with forest fires in Himalayan States as they are highly inflammable. Pine needles, when they fall, cover the ground causing problems like depletion of underground water table as they stop water absorption by soil. The growth of grass, which the cattle feed on, is hindered by fallen dry pine foliage which obstructs sun rays from reaching the ground. Pine tree trunks are heat resistant and, therefore, survive during forest fires. But, in the process, destroy the growth of other plant species. The process of producing biomass briquettes involves collection of pine needles, which leads to clearing of the fallen dry pine foliage which, in turn, leads to prevention of problems associated with pine needles.

Biomass is organic matter derived from living or recently living organisms. It can be used as a source of energy and often refers to plants or plant-based materials. Biomass briquettes, on the other hand, are bio-fuels which are substitutes of coal and charcoal. Agro-industrial residues, such as bagasse, rice husk, groundnut husk, corn cobs, sawmill waste and de-oiled cakes, are estimated at around 150 million tonnes per annum. Horticultural waste would add another 75 million tonnes of waste per annum. Forest waste could be yet another major source of biomass residue. Significant portion of raw materials

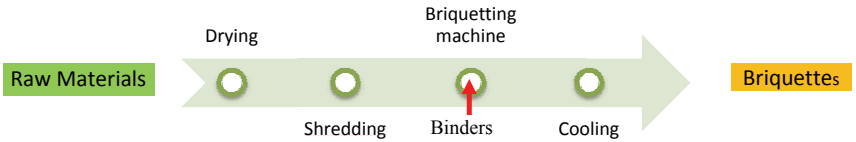

Fig: **Schematic diagram showing stages in bio-briquetting process**

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for producing briquettes originates in the rural areas of Himalayan foothills. Pine needles, which are a biomass waste, can be instead utilised as feeds for bio-briquettes. Bio-briquettes are compressed blocks of combustible biomass material, such as pine needles, sugarcane bagasse, charcoal, sawdust, wood chips, rice husk, coal dust, organic wastes, etc. Bio-briquettes are good substitutes for coal and charcoal in meeting energy needs in rural households and industries. This case study covers pine needles briquetting units in Kotdwara, Uttarakhand.

Biomass energy projects are undertaken by the Ministry of New & Renewable Energy (MNRE), Government of India, at the national level. Uttarakhand Renewable Energy Development Agency (UREDA) is the nodal agency for these projects in Uttarakhand State. MNRE and UREDA grant various funds and subsidies for new establishment of bio-briquetting units in the State. Major briquetting centres are spread across the following states:

State	No. of units
Gujarat	150
Maharashtra	85
Tamil Nadu	50
Karnataka	45
Punjab	40
Uttar Pradesh	5

The technologies for briquette manufacturing are:

- Piston Press
- Screw Press
- Hydraulic Piston Press
- Pelletisation

In India, piston press technology is the most widely used one to manufacture briquettes. They produce 65 mm diameter and 90 mm diameter briquettes.

Kotdwara briquetting units

Kotdwara region is situated in the foothills of Himalayas in Uttarakhand. The air pollution in this region was earlier very high due to presence of factories that produced bricks and iron. This was mainly because a large amount of coal was used as fuel to feed fires to harden the bricks in underground kilns. Biomass waste from forestry and agriculture as well as industries got accumulated annually. Due to their low density and high water content, these waste materials could not be processed before and therefore, were not put to any use. But, with the advent of local organisation, Rural Renewal Urja Solutions Pvt. Ltd (RRUSPL), located in the Garhwal region of Uttarakhand, the scenario has completely changed. The previously unused raw material waste is now being used by RRUSPL to produce fuel. Biomass briquettes are being manufactured using pine needles, other forest residues and agricultural wastes and supplied to companies producing brick kiln and rod-iron in Uttarakhand and Uttar Pradesh. Coal is now being replaced with climate neutral biomass pellets, or briquettes.

RRUSPL was founded by Rajesh Rawat and Brijesh Rawat. RRUSPL's initial project involved 50 villages near Kotdwara in the Pauri-Garhwal district of Uttarakhand. Village Self Help Groups were included in the project in

which the 8-10 members of the group (mostly women) collected biomass, primarily comprising of agriculture waste and forest waste, including highly inflammable pine needles. This acted as an additional source of income for the worker which was higher than the minimum official wage.

Large quantities of dry pine needles on the ground are collected by villagers in portable plastic tents, which are collection points for dry pine foliage in every area. Villagers earn Rs 1,000/tonne for collecting dry pine needles. They are transported to briquetting units in Kotdwara in trucks. These dry pine needles are then put into the shredder machine with other biomass residues and then pressed into briquettes using ram piston briquetting machines. The composition of briquettes produced using forest residues and other industrial and agricultural wastes is 60 per cent of dry pine needles, 30 per cent of saw dust and 10 per cent of other agricultural wastes like lantana, cow dung and sugar mud. This raw material is briquetted to a density of more than 650 per cubic metre. And, 1.3 kg of briquettes replaces 1 kg of coal and 3 kg of briquettes replace 1kg of LPG usage.

Latest government figure for cost of domestic coal is Rs 1716/ tonne. Bio-briquettes from pine needles are available at Rs 375/tonne. Brick kilns owners have shifted to bio-briquettes as they reduce their cost by almost four times as compared to coal.

Uttarakhand Government project figures for bio-briquetting unit in 2010 are:

Machine:

250 Kg/hr *(Briquettes Output Rate)*

- Cost of machines: Rs 5.7 lakh
- Space required: 10 m X 10 m
- Power required: 15 KW
- 90% subsidy on capital cost from *UREDA*
- Raw material required for 8 Hrs – Daily operation: 500 Quintal/Month (25 days x 2.5Quintal x 8hrs)
- Purchase Price of raw material: 180/ Quintal (including transportation, drying and handling)

Expenditure (Monthly):

- Cost of raw material: Rs 90,000
- Electricity Consumption: Rs 9,000 *(25 days of 250 Kg/Hr Briquetting Machine)*
- Manpower cost (2 Nos.): Rs 12,000
- Rent and maintenance: Rs 7,500
- Total expenditure: Rs 118,500
- Production Cost (per Quintal): Rs 237 /Quintal *(118500/500= 237)*
- Interest, Insurance, Transportation: Rs 75 /Quintal
- Cost of briquette at use point: Rs 312 /Quintal

Income (Monthly):

- Sale price of Biomass Briquette: Rs 375/Quintal
- Net income: Rs 63 /Quintal
- Actual Income: Rs 63 x 500 Quintals = Rs 31,500

Annual Income: Rs 3.78 lakh

RRUSPLA estimates investment requirement for a briquette processing unit of 15,000 tonnes at Rs 2 crore. Initial investment can be raised through bank

loan at 14 per cent interest rate for a five-year term followed by government subsidies and self financing. *My Climate* is a Swiss agency which is one of the world's leading providers of voluntary carbon offsetting measures. 'My Climate' develops and supports projects around the world that directly reduce greenhouse gases. This directly protects the climate. An important factor of success for 'My Climate' is demanding customers and partners who assume responsibility for climate change. Small and medium-sized companies, globally active companies, NGOs and State institutions appreciate the pragmatic approach of 'My Climate', which has entered into an agreement with RRUSPL to buy carbon credits generated by the project. 'My Climate', in turn, will sell these carbon credits to air travellers who want to reduce their carbon footprint. With this arrangement, while the project at one end contributes to generate renewable energy and empower rural population, at the other end, at the global level it aims at enabling high society air travellers living in European countries to reduce their carbon footprint.

There is a scope for setting up of five such units in the pine and lantana regions of various hill States of India. This will result in generation of employment opportunities in the rural and semi-urban areas.

RRUSPL estimates production of 20,000-30,000 certified emission reductions (CERs) per briquetting unit. As briquette manufacturing from forest residues and agricultural waste is a relatively new technology, training has to be given to people on production, operation and maintenance of briquetting units.

The climate-friendly energy supply is thus replacing coal, a greenhouse gas-intensive fuel, in the kiln and iron production. The project not only includes manufacture of renewable and clean fuel, but also distribution of an efficient and smokeless cooker (*chulha*) for restaurants, temple complexes, day schools and hospitals. These rural institutions were previously dependent on liquefied petroleum gas (LPG) for cooking. The new efficient gas cookers were developed by the Indian Energy and Resource Institute (IERI) and save about 50 per cent of fuel in comparison to conventional cookers.

The briquette machine has been successfully used in many parts of India, which has resulted in large reduction of dependency on fossil fuels by the local population. Other benefits of biomass briquettes are:

- Large reduction in emission of carbon-dioxide in the atmosphere.
- Reduced dependency on firewood for energy needs in rural areas.
- Biomass briquettes are cost effective as they produce same amount of heat as coal but at a lesser price.
- Use of biomass briquettes lead to large savings; about 70% of net saving in comparison to the use of LPG.
- There is livelihood generation for rural population, especially women.

Conclusion

Kotdwara briquetting unit is a successful story in tapping of pine needles as a renewable energy resource along with

empowerment of rural population in Uttarakhand. Overcoming operational problems associated with briquetting technology is crucial in determining its continued commercial success and business expansion. In addition, the importance of this technology lies in conserving wood, a commodity extensively used in developing countries, which leads to widespread destruction of forests. There have been more failures than successes throughout the world because of over-optimism about economic competitiveness of briquetting. However, under right circumstances, briquetting plants can make a useful contribution to fuel supply and can be commercially successful as in the case of Kotdwara pine needles briquetting unit.

MANIPUR

Cultivation and management of *Bambusa tulda*

Bambusa tulda is an economically and ecologically significant bamboo species in the State which deserves proper attention for commercialisation and conservation

Rebika Soibam Chanu

Bamboos are tall, perennial, woody and fast growing arborescent grasses belonging to sub family *Bambusoideae* of family *Poaceae*. They are popularly called the green gold, or the poor man's timber. India is the second-largest producer of bamboo in the world. Bamboos form an important component in home garden system, in the backyard and in the periphery of holdings and our association with bamboo is as old as the human civilisation. In India, bamboo is found growing in 8.96 million hectares of forests, which is more than 10 per cent of the total forest area in the country. Out of 126 species of bamboo reported from India, over 40 species are found in Manipur and about 15 species of bamboo species are native of Manipur (Chauhan, 1999). They are distributed abundantly throughout the length and breadth of the State. Most of these are economically important to the people of the State and play immense and commendable role in everyday life and meet the basic necessities of life i.e. food, fuel, clothing and shelter as well as raw material for many industries such as paper (Negi, 1996).

Bambusa tulda, locally known as *Saneibi,* is one of the most significant species of bamboo to the local people of Manipur (Meiteis). A case study

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was taken up on the traditional cultivation of this bamboo species for proper assessment, conservation, management, sustainable utilisation and effective commercialisation. Several localities in different districts of the State were surveyed for the availability of *Bambusa tulda*. It was recorded as growing prominently in Andro, Bamon Kampu, Baruni foothills, Top, Jiribam riversides in Imphal East, Lamdeng, Lamshang, Konthoujam, Leimaram, Khumbong, Malom, Sekmai, Pheidinga, Khonghampat, Langol area in Imphal West district, Phayeng, Nambol, Thanga, Kumbi-Keirenphabi in Bishnupur district, foothills of Churachandpur district, Lilong, Thoubal, Kakching and Pallel in Thoubal district. Other bamboo species found in Manipur include, *Bambusa balcooa Roxb*., *Bambusa bamboos*, *Bambusa cacharensis*, *Bambusa griffithiana* Munro, *Bambusa khasiana* Munro, *Bambusa longispiculata, Bambusa pallid* Munro, *Bambusa teres, Bambusa tulda Roxb*., *Chimonobambusa callosa (Arundinaria callosa), Dendrocalamus brandisii* Kurz., *Dendrocalamus hookeri* Munro, *Dendrocalamus hamiltonii*, *Dendrocalamus longispathus* Kurz, *Dendrocalamus sikkimensis* Gamble, *Gigantochloa apus*, *Gigantochloa macrostachya* Kurz., *Gigantochloa rostrata* Wong, *Melocalamus compactiflorus*, *Melocalamus baccifera*, *Schizostachyum capitatum, Schizostachyum dullooa, Schizostachyum griffithii, Schizostachyum latifolium, Schizostachyum mannii, Schizostachyum pallidum, Schizostachyum pergracile, Schizostachyum polymorphum, Sinarundinaria elegans, etc.*

Methodology

Information regarding harvesting of bamboo culms, seasons of harvesting, pattern of transportation was gathered through survey, field visits and interaction with bamboo growers. Harvesting was reported to be done both by selective felling and clear felling. Age group between 10-20 years were selected and labelled with paints for harvesting purposes. Market prices were recorded mainly from the city markets at Imphal and, accordingly, range of prices of articles were noted seasonally. Seasonal demands of each articles on the market was also analysed. It supported a number of traditional cottage industries, such as basket making, furniture, handicrafts, etc. The study attempted to assess the traditional knowledge base system of bamboo management and its importance in sustainable development in the bamboo sector. Such knowledge will facilitate in developing better utilisation and management practices for higher yield.

Description of *Bambusa tulda* Roxb

It is a moderate sized, densely tufted, sympodial bamboo species. The culms are green, glabrous when young, without spine, 8-20 m high, 5-10 cm in diameter, erect with branches that give a very bushy look. The internodes are 30-60 cm, culm sheaths 15-25 cm long and 18-30 cm broad, rounded or triangularly truncate at top. Leaves linear-oblong or linear-lanceolate, 15-25 cm long and 2-4 cm broad, usually rounded at the base, ends into a 5 mm long hairy petiole;

inflorescence variable and large with interrupted clusters of few (1-5) usually fertile long spikelets, supported by shining bracts of rachis smooth striate. Spikelets variable in length, 2.5-8 cm long sessile, glabrous, cylindrical and acute at first, afterwards divided, 7-12 flowered, central floret hermaphrodite, lemmas smooth, shining, acuminate, membranous at the base.

Distribution

The species is endemic to North-Eastern region and West Bengal. It grows suitably in moist tropical climate, preferably in alluvial soil in good rainfall areas and extends its altitudinal distribution up to 1500 m above sea level, sometimes reaching up to temperate regions. In Manipur, the species is distributed in wild as well as in cultivated forms. It is a fast growing species and is usually found in the periphery of gardens, sides of pond and landscape of fields and foothills. Interestingly, the species is usually planted traditionally in home gardens of most of the houses in Manipur as *wapal* i.e., a patch of bamboo planted around the house to protect from wind, storm, animals encroachments and for its use in ritual ceremony and household purposes. *Wapal* is a way through which bamboo species is conserved traditionally.

Ethno-botanical uses of *Bambusa tulda*

There are certain ethno-botanical uses of this particular bamboo species amongst the Manipuris. This bamboo is erected as a pillar (*Ukhong*), or a post called *jatra,* while constructing a *mandop* (tent house) for the inauguration of every religious ceremony, whether it is a wedding or a death ceremony. It is used as a medicine. The crush bamboo shoot juice is applied to the injury of nails due to iron sword or arrows. The boiled decoction of the fermented shoot is prescribed for ring worm, tumours and meningitis. The fruit is believed to enhance fertility. Whole bamboo culm of suitable length and size are used as pillar (*Ukhong*) in bamboo huts (*Shang*) and houses (*Shanglen*). The first pillar of the house, traditionally called *Yatra,* is usually the culm of this species. It is commonly used in fencing as well. Suitably cut bamboo culms are used as pillars, while split culms are used as horizontal guards which are again fastened to the pillars. This fencing system is known as *Sambal*. Good quality culms and split culms are also used for suspension bridges built across big rivers joining hills, mountains with villages enabling the villagers the collection of forest products for their livelihood. *Thongra* is prepared using 1.5-2.4 m long, of 3-5 numbers of culms. The culms are placed together, forming a platform over water being supported by other 4 stands and two horizontal supports. This platform, the so-called *Thongra,* is built to facilitate fetching water, bathing, washing clothes, cleaning utensils, etc., from ponds and rivers. Culms of this species are also used as guard walls for staircase of houses, gates and boundaries of houses, to prevent erosion of river banks, apart from using in *Konthong*, the traditional gate for houses, farm houses, etc. It is constructed using 6-10 big sized culms. It is also used in making baskets and

containers (*polang, thumok, phingairuk, kharai, yangkok, phiruk, ngarubak, phoura*, etc., all are prepared from *Paya*). Decorative items include artificial flowers, wall hangings, *phiruks*, flower vases, pen slits, trays, etc. It is consumed as vegetable too. The fresh bamboo shoot, known as *ushoi*, and the fermented bamboo shoot, commonly called *soibum*, are of high delicacy and are much in demand. *Ushoi Uti* (curry prepared from *Ushoi* and peas) is a special item of curry in every celebration. Other uses include stuffing, fuel (the whole bamboo is used as firewood after it is dried mainly the leaves, culm sheaths, and the dried culms), fishing equipment (*Taijeb* and *long-oop*, *lu*) brooms, stools, etc.

Propagation

The bamboo species is successfully propagated through the traditional method by selecting a 1-2 years old, healthy culm. This culm, along with rhizome and root system, is carefully separated from its mother clump by cutting at its neck. It is then cut above the first internode towards the top. Then, the cut top of the clump is covered with mixture of mud and cow dung to prevent drying up. This cover should be air tight and water should be sprinkled frequently. This is an offset ready for plantation. A pit of 60 x 60 x 60 cm^3 is dug and sufficiently watered. The offset thus prepared is planted in this pit and covered with soil in such a way that no air space is left. Planting should be done during or just before rainy season. However, there are certain disadvantages associated with traditional system of *Bambusa tulda* cultivation using offset such as limited number of offsets, extraction and transportation difficulty, synchronous flowering in the propagated clump with that of parent clumps, non feasibility for raising largescale plantation due to intensive labour, risk of damage to the rhizome system of the mother culms due to extraction of more number of offset from a clump which reduces productivity of bamboo stands. Clear felling strategy of clump management has a severe effect on the clump growth parameters, like new culms production,

culm height and culm DBH. Seeds can be used for largescale propagation as it undergoes gregarious flowering inspite of being a monocarpic species. The seeds show three month viability, germination takes in 9-30 days; 92 per cent viability under proper storage condition (Ahlawat et al., 2002).

Moulding of the soil to the bamboo clumps prior to rainy season is practiced every year which, according to bamboo growers, keeps the newly emerged shoots healthier and even reduces their mortality rate. Leaf litters and farmyard manure are added around the clumps every year for fulfilling the nutrient requirement of growing culms in the clump. Harvesting of culms from a newly developed clump begins only after it exceeds five years of age, thus keeping the younger culms undisturbed. Under traditional management system, vegetative propagation is practiced through offset method in which offset from 1 to 2 years old culms is cut at about 1.5 to 2.0 m height, that is excavated along with a portion of the rhizome with its root system intact and planted during rainy season. Clear felling is done during rainy season and 85-100 per cent of the total culms are harvested. Production of the new culms and yield was reported to be higher under selective felling (almost three folds higher).

Post-harvesting processing

Harvesting and processing are also done traditionally. It is always better to harvest fully matured bamboos which are at least 3-4 years old during dry season i.e. from the month of October to March when the habitat area is comparatively drier. Meities have rich traditional pre-treatment knowledge to protect the culm from insect and fungal infections. The culm is kept deep inside water for 3-4 months. In case the culm is to be used for furniture, some salt is added to the water. Bamboo culms are also treated with cow urine for about 10-15 days. After this, these culms are taken out and allowed to dry in the sun for another 10-20 days.

After Harvesting, the bamboo is also processed by keeping the culm for 10-15 days at the very place of harvesting by removing the culm sheaths and leaves, branches, etc., while covered by bamboo leaves and culm sheaths for about 20 days. By doing this, culms become lustrous and free from fungal attack. Processing of bamboo is also done traditionally by putting the bamboo culm in pit full of cow dung for about 10-20 days. This makes the culms straighter and lustrous.

Scope of market and commercialisation

The various bamboo markets in the state are Churachandpur, Imphal, Jiribam, Thoubal and Tamenglong. There is a significant scope for commercialisation

Table. 1. **Value added articles of *Bambusa tulda* having commercial implications**

Articles in their traditional name	Raw material	Skill	Quantity	Cost of raw material (Rs.)	Market price in rupees (Rs.)	Demand
Ukhong	Whole culm (mature)	B	One piece 50/--120/-		70-150/-	High
Wachet	Whole culm (mature)	B	1-3 bunches		50-150/-	high
Ushoi	Fresh young shoot	B			10-50/-	Seasonally very high (May-August)
Soibum	Young shoot	A	1 kg	10/-	30-40/-	Very high
Phiruk	Paya	A	4-6 bunches	60-90/-	250-300/-	moderate
Paya	Longitudinal slices of bamboo culm	B	1 meter length culm	10-15/-	20-30/-	moderate
Polang	Paya	A	1 bunch	10-15/-	30-50/-	high
Phoura	Wachet	A	1-2 bunch	50-100/-	200-300	Moderate
Yangkok	Paya	A	2-4 bunch	30-45/-	60-90/-	Moderate
Kharai	Paya	A	1-2 bunch	15-30/-	25-40/-	Moderate
Sumjit	Paya	B	½ bunch	7/-	10/-	High
Mora	Wachet	A	½ bunch	25/-	100-150/-	High
Ngarubak	Paya	A	½-1 bunch	7-15/-	20-30/-	High
Long-oop	Wachet	A	1½-2 bunches	35-50/-	160-200/-	Moderate
Taijeb	Wachet	A	½-1 bunch	7-15/-	35-50/-	Seasonal very high (July to September)
Lu	Wachet	A	½-1 bunch	7-15/-	35-50/-	Seasonal very high (July to September)

A=high skill required, B=less skill required

of this bamboo species since it can be an efficient, cost-effective raw material for small-scale handicraft industries. This species is one of the high yielding bamboos suggested for largescale plantation (Prasad, 2008). Durability, fast growing (could be used within 2-3 years after plantation), easy multiplication, readily availability, easy handling, requiring only manual labour, need for little care, and less affected by diseases adds up to its

Various uses of *Bambusa tulda*

efficiency for commercialisation. Even 18 months old plants can yield pulp for paper. One mature bamboo produces 1-3 young shoot(s) per year, which is a good rate of natural multiplication. The bamboo species could be sold as a raw material or in the form of several articles of daily use in Manipur. Manual labour is a must and well-trained skilled handicraftsmen are required for setting up small scale industries. The more is the handwork, the more is the price of the article. Jobless local people, either male or female, could help in this purpose. Availability of market is not a problem since products are used essentially in daily life of Meities of the State. There is also a huge demand for these products in the US, the EU, Latin America and the South East Asian Countries. The demand of this bamboo even in the local market is very high and could not be met with the present scale of production, which largely depends on plantation by local people in their plots as boundary plants.

Conclusion

Bamboo is an under-utilised natural resource, though it is one of the best natural engineering materials which grows faster and has more strength than wood. It can also be recurrently harvested. A dense bamboo cover enriches the soil by arresting erosion and taming flash floods. It offers fodder to animals and sustainable food and livelihood security to humans. Considering the potential for socio-economic development, especially in rural areas, there is an immediate need to carry out massive plantations in forests, farms and vacant community lands. Systematic collection and incorporation of farmer's knowledge should be given priority while developing any programme for the promotion of cultivation for conservation, management and sustainability. *Wapal* is a way through which bamboos are planted, conserved and managed sustainably by the local people. However, due

to overpopulation, development of cities, urbanisation and construction of houses close to each other, this culture is being abandoned slowly in the city areas of the State. In such a situation, an increase in plantation of this particular species is highly needed. These could be planted in and around the farmlands as a purpose for bio-fencing, near ponds and river banks for soil binding and to prevent soil erosion. There are certain non-degradable plastic articles (plastic ropes, baskets, brooms, stools, decorative items, etc.) which can be replaced easily by bio-friendly and degradable products of this bamboo species. From the economic point of view, largescale production is highly imperative for better commercialisation. In this connection, introduction of a well managed programme for the plantation and conservation of this particular species is highly recommended for their sustainable utilisation. Further, highly skilled local people could be utilised for establishing small-scale industries as market is already available. Singh (2008) mentioned that almost Rs 5,000 crore worth of raw bamboo is available in North-East India and even two-fold value addition can create an industry worth Rs 10,000 crore. Value-added articles could be the basis of industrialisation. This, if, implemented, can also help in preventing fast depleting timber resources of the State. Therefore, *Bambusa tulda* is an economically and ecologically significant bamboo species in the State which deserves proper attention for commercialisation and conservation.

Some of the indigenous knowledge based system of bamboo clump management has negative features that can endanger the productivity. The existing management system, especially traditional clear felling of clump management, is unscientific. Some strategies have to be formulated to overcome the weakness of traditional knowledge. Strategies include boosting research and development activities for genetic improvement in bamboos, development of efficient methods for mass production of superior quality planting stocks, conservation of genetic resources, exchange of information between researchers and bamboo growers, integration of traditional and modern knowledge for better management of bamboos, improved silvicultural practices and methods for harvesting. Storage and processing need to be devised, marketing forces need to be activated and organised and linkages between producers and marketing agencies should be established. There is also a need for better policy guidelines for harvesting bamboos, organisational and institutional support to convert farmer's skill and knowledge into commercial production. Different aspects of traditional utilisation of bamboo provide direct and indirect economic benefit through employment generation that is accessible to low income and socially disadvantageous group.

ASSAM

Conservation and management of *Morinda citrifolia L.*

Noni cultivation in the North-East can contribute significantly in improving the livelihood of tribal people from its NTFP products

Nayanjyoti Rajbangshi

Morinda citrifolia L, (Family: *Rubiaceae* - Indian Mulberry) popularly known as '*Noni*' is an important food and medicinal plant, Native to Indonesia and Australia, it grows widely throughout Asia and Asia-Pacific. It is known for its wide adaptability and can grow in varied environmental conditions, except under frost conditions. The tropical humid climate is very much suitable for cultivation of *Noni*. In India, it is widely grown under natural conditions in Andaman and Nicobar Islands.

It is a small evergreen shrub or tree, usually less than 3 m in height and occasionally rising to 6m. *Noni* is considered as the nature's gift to humanity. It has a rich history in India where it has been used for centuries in Ayurveda and Siddha systems of Indian medicine, in addition to tribal folk medicines. *Noni* contains more than 160 nutriceuticals, cancer inhibiting compounds, essential vitamins, minerals, anti-oxidants, alkaloids, amino acids and health-enhancing attributes which are anti-bacterial, anti-inflammatory, analgesic and anti-congestive.

Plantation of Noni in RFRI Jorhat

SFS- (2015-2017) Batch

However, in North-East India, no commercial cultivation of *Noni* is noticed. Nearly 80% of the people in the rural sector, especially in North East India, are dependent on natural products (folk medicine) and resorted to traditional ways of treatment because of its easy availability and cheaper cost. Since the North-eastern part of the country has tropical humid climate, which is very much suitable for *Noni* cultivation, growing it can be tried in different agro-climatic conditions. *Noni* cultivation in the North-East can contribute significantly in improving the livelihood of tribal people from its NTFP products.

With these views in mind, the scientists of Rain Forest Research Institute, Jorhat, experimented with some objectives under the funding agency National Medicinal Plant Board (NMPB).

Objectives

1. Field survey and selection of elite planting material and introducing into the selected sites in Assam, Mizoram and Tripura.
2. Establishment of nursery and germplasm bank at RFRI, Jorhat, and standardisation of propagation techniques through seed and stem cuttings.
3. Studies on growth parameter, inter crop trials.
4. Insect-pest management and biological control.
5. Qualitative and quantitative analyses of fruits – antioxidant property, total dissolved salts, alkaloids, phenolic compounds, etc.
6. Training programmes and awareness creation among local people – health benefits of Noni, its propagation and conservation.

Physical Achievements

- PI and CoPI visited CARI (Andaman & Nicobar Island), had a discussion with Dr DR Singh, Principal Scientist, and visited *Noni* plantation sitesthere. They brought 750 tested *Noni* planting stock to RFRI.
- Visited CPCRI, Kasaragod, Kerala, and brought 400 planting stock – stem cuttings.
- Procured 1,500 seeds from Velgod, Karnool District, Hyderabad (Mr MR Bhanja Additional PCCF, Hyderabad).
- Visited World Noni Research Foundation, Chennai, discussed with Prof T.Marimuthu and Prof KV Peter about Noni Research India and collected literature.
- Visited Noni plantations at GKVK, Bangalore and Mysore.

Raising of Noni plantations

Successfully raised plantations at Rainforest Research Institute, Jorhat, Assam; Advanced Research Centre for Bamboo and Rattans (ARCBR), Aizawl, Mizoram; and, Panchakarma Unit, Forest Department, Agartala, Tripura (with the help of CFLE, Tripura).

Nursery cultural practices

Seeds can be stored almost for one year, however seed viability percentage decreases with time. Viability of seeds can be prolonged to one year if seeds are stored in sealed bottles and kept in

a refrigerator. At room temperature, seeds lose viability after three months if stored in tin containers. The viability ranges from 35-45% after 3 months of storage and10-15% after 6 months of storage.

Sowing/nursery practices pre-showing seed treatment produces better results regarding seed germination and growth of seedlings. Soaking of seed in water for 48 hours before sowing improves and hastens germination.

Seed Germination Experiments

- Conducted seed germination studies following different treatments – growth hormones, mechanical scarification, acid treatment, hot water treatment, etc.
- Paper-top, germination paper, tray soil and nursery bed methods used; all experiments in triplicates.
- Seeds positively photo-blastic and exhibit physical dormancy; hard impermiable seed coat and buoyancy.
- Mechanical Scarification + Gibberelic acid (800ppm) for 24h @ 50% germination (20 days).
- Mechanical Scarification + Ethrel (5%) for 12h@20% germination (20-30days).
- Kinetin + Gibberilic acid 1000 ppm – 24 h(13.33%) (30 days).
- Seeds sown deep in soil and kept inside germination papers and placed in darkness failed to germinate.
- Optimum spacing in the nursery is 20*20 cm.
- Seed sown at a depth of 1.5 cm
- Weeding and irrigation of nursery beds is necessary.
- About 1 kg seed is sufficient to sow in one hectare.
- Nursery beds are prepared by mixing of sand, farm yard manure and soil in the ratio 1:1:2.
- Seedlings are raised both in nursery beds and polythene bags.
- Sowing is done in March-April, depending on climatic condition.
- Application of vermicompost/ organic manure and neem cake has significant effect on the growth of the plants.
- Seedlings become ready for planting when 3-4 months old and attain a height of 20-25 cm.

Propagation through stem cuttings treated with rooting hormone

Noni can also be propagated by stem cuttings. Stems should be made from well developed plants. Hard wood cuttings with 4 nodes and sap flow from the cut end give better result than hollow cuttings. Stem cuttings should not be stored in dry conditions. Soaking of cuttings with 4000 ppm of NAA or 6000 ppm of IBA is found successful as it gives faster rooting. Stems should be planted during July, but under irrigated conditions stems can be planted even in March-April.

Intercropping with annual crops, medicinal and aromatic plants and vegetables is recommended. However, crops like banana, sugarcane, papaya, rose and other crops, which require more water, should be avoided as they may promote parasitic nematode population.

Fig. **Root formation in stem cutting seen in RFRI**

Rootex and IBA-leaf initations occurs after 10 days and roots formation occur after 30 days.

Insect-pests and control (plant protection)

The seedling and saplings are also killed by severe frost. Grasshoppers/ caterpillers feed on leaves and scales. Mealy bugs and mites are the common pest reported on *Noni*. Regular weeding and the application of neem cake soaked with water helps to deter the pest. The leaf eaters in nurseries and young plantation can be controlled by application of neem oil, 10-15 ml/litre of water.

Figs. **Insect pest seen in Noni plantatation of RFRI.**

Importance of conservation of *Noni* plant in RFRI

There is a great demand for Noni products in the market and their cost is very high price. *V*arious *Noni* products like juice, capsule and creams are sold in the market. The plant has both medicinal value and marketing value to enhance livelihood generation.

Training and awareness

- Tree Growers Mela
- Organised awareness programme on *Noni*, cultivation, uses, etc., during Tree growers Mela at RFRI during March 20-21, 2015.
- Distributed brochure on *Noni* cultivation – package of practice, uses, development of value added products.
- At Kakogen College on June 5, 2015, Biodiversity Day Programme was held training and awareness programmes on *Noni* plant organized.

Conclusion

1. This is an important plant with nutritive and medicinal value.
2. It can promote animal husbandry.
3. Fruits of *Noni* plant form excellent fodder for pigs.

Pictures of Noni conservation site in RFRI, Jorhat

NTFP DEVELOPMENT

Citronella, high potential

Citronella as an NTFP embodies the sustainable development concept and provides a solution to problems of conservation and development

Mriganka Borah

Non-timber forest products (NTFPs) are an important element of forest resources in India. However, they have not received due attention. Sustained development of NTFPs within the socio-economic sphere of forest management in India offers challenging opportunities for forest managers to improve productivity from the forest and have the opportunity to meet the demand in wider prospects. A better understanding of resource use, flow and economic returns from various NTFPs is essential.

Citronella oil is one of the major essential oils and mainly used in the perfumery and cosmetic industry. Citronella oil is obtained from the *Cymbopogon genus* plant family. More precisely, it is extracted through steam distillation of the grasses *Cymbopogon nardus* (Jowitt) and *Cymbopogon winterianus* (Rendal).This results in two types of citronella oil – Ceylon, which is obtained from *C. nardus* and is a native product of Sri Lanka and Java, which is distilled from *C. winterianus.*

Ceylon citronella oil has a warm, citrusy, and wood scent, and has a pale to dark yellow colour. Java also has a fresh lemon-like scent but is darker in colour. Between the two, java citronella is considered to be of higher quality. The main components of citronella oil are citronellol, citronellal, and geraniol. The two types of citronella oil vary in the amounts of geraniol and citronellal.

Citronella holds a very important prominent place in essential oil industries. It is a raw material for production of geranial, citronellal, hydroxy-citronellal and other similar high value perfumery bases. The crop is grown in the States of Assam, Gujarat, Jammu & Kashmir, Karnataka, Maharashtra, Tamil Nadu, West Bengal and Uttar Pradesh. It comes under the family *Poaceae*. It is a tufted aromatic perennial herb with fibrous roots; erect over 2 m tall, with smooth leaves and bearing a large inflorescence. Centre of origin is Sri Lanka.

The species has been found to grow well under varying soil conditions, but the sandy loam soil with abundant organic matter is the most suitable. Citronella thrives well under the tropical and sub-tropical conditions. It requires abundant moisture and sunshine for good growth. A good rainfall of about 2000-2500 mm, well spread over the year, and high atmospheric humidity

ute of Forest Genetics and Tree Breeding, Indian Council of Forestry Research and Education, P

appear to influence the growth of the plant, yield and quality of the oil.

It is also widely used as a starting material for various aromatic chemicals such as scented soaps, sprays, deodorants, detergents, polishes, mosquito repellents, etc. Apart from being used on humans, citronella oil is also used to keep ticks away from livestock and pets. Citronella has potent anti-fungal properties that help suppress the growth of fungi species. Due to its anti-fungal properties, citronella oil is also used to treat insect bites. It also has anti-bacterial and antiseptic nature. These compounds prevent the growth of bacteria in the body and help treat wounds as well as infections that may occur in the colon, urethra, bladder, gastrointestinal tract, prostate, and kidneys. Citronella essential oil is often used in aromatherapy providing relief from anxiety and a light feeling. It can also provide relief from menstrual cramps and muscle spasms.

The oil can also help inhibit inflammation in the liver, stomach, and digestive tract. Environmental Protection Agency (EPA) classifies it as a bio-pesticide with a non-toxic mode of action. Citronella oil can be found in dozens of registered pesticide products, such as sprays, lotions and candles. It helps to clear the mind and has a general toning and tonic effect on the body. It is helpful with colds, flu and minor infections and also has deodorising qualities.

Because of its healthy net return and high market demand, the crop may

score better than other crops in terms of demand. The essential oil industry in India has witnessed a remarkable growth since the early 1970s. From a production of around 50 TPA in 1973, the industry has registered increase in production and the current production is about 700 TPA. Citronella oil constitutes over 90 per cent of the production of essential oils in the country. The present demand is placed at around 3,400 tonne per year. Assuming that the trend would continue the demand is estimated to rise to 5,000 tonne per year.

Besides the domestic demand, there is good potential for exports. Though there are no exports at present, the quality of essential oils produced in Assam is reported to be better than that produced in Sri Lanka and Indonesia, the two major exporters at present. Citronella oil is being produced in the north-eastern states of Assam, Meghalaya, Arunachal Pradesh, Nagaland and Manipur. The major customers are manufacturers of cosmetics and perfumes who are mainly located in Mumbai, Bangalore, Chennai. Procurement of citronella oil is in the hands of four major buyers, namely, Hindustan Lever Limited, Industrial Perfumes, KV Aromatics and Gupta & Co.

An increase in applications of Citronella in various fields has led to an increase in demand. At present, about 1800 MT is being produced in the world out of which India produces about 600 MT/year. At present the major producers are China, Vietnam, Indonesia, Argentina, Taiwan, Sri Lanka, Brazil, Madagascar and India.

Citronella as an NTFP embodies the sustainable development concept and a solution to problems of conservation and development thus improving people's livelihoods and capturing the value through improved production, processing, and marketing, also improving the livelihoods of poor peoples.

NORTH-EAST & NEPAL

Conservation and management of rattan

Management of rattan started not long ago. However, progress is being made in Nepal allowing local communities to manage natural resources by their own decisions

Chinpilhing Kipgen

Rattans are climbing spiny palms belonging to *Calamoideae*, a large sub-family of Palm family (*Palmae* or *Arecaceae*). There are around 600 species of rattans belonging to 14 genera in the world (Dransfield, 1981). These are naturally distributed in the South East Asia from Fiji Island to Africa and from southern China to Queensland (Australia) with the greatest concentration in the Dipterocarp rain forests of the Malaysian Archipelago (Weidelt, 1990). India has a good representation of rattans with 5 genera and 60 species mainly found in Western Ghats, Andaman and North-East India (Renuka, 1999). In fact, the rattans comprise more than fifty per cent of the total palm taxa found in India (Basu, 1985).

Distribution and habitat

In India, there are about 60 species of rattans under four genus, *Calamus, Daemonorops*, *Korthalsia* and *Plectocomia*. They are mainly distributed in three major geographic regions, the Western Ghats of Peninsular India, Sub Himalayan hills and valleys of eastern and northeastern India and Andaman & Nicobar Islands. The rattans comprise more than 50 per cent of the total palm taxa found in India. One genus and 21 species have been so far reported from Western Ghats; 3 genera and 18 species from Andaman & Nicobar Islands and 3 genera and 17 species and two varieties from North Eastern States.

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Each region has its own specific rattan flora and the species distribution does not overlap. Out of the reported species only 25 per cent are economically important.

Peninsular India

Western Ghats of Peninsular India, with its tropical evergreen rainforests, form one of the ideal habitats of rattans. They are also seen in the Nilgiris and in the Ghat forests of Andhra Pradesh. Depending on the species, they are distributed in the evergreen, semi evergreen and moist deciduous forests. Rattans occur from almost sea level to 2000m elevation, most showing altitudinal preferences. With the exception of *C. rotang*, a cane of the plains, all others are plants of the hills and mountains. Most of the species are distributed below 1000m and only four species are seen above this level. More species occur towards the southern part of Western Ghats.

North-East India

Rattans are found in the evergreen, sub montane or the sub Himalayan mixed forests of north-eastern states. Rattans are also distributed in the moist deciduous forests in Odisha and Bihar and in the coastal swamp forests of West Bengal and Odisha. They have their range of distribution from alluvial plains to the moist hill forests up to 2000m altitude. Most of the species are found below 500m while *C. acanthospathus* and *P. himalayana* are seen at much higher altitudes, around 2000m.

Andaman & Nicobar Islands

While the uninhabited islands are much richer, the inhabited ones also harbour several taxa of rattans along the boundaries of farms, roadsides and in fallow lands. The species are not evenly distributed in the islands. While *C. andamanicus* and *Korthalsia laciniosa* occur both in the Andaman and Nicobar group of islands, most others have restricted distribution in certain parts only. Eleven species are confined to the Andaman group and five to the Nicobar group.

Plant habit

Rattans have long and flexible stems that need support. Some species are single-stemmed while others are multi-stemmed. Single-stemmed species can only be harvested once, while the multi-stemmed ones can be harvested sustainably/multiple times. Surrounding the stem are sheathing leaf bases which are nearly always fiercely spiny, the spines are sometimes arranged in neat rows and interlocking to form galleries in which ants make their nest, to provide extra protection to an already well protected plant. This may prevent animals from feeding on the tender growing point (called "cabbage"), hidden within the leaf-sheaths. In addition to sheath spines, rattans usually have whips, either on the leaf sheaths or at the ends of the leaves. They are armed with grouped, grapnel-like spines and play a major role in supporting the rattan as it climbs in the forest canopy. These whips and spines make collection unpleasant.

Floral biology

Rattans are dioecious, the male and female plants being separate and the flowering is annual, although *Korthalsia* is a monoecious genus in Asia and the flowers are bisexual. If the rattan is a single stem species the whole plant dies; on the contrary, if the plant belongs to clustering species only the individual stem dies.

In pleonanthic species, after a juvenile period of vegetative growth, maturity is reached and inflorescences are continuously produced without compromising the vitality of the stem. All the species of *Korthalsia, Laccosperma, Plectocomia, Plectocomiop* and *Myrialepsis,* and a few species of *Daemonorops* are hepaxanthic. All other rattan species are pleonanthic.

Current status of rattan

An analysis of distribution of rattans in the three different major areas in India shows that much change has taken place in their distribution over the years because of the shrinkage of the natural forest cover. In the north-eastern States, shifting cultivation had been degrading and denuding the forests since long ago. Many of the species reported earlier from certain localities are absent now. The growing popularity of rattan furniture resulted in overexploitation of this important forest resource. In many regions commercial species have been seriously depleted as the rapid exploitation continues unabated. This situation, if left unresolved, will bring about severe economic and social repercussions. *Calamus travancoricus, C. rotang, C. dransfieldii* and *C. nambariensis* have become extremely rare in their original localities.

Of the approximately 600 species of rattan, 117 are recorded as being threatened to some degree (Walter & Gillett, 1998); of these, 21 are endangered, 38 are regarded as vulnerable, 28 as being rare and 30 as indeterminate (IUCN Red List Categories, 1997). North-eastern States alone accounts for 4 genera and more than 20 species. Out of these 20 species, 14 species are being threatened, including 11 endemic species.

Uses of cane

Cane finds a variety of uses due to its remarkable pliability, strength and the long lengths in which it is usually obtained. It is used as a substitute for ropes and cables in suspension bridges. It is extensively used in industry – thick canes for making furniture frames, walking sticks, polo sticks and umbrella handles and thinner ones for making baskets, large quantities of which are used in tea gardens, in collieries and in the railways. Canes are also split and the strips from the outside with the smooth outer surface are largely used for making seats and backseat of chairs and sofas, while the lusterless strips from the inside of the canes serve for making various articles such as furniture, basket, sieves, mats, etc. Canes are also used in wicker-work and in the manufacture of sports goods, etc. Even the refuse from the split cane is useful for stuffing and packing and for making rough cordage, matting and a variety of other article.

Issues and challenges

Because of high demand for rattan products worldwide and its collection from wild habitat, rapid deforestation and land-use/land-cover change, there exists a considerable threat to the survivability of most of the species of rattans. Threats to rattan come from several sources including:

- Decreasing natural forest cover leading to loss of habitat.
- Selective exploitation of stems for the furniture industry.
- Increased exploitation for handicrafts.
- Exploitation of apical stem and seeds for food (most damaging of all threats).
- Biotic factors such as diseases and pests.

Rattans are dioecious, *i.e.*, the male and female plants are separate but the sex of the plant cannot be identified till they flower, which is after 5 years of planting (Ahmad & Ghani, 1989). Hence, extraction before flowering may reduce the number of any one sex of the plant in the population. In India, reproductive biology of rattans has not been studied in detail. Application of molecular tools (markers, particularly DNA markers), for sex determination in early stage is very much desired. At present, out of the species reported, six species are critically endangered, eight are endangered and 26 are vulnerable and have no conservation strategy.

In rattans, even though fruits are produced in large quantities in natural forests, practically no natural regeneration from seeds is seen near the mother plant in many areas. Whether this is due to dispersal mechanisms, or due to other ecological reasons, is not known.

Since the rattan requires the stake for its proper growth and development, thereby it can be intercropped with the important economic agro-forestry species. Suitable tree species for rattan farming and silvicultural model have to be identified. Also, package of practices for its cultivation has not yet been developed. Little information is available on the edaphic and climatic requirements of different species of the rattan.

Conservation and management strategies

The livelihood of many people depends on rattan as it is used to make a wide range of furniture products and handicraft articles. To meet the demand of industries, rattan has been harvested unsustainably by the tribal people of North-East India. This unscientific exploitation of rattans has depleted the natural rattan resources of the region. To conserve the rattan resources, following strategies should be implemented and applied in the field:

Preservation of Natural Resources

Even though strict control of the exploitation of wild stock is prevalent, many times this cannot be effectively implemented. It is practically impossible to control the illicit extraction from the forest areas. Extraction can be controlled in protected areas like Biological Parks and Wildlife Sanctuaries and this will help to conserve rattan to a certain extent.

Cultivation

Cultivation of commercially important species for the industrial sector can relieve the pressure on the wild stock. Before adapting the species for largescale plantations outside its natural home, species trials should be conducted to assess the suitability of the species for a particular geo-climatic region. Though rattans occur from almost sea level to 2000 m, most of them show altitudinal preferences. Many of the species are distributed below 1000 m, while some are found only at higher altitudes. Some species are restricted to certain localities.

In situ conservation

In India, there has been no serious effort so far to conserve rattans *in situ*. Even though National Parks and Bio-reserves are helpful in promoting *in situ* conservation, illicit harvesting cannot be controlled efficiently. For conserving the natural populations, some of the State Forest Departments have introduced extraction rules. Generally the extraction is carried out on a 4-year rotation. The government has also banned the export of the raw material. Rattans are planted and protected in sacred groves. There are about 80 rattans bearing sacred groves in Kerala alone.

Ex situ conservation

State forest departments of Kerala, Karnataka, Tamil Nadu and Goa have started largescale plantations of rattans. Certain species are cultivated in homesteads. But only three or four economically important species are protected like this. A live collection consisting of about 30 species is maintained in the Kerala Forest Research Institute campus. Seed stands of 12 species have been raised in Thrissur Forest Division. The State Forest Research Institute in Arunachal Pradesh has also started Germplasm conservation. Advanced Research Centre for Bamboo and Rattan (ARCBR), Aizawl, Mizoram, a unit of Rain Forest Research Institute, Jorhat, Assam, under the Indian Council of Forestry Research and Education (ICFRE), Dehradun, Uttarakhand, have conserved all the 4 genera of rattan found in this region (*Calamus*, *Daemonorops*, *Salacca* and *Plectocomia* spp.), collected from different parts of North-East India. These genera are planted in the reserve forest of the ARCBR campus and maintained for research and extension purposes.

Biotechnological approaches

Since rattans are dioecious in nature and their reproductive biology has not been studied in detail mainly because of lack of rattan plantations and the inaccessibility of the natural populations in forests, therefore, there is an urgent need for the sex-determination in the early stage by employing the molecular and biotechnological approaches which may be helpful in conservation of rattan resources.

Community rattan management in Nepal

A case study of Karnali CFUG (community forest user groups) was conducted by SK Paudel and Chowdhary in 2005 to highlight the community based management, which

Table 1. **Traditional management system of Rattan** (SK Paudel and CL Chowdhary, 2005)

SN	Activity	Previous System	Remarks and Improvement
1	Seed collection	Seeds were not collected in the past except by few individuals for their own private nursery. The seed collection time was generally in Feb–May when it ripens.	The main shortfall was the harvesting age of rattan. They used to harvest in 2 years rotation, when rattan is not able to produce productive seeds. As the rattan seeds are also easily marketable, they were suggested to harvest rattan in four years rotation so as to get productive seeds.
2	Nursery	Community did not have any nursery. They were fully dependent upon natural regeneration for the revival of rattan forest.	They established one rattan nursery in 1997 after receiving training from experts. They used seedlings for planting community lands and surplus they sell to other communities.
3	Seed treatment	They did not have any knowledge on seed treatment. However an owner of private nursery of adjacent village treated seeds by removing epidermis layer and the inner fleshy parts. He claimed 70% germination.	Soaking seeds in water for 24 hours would give better germination percentage. The community practiced this method of treatment when they established their own nursery.
4	Rattan plantation	No plantation carried out previously as the rattan seedlings were not easily available and, if available, were expensive (NRs 10 per seedling).	They required plantation of rattan in some of the areas where natural regeneration was poor. They started enrichment plantation after having their own rattan nursery.
5	Conservation	They have hired forest guards to regularly patrol the forest. In addition, community members also do rotational patrolling in the forest.	The current protection system is highly effective. Community members are committed to stop the illegal harvesting and unmanaged cattle herding.
6	Silvicultural operation	Not any kinds of silvicultural operations carried out in the past in the rattan forest.	Enrichment plantations of rattan, weeding of unwanted shrubs and plantation of fast growing trees are needed for better rattan growth.
7	Harvesting	The traditional harvesting system was highly unscientific. The community used to sell green rattan to an Indian contractor at lump sum basis. The contractor employed Indian labour for the harvesting. Local users believed that they did not have basic skills as compared to the Indian labours that they believed were faster and more efficient for this purpose. The general practice was to set fire in the rattan forest before the harvesting to avoid insects and to make the harvesting work easy.	Contracting and hiring Indian labourers have significantly reduced their net income from the rattan. It would be economically beneficial to the local community if they harvested rattan by themselves. Additionally it would give employment to the local people. Setting fire on rattan forest before the harvesting must be discouraged as it degrades the quality of rattan and destroys regeneration of associated species.
8	Harvesting	No post-harvesting and value addition works done in the past.	Post-harvesting would add value of the rattan. Proper drying and oil curing of rattan.

is a good example of community rattan management in Nepal.

About the community

Sati Karnali CFUG is located in Kailali district, the far western Terai region of Nepal, about 32 km south from the east–west highway. The fairly large community of 623 households manages 298.5 ha of natural forest, 47% of which (170 ha) is covered with natural rattan (*C. tenuis*). The District Forest Office handed over the forest to the community in 1994. The forest is an island in the Karnali River, which is one of the biggest rivers in the country. The rattan forest was highly degraded and virtually no management existed until 1992 when the forest was brought under the community forestry regime. The Indian contractors used to harvest rattan every year and the annual revenue never exceeded NRs 200000 (US$2650). Standing rattan was usually sold to Indian contractors, while there was no systematic mechanism of harvesting. Pre-harvesting forest fire was the common practice of the harvesting.

Even after the forest was handed over to the community, they continued the previous system for the first few years until a training course on rattan management took place in 1997. With the support of experts, the community prepared a rattan management plan and divided the rattan forest into six blocks for 5 years rotational harvesting. One of the blocks was maintained for research and conservation purposes. The management plan includes an improved harvesting technique (avoiding pre-burning), simple technique for the removal of leaf sheaths, air seasoning and storage techniques. The details of pre- and post-harvesting techniques of the previous management system and the changes for improvement are given in Tables 1 and 2, respectively. The present average growing stock of the rattan forest is 19 840 stems/ha. The size of canes (length and diameter) varies according to the site conditions within the forest. The average length of rattan is 6.4 m with a maximum of 22.5 m, and the average diameter of cane is 2.9 cm with a maximum of 6 cm.

Management plan

The community prepared a rattan management plan with the support of the rattan experts. The features of the management prescriptions that were recommended in the plan are summarized in Table 2. During the first rotation (4 years) the yield of rattan was irregular, as a lot of management activities were required and the rattan was heterogeneous according to size and age. However, from the second rotation the yield could be predicted, as the age and size of the rattan in each block were more uniform.

Costs and benefits

The forest consists of natural rattan and, therefore, does not require any investments for the regeneration of the resource. Proper protection was enough to restore the growing stock. After the forest come under the community management in 1994, the community made efforts aimed at conservation so as to revive the degraded resource. Each community household participated in

Table 2. **MANAGEMENT ACTIVITIES OF RATTAN (**SK Paudel and CL Chowdhary, 2005**)**

Year 1	• Demarcation of 5 blocks by using natural boundary or by making fire lines. • Total harvesting (clear cut) of all the rattan in block 1 and selective harvesting in other blocks. In selective harvesting, only mature rattan above 1.5 m high should be harvested (not more than 25% of the total growing stock). • Very old trees in all the blocks should be harvested. Enrichment plantation of *Dalbergia sissoo, Acacia catechu, Trewia nudiflora and Bambax ceiba* is to be done at the spacing of 6 m. • Some of the pocket areas where rattan is sparsely distributed, enrichment plantation should be done at the spacing of 2 m.
Year 2	• Weeding is required in block 1 (last year's clear-cut area) as the regeneration will start and weeds might retard the growth. • Enrichment plantation of rattan in block 1 in the areas where the natural regeneration is not well. • Total harvesting of block 2. Selective harvesting in block 3 and 4 where mature rattans more than 5 feet high would be harvested. The total harvesting should not exceed 25% of the total growing stock.
Year 3	• Weeding in block 2 (last years' clear-cut area) where natural regeneration is already started in the third year. • Enrichment plantation of rattan in block 2 in the areas where nature regeneration is not enhanced. • Total harvesting of block 3. Selective harvesting in block 4 where only mature rattan above 5 feet high should be harvested not exceeding 25% of the total growing stock.
Year 4	• Weeding and enrichment plantation of rattan in block 3. • Total harvesting of rattan in block 4.
Year 5	• Weeding and enrichment plantation of rattan in block 4. • Total harvesting of rattan in block 5. • Selective harvesting of block 6 which is just for the research purpose.
Year 6	• Weeding and enrichment plantation of rattan in block 5. • Total harvesting in block 1 and block 6. • No selective harvesting from the second rotation. • Maintenance of block demarcation (fire lines).

rotational patrolling in the beginning, which did not include any direct cost. However, the community later hired a few forest guards after they earned money out of the resource selling. The actual costs of rattan management, therefore, mainly involve labour cost of harvesting, leaf sheath removal and transportation. In addition, the regular costs of administration and staff salary could also be counted though these costs are not only for the rattan management but also for the whole community forestry process and are not included here. The total cost of rattan harvesting, leaf sheath removal and transportation from harvesting site to depot is calculated at NRs 2–3 per kg of dry rattan. On the other hand, there are several benefits derived from the rattan. The main benefits come from the selling of raw rattan, rattan seeds and seedlings. The annual production of canes is 6-8 tonnes (dry weight) per ha. Selling at auction at a minimum price of Rs 30 (US$0.40) per kg results in about US$2000 per ha annually. The total annual income is NRs 4 to 5 million (about US$50,000–65,000 per year). The income per year is about

25–30-times more than in the previous unmanaged condition. Average annual area of harvesting = 32 ha, annual yield = 5-8 tonne (dry weight), annual income before management =NRs 200,000 (US$2650), annual income after management = NRs 4-5 million (US$50,000–65,000).

The community has also a rattan nursery where they produce and sell thousands of seedlings every year at the rate of Rs 10 (US$0.13) per seedling and they also sell rattan seeds at the rate of Rs 300 (US$4) per kg. They collect 100-150 kg of rattan seeds every year. The community decides on the expenditure of the income. Generally the income is spent on rural infrastructure (school, road, sanitation), rural development programmes (education, health, training, etc.) and other forest development programmes. The community has recently built a big storage hall and an elegant office financed by rattan income.

Conclusion

Rattan is one of the most important non-timber forest products mostly distributed and highly traded in Southeast Asia. Out of 600 species in the world, only 7 species occur in Nepal, but these play a significant role in the income generation of communities. However, rattan resource base has been depleted significantly due to overexploitation, immature harvesting and habitat destruction. This case study highlights the community rattan management in the far western Terai region of Nepal. The income of the community has been increased up to 30 times after the proper management of rattan. Since 1996 the community has earned about US$40,000 each year from the rattan sale and a number of community development activities has been carried out with the funds generated. This is an exemplary work to demonstrate how rattan management can bring positive changes on rural economy, natural resources and social capital.

Management of rattan started not long ago, therefore, there is little knowledge and experience in this field so far. However, progress is being made in Nepal, allowing local communities to manage natural resources by their own decisions. This has benefited rattan significantly. The degraded rattan resources in community managed areas have been restored and income has increased considerably. The replication of a similar approach could enhance the management of rattan in a country like India which has a vast diversity of the resources and many of the species are on the verge of extinction if not manage well.

Acknowledgement

This article is a mere reproduction of the research work done by others. The writer is thankful to those researchers who have contributed in this field and allowed to reproduce the article for knowledge sharing, which will be useful in conservation and management of our valuable resources, many of which are on the verge of extinction.

CHANGLANG / ARUNACHAL PRADESH

Contribution of wild edible plants to livelihood economy

Enhanced use of forest resources would not only check food shortage, but also contribute to necessary nutrient requirement of people and improve the rural economy

Tabom Soki

Forests provide significant social and economic benefits at all levels, especially in developing countries. Economics of people living in forest finger have traditionally been dominated by subsistence agriculture. However, non-timber forest products (NTFPs) play vital role among the tribal people and provide a source of income and subsistence living. NTFPs, like fuel-wood, medicinal plants, wild edible vegetables, house building materials, etc., are integral part of day-to-day livelihood activities, especially for tribal people. Since the early 1990s, the role of NTFPs for sustainable forest use and poverty alleviation has received increased attention. The use of wild plants is integral part of their strong traditional and cultural systems and practices that have developed and accumulated over generations. These systems form the basis of local level decision making in agriculture, food production, human and animal health and natural resource management. World over, tribal population still stores a vast knowledge on utilisation of local plants as food material and other specific uses. The tribal communities draw their sustenance mainly from forests, which provide them food plants and other material requirement.

The article focuses on contribution of NTFPs to household economy of the people of Changlang district of Arunachal Pradesh. Socio-ecological status of the villages was also taken into consideration.

Methodology

Extensive field surveys were done during 2002-2005 about contribution of wild edible plants. Five circles – Vijoynagar circle, Miao circle, Diyun circle, Bordumsa circle and Nampong circle – of the Changlang district and six villages from each circle were selected for the survey. Detailed household surveys, using a semi-structured questionnaire emphasising on the used pattern of NTFPs, were done. About 10 per cent households in each selected village were sampled randomly. Information on NTFP plant species and their utilisation pattern were collected through personal interviews with the village headman and other villagers

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FIG: **Map of Changlang district of Arunachal Pradesh**

of different age groups and sex. The information gathered was again cross-checked with other villagers of the same tribe. Official information was collected from the Forest Department as well as from civil administration. Wild edible plants' consumption was estimated separately in two different seasons, *viz.* winter (October to March) and summer (April to September). The monetary value was calculated by multiplying the quantity consumed with the average market price of that particular product prevailing at nearest local market. Market surveys were conducted by periodic visit to the local markets in all selected sites. Quantities of the supplied NTFPs with their local market values were recorded separately.

Factfile of Changlang district

Changlang district lies between latitudes 26^0 40/N and $27^0$40/N, and longitudes 95^0 11/E and 97^0 11/E. It is bounded by Tinsukia district of Assam and Lohit district of Arunachal Pradesh in the north and by Tirap district in west and Myanmar in south east. The district is home to many interesting and fascinating tribes, such as Tangsa, Singpho, Khampti, Nocte, Lisu (Yobin), Deori and few Adivasi tribes. The area experiences both tropical and sub-tropical conditions and is well known for excessive rainfall (250-400 cm per annum) and varying temperatures ranging with relation to changing altitude, i.e. from 4^0C to 35^0C. The temperature usually falls below freezing point during winter. The relative humidity remains high and varies from 47 per cent to 93 per cent.

Sources and utilisation pattern of NTFP

Wild edible vegetables are common NTFPs that have been extracted widely throughout the district. The Chakma villages, especially Abhyapur under Diyun circle and Bhudhisatta under Miao

circle, where people generally practice both settled as well as intensive *jhum* cultivation, gather huge quantities of wild edible vegetables which has been estimated at Rs 9,700.00 per household year. In addition, medicinal plants and wild edible fruits were also found playing an important role in day-to-day life of the local people. On an average, the total contribution of NTFPs to annual household income was maximum (23 per cent of the total income) in the villages of Miao circle followed by Diyun circle (21 per cent of the total income), Nampong circle and Vijaynagar circle (19 per cent and 18 per cent of the total income, respectively). It was minimum (11 per cent of the total income) in the villages of Bordumsa circle.

Contribution of wild edible plants

Wild edible NTFPs that include mainly leafy vegetables, bamboo and cane shoots, wild edible mushrooms and honey, are commonly collected from the forest for self subsistence as well as for cash generation. Monetary value of consumed wild vegetable has been estimated in the range of Rs 1,229.00 per household year at Lamabasti to Rs 9,546.00 per household year at Bhudhisatta village.

Market survey at different local markets showed that leafy vegetables, bamboo and cane shoots, wild edible mushrooms and honey play a significant contribution for cash generation. Annual market supplying bamboo shoots and wild edible mushrooms were recorded maximum (1622±301 kg and 1767±229 kg, respectively) at Diyun market while leafy vegetable was higher (3478±564 kg) at Miao market. Besides, wild edible forest products like the broom grass is another important NTFP, with estimated annual market return of minimum Rs 13,150.00 at Nampong market and maximum Rs 63,882.00 at Diyun market. Honey, the animal origin NTFP, commonly collected from wild and sold at local market, fetched them from Rs 15,990.00 to Rs 67,938.00 per annum.

Table1: **Contributions by wild edible vegetables**

VILLAGES	Kg Household-1Year-1	Rs Household-1 Year-1
1. VIJAYNAGAR CIRCLE		
Dawdi	523± 63	4251±671
38 mile	571 ±102	4451 ±659
52 mile	607± 144	4501 ±587
Hozolo	477 ±69	4277 ±453
Gandhigram	780± 121	6372 ± 860
2. MIAO CIRCLE		
Lama basti	133± 021	1229 ±135
Anandpur1	976 ±123	9199± 829

Anandpur2	949 ± 163	8988 ±732
M pen1	1067± 133	9933± 160
M pen 2	822± 143	7748± 583
3. DIYUN CIRCLE		
Santipur	648± 95	6401 ±678
Moytripur	338± 55	3043± 558
Kamakhyapur	760 ±126	7118± 608
Rajnagar	651± 110	6581± 510
Abhyapur	1164± 155	9700 ±770
4. NAMPONG CIRCLE		
Rima	440± 67	3776± 694
Tikhak kamlang	447 ±54	3419 ±632
Longpong	498± 97	4109 ±723
Mossang putak	552± 92	4290± 592
Tengpung	507± 79	4577± 827
5. BORDUMSA CIRCLE		
Giding	460± 80	3955± 520
Podumoni	413± 55	3667± 437
Balijan	351± 51	3505 ±402
Bordumsa village	402 ±64	3753± 459

Sources: Indian journal of Fundamental and applied life science 2011 Vol. 1 (2) April – June, pp. 157-169/Sarmah and Arunachalam

Table 2: **WILD EDIBLE PLANTS IN LOCAL MARKET (Kg year-1)`**

NTFPs	Miao circle	Vijaynagar circle	Bordumsa circle	Nampong circle
1.Bamboo shoots	494±73	670±133	874 ±168	621 ±121
2.Wild leafy vegetables	3478 ±564	1186 ±114	2733±386	848 ±115
3.Wild mushrooms	579 ±97.6	405 ±75	1463±188	517 ±103
4.Cane shoots	676 ±122	465 ±85	578 ±111	481 ±94

Sources: Indian journal of Fundamental and applied life science 2011 Vol. 1 (2) April – June, pp. 157-169/Sarmah and Arunachalam

Table 3: **Monetary benefits of Wild edible plants in local market(Rs yr^{-1})**

NTFPs	Miao circle	Vijaynagar circle	Bordumsa circle	Diyun circle	Nampong circle
1.Bamboo shoot	5021.00	3458.00	5245.00	13460.00	3103.00
2.Wild leafy vegetables	32931.00	10320.00	21866.00	27716.00	6616.00
3.Wild edible mushrooms	12727.00	12870.00	26325.00	38868.00	5425.00
4.Cane shoots	6760.00	2788.00	7520.00	7829.00	3367.00

Sources: Indian journal of Fundamental and applied life science 2011 Vol. 1 (2) April – June, pp. 157-169/Sarmah and Arunachalam

Conclusion

Food gathering and harvesting of wild edible plants is a common activity of local communities of Changlang district. Enhanced use of these resources would not only check food shortage, but also would contribute to necessary nutrient requirement of people and improve the economy of rural people. Investigation on edible wild plant species locally used for consumption reveals a potential to become valuable staple foods and important alternatives to the usual cultivated agricultural crops. Selection for potential species can be done, based on the local priority and nutritional content, as most of the wild edible species have high nutritional values. Therefore, it seems imperative to carry out studies on the nutritional values of these plants. An emphasis on the sustainable harvesting of wild edible plants will help enhance and maintain the region biodiversity. There is a need for systematic incorporation of information on current use of wild food resources in any programme dealing with sustained food security and rural development for the benefit of the local people. Besides wild edible plants, Apiculture could be promoted to strengthen additional income sources of local communities.

ASSAM

Edible fern as NTFP

Edible Fern, collected from forest, has been a source of livelihood for the tribal and rural people living in and around the forests and if organised properly can have a much larger impact

Khanindra Kalita

Non Timber Forest Product (NTFP) refers to all biological materials other than timber extracted from natural forests for human and animal use. It includes plant tissue used for fiber, building material, medicine, edible leaves, roots, flower, fruit, seed, nuts, honey, resin, glue, lac, etc., and has both consumptive and exchange value.

The NTFP of economic importance in India can be grouped into the following categories:

- **NTFP for Food Security**: Honey, mushroom, edible fruits, leaves and nuts, foliage and rhizomes.
- **NTFP for Wood and Biomass**: Useful for fuel, furniture, thatching, forage and manure.
- **NTFP for Medicines and Plant Protection**: For human beings, animals and for control of pests and diseases in agricultural crops.
- **NTFP for Aromatics, Dyes and Oilseeds**: For medicinal and industrial uses.

Prior to the National Forest Policy (NFP), 1988, NTFPs were popularly known as Minor Forest Products (MFP) and were centered around Tendu leaves (*Bidi Patta*) and few other products. NTFPs have income potentials and provide employment opportunities. Besides the economic value, the non-economic value of NTFPs for the forest dwellers is more important since quite a good number of such products do not enter into the market and are primarily consumed at local level with a little value addition. NTFPs are a part of the socio-cultural life of tribal people who mainly maintain a symbolic relationship with the forest and forest-based products. More particularly, the reliance of tribal on NTFPs becomes very high during uncertain agricultural yields for both food securities during seasonal shortages as well as for household medicine and income needs.

Assam is one of the North-Eastern States of India known for its rich biodiversity. Assam, situated at the foothills of the eastern Himalayas, is endowed with wide-ranging flora and fauna and is the largest State in North-East India. It lies in the middle reach of the river Brahmaputra and Barak. The State accounts for nearly 2.4 per cent of India's total geographical area. The forest and tree cover in the State is

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29,237 sq km, which is 37.27 per cent of the geographical area (*Source: India State of Forest Report 2011, Forest Survey of India).*

Forests provide a variety of products for both commercial as well as household consumption that include industrial wood, fuel, bamboo, thatch and thatching material, cane, traditional medicines, edible fruits, leaves and nuts, bark, gum and resin, fiber and floss, etc.

Edible Fern is a NTFP which has been in use since long in different parts of the globe. *Diplazium esculentum* is an edible fern found throughout Asia and Oceania. It is probably the most commonly consumed fern. It is known as *pucuk paku* in Malaysia, *paco* in the Philippines, *dhekia* (ঢকৌয়া) in Assam, *dhenkirshaak* (ঢকেঁরি শাক) in West Bengal, and *linguda* in northern India. In Thailand, it is known as *phak khut*. The genus *Diplazium* belongs to the family *Athyriaceae*.

Edible Fern collected from forest has been a source of livelihood and of domestic use for the tribal and rural people living in and around the forest in Assam. It is still in demand in Assam. It has also been able to find place in big hotels and restaurants as it one of the favourite edible vegetables in Assam.

The varieties of wild edible fern (*Dhekia Sak*) found in Assam are:

1. *Ceratopteris thalictroides (L.) Parkeriaceae*
   Vernacular Name: *Pani Dhekia* (Assamese)
   An aquatic fern with much dissected frond, common in stagnant water bodies. Fronds are cooked by the Mishing tribe.

2. *Diplezium asperum Bl. Woodsiaceae*
   Vernacular Name: *Dhekia Sak* (Assamese)
   A rhizomatous fern with shining pinnae. Tender frond is circinate which is eaten by almost all communities.

3. *Diplezium esculentum (Retz.) Sw. Woodsiaceae*
   Vernacular Name: *Dhekia sak* (Assamese)
   A rhizomatous fern with shining pinnae. Tender frond is circinate eaten by almost all communities.

Uses of Fern: It is generally eaten as a vegetable in Assam. But today, lots of restaurants serve ferns in different forms. Pickle of ferns is also served. It is also used in some traditional medicines.

Nutritive Value: Analysis for major nutritional components on dry weight basis shows that they are very rich in crude protein, ranging from 18.63 to 33.2 mg/100 mg. Total carbohydrate varies from 5.6 to 11.01 mg/100 mg. Lipid contents are low, ranging from 2.42 to 3.8 mg/100 mg. Crude fibre and ash content vary from 7.8 to 20.93 mg/100mg and 9.66 to 14.0 mg/100 mg, respectively *(Source: Nutritive Values of Five Wild Edible Ferns of North East India by AK Handique).*

Economy: Edible ferns are in great demand nowadays. It is easily available in rural areas but the demand is higher in cities and towns due to non-availability. The main reason behind the demand

is its taste and place in Assamese food habit and culture. Second reason for its demand is the consciousness of people about pesticides used in most green leafy vegetables. Ferns are collected from the wild alone, out of reach of any pesticide.

Market: Guwahati is the major market of edible ferns and other wild edible plants, where all the collected ferns from different rural and forest areas are brought for sale as there is a huge customer base of all classes. Tribals from neighbouring Meghalaya also come for selling ferns and other wild edible vegetables in Guwahati. Major towns like Dibrugarh, Jorhat, Tezpur, Lakimpur, etc., are also good markets. At the same time, ferns are also available in all local markets throughout Assam.

Collection and how fern reaches from village to the main market: Rural people collect the ferns from forests. It is then made into bundles, consisting of about 20 to 30 leaves (called *Mutha* in Assamese). The agents or middlemen buy the ferns at the rate of about Rs 60 to Rs 80 per 100 bundles. They transport it to the nearest towns or main market where the price of one bundle becomes Rs 5.

Dhekia Saak *(Diplezium esculentum)* in wild

Bundles of ***Diplezium esculentum***

The role of Forester

Tribals, local villagers or the forest dwelling community as a whole are the main concern of the Forest Department as far as the conservation of forest is concerned. They do not get the benefit from the collection of ferns as the price is very low due to availability in rural areas and also they cannot afford to go to the town and cities to sell them directly in the market. The middlemen or the agents get the main benefit.

The Forest Department should play a role in this regard by fixing minimum support price, involving JFMCs or SHGs for market linkage.

Conservation scenario

As fern is consumed by all communities of Assam, there are some traditional methods of conservation. It is neither collected nor eaten in the winter, from September to March. It's a belief that it is not good to eat fern at that period but the main reason is the growth of fern in this period is slow. In the rainy season, ferns grow abundantly and they are eaten from the month of April (from Bahag Bihu) to July.

Conservation of forest is the main priority of the Forest Department along with conservation of different NTFPs. So, steps should be taken so that natural regeneration of trees in forest is not hampered and forest floor is not damaged while collection of ferns. Awareness is very important in this regard so that the forest dwellers get benefited by NTFPs and the forest is also protected at the same time.

The primary player or the collector of fern and other wild edible vegetable are women folk of different communities. So, awareness and education of women can be very helpful from the conservation point of view.

Although it grows naturally in forests, over-exploitation due to its demand may lead to extinction in near future. It is also observed that due to increasing temperature and erratic rainfall, certain varieties of edible ferns are disappearing fast. Multi-tier wild edible garden can be an effective measure for conservation and sustainable management of wild edible vegetable, including ferns, throughout the year for income generation and food security of the tribal or the forest dwelling community. It will also be effective for the conservation of forest as well. At the same time, involvement of community is a must for profit making. In this regard, JFMCs and SHGs can play a big role.

Conclusion

Fern as NTFP is providing benefits to the tribal and forest dwelling communities in Assam. To make it sustainable, the Forest Department should come forward for conservation of ferns as well as the forest by involving locals in the process. Traditional method of conservation of ferns in Assam is still very effective. Awareness about relationship of tribals with forest and the benefit they get from forest can play a great role in conservation. If organised properly, from collection to the selling of ferns, more benefits can be obtained without causing any damage to the forests.

UTTARA KANNADA / KARNATAKA

Harvesting of *Uppage* fruit in Kelaginkeri

The increased involvement of the local populace has helped improve the sustainability of species population

Leishangthem Jeeceelee

Garcinia gummi-gutta (L.), Robson (family Guttiferae), which is commonly called *Uppage* in Kannada, is a medium sized understory evergreen tree and is one of the most important high value NTFPs in the Western Ghats. Traditionally, the fruit of the species is mainly harvested for its seed which is reported to contain 30 per cent fat and used to prepare clarified butter (a substitute of *Ghee*) and also for its dried fruit rind used as condiment and culinary additive. The acidic properties of the *Uppage* rind allow its usage in preparation of vinegar; replacing the use of acetic and formic acid in the coagulation of rubber latex and for polishing gold and silver. Its rind decoction is also useful in curing rheumatic and bowel complaints, and also for mouth diseases of cattle.

Kelaginkeri village of Uttara Kannada district (Karnataka) is located in the Western Ghats, one of the hottest biodiversity hot spots at an altitude of 620 m. The district has a proportion of 79 per cent forest cover. The area receives an average annual rainfall of about 360 cm restricted mainly during June to October and supports the tropical wet forest type.

The main occupation of the villagers includes paddy cultivation and *Areca* plantation, besides specialising in the collection and trade of a few high-value NTFPs from the surrounding forest. The households of the village earn about 14 per cent of their total income from the collection of NTFPs of which about 80 per cent is from the collection of *Uppage* only.

The forest in the case study area can be grouped into three types based on different usufruct rights *viz.*, Reserve Forest, *Soppinabetta* and Minor Forest. However, all forest is state owned. The proportion of each category of forest in the range in which the Kelagineri village is located is 56 per cent Reserve Forest, 23 per cent *Soppinabetta* and 21 per cent Minor Forest.

Soppinabetta are leased forest patches which are allocated to collect green mulch for use in *Areca* plantation, besides extraction of other forest produce like fuelwood, fodder and NTFPs. Even though the farmers have full control over extraction of NTFPs,

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they can sell the harvested produce only to contractors appointed by the State Forest Department.

Uppage is harvested in both Reserve Forest and *Soppinabetta*. The advantage of *Soppinabetta* over the open access reserve forest in terms of NTFP harvest is the secure tenurial system. In Reserve Forests, the right to extraction and trade in NTFPs is auctioned by the State Forest Department, resulted in rendering the reserve forest an open access situation for NTFP collection. This open access situation leads to unsustainable harvesting of NTFPs, thereby affecting the regeneration and conservation of high-value NTFPs. Owing to a short lease period (usually 2 years) and open access in Reserve Forest, private contractors compete to harvest the maximum before the season without waiting for the fruit to ripen. They resort to cutting the lateral branches of the tree to facilitate the harvest of both ripe and unripe fruits, thereby threatening the resources. There are high incidences of damage to the trees during fruit harvesting. However, the early harvest fetches lesser price as the rinds obtained from unripe fruits weigh less than the ripe ones, besides being of low grade quality due to under-development of the fruit.

In *Soppinabetta,* where there is secure right, the harvest practice is different. For collecting the *Uppage* fruit, the owners of *Soppinabetta* wait for the fruit to ripen and collect the fruit fallen on ground after ripening or the rinds discarded by primates after consuming the pulp inside. This fashion of harvesting offers various advantages like:

- Lesser effort is required for harvesting.
- Prevents dangerous harvesting practices of climbing and cutting the trees.
- Ripe fruit are easy to de-seed, thereby reducing processing time.
- Ripe fruit, besides providing higher quality rind, fetch higher economic returns.

However, it necessitates frequent visits to the same tree for collecting ripe and fallen fruits.

The practice of delayed harvest and collection of fallen rinds of the *Uppage* fruit in *Soppinabetta* also helps in maintaining the population structure of the species. There is satisfactory regeneration of seedlings in *Soppinabetta* when compared to the Reserve Forest. The secured tenurial system is credited for the sustainable harvest of NTFPs, thereby stabilising the population of a species. The reduced regeneration status of *Uppage* in Reserve Forest may be attributed to early and direct collection of fruits from the trees due to competition among the contractors and insecure right to access, resulted in decrease in dispersal of seeds.

There is also a concern over the high amount of fuelwood used to dry the rind of the *Uppage* fruit. The fuelwood is extracted from the forest and it is estimated that for obtaining 1 kg of dried rind, 25kg of fuelwood is used. There are instances of developing fuel-efficient dryers to reduce pressure of fuelwood dependence on the forests. In some divisions under the Karnataka Forest Department, plantation programme of *Uppage* has been initiated as

an effort of afforestation.

The increased involvement of the local populace in controlling the forest resources and securing tenure of accessibility will improve the sustainability of species population through sustainable harvest and also reduction of damage during harvest of NTFPs. The sustainability in harvest of forest produce also depends on social dynamics of the fringe villagers, accessibility to forest and market demand for the products. Regular ecological monitoring of the status of species and transparency in the trade of the products will contribute to sustainable harvesting of NTFPs.

KAZIRANGA / ASSAM

Management of *Imperata cylindrica* grasslands

In present day context, grasslands management is an integral component of management of protected areas

Biswa Jyoti Das

Kaziranga National Park, in the Golaghat and Nagaon districts of Assam, hosts two-thirds of the world's great one-horned rhinoceros. According to the census held in March 2015, jointly conducted by the Forest Department of the Government of Assam and some recognised wildlife NGOs, the rhino population in Kaziranga National Park is 2,401. It comprises of 1,651 adult rhinos (663 male, 802 are females, 186 unsexed); 294 sub-adults (90 males, 114 females, 90 unsexed); 251 juveniles and 205 cubs. Kaziranga also has the highest density of tigers among protected areas in the world, and was declared a Tiger Reserve in 2006. The park is home to large breeding populations of elephants, wild water buffalo, and swamp deer. Kaziranga is recognized as an Important Bird Area by Bird Life International for conservation of avifaunal species and is a World Heritage Site. When compared with other protected areas in India, Kaziranga has achieved notable success in wildlife conservation. Located on the edge of the Eastern Himalaya biodiversity hotspot, the park combines high species diversity and visibility.

Kaziranga is a vast expanse of tall elephant grass, marshland, and dense tropical moist broadleaf forests, crisscrossed by four major rivers, including the Brahmaputra, and includes numerous small bodies of water.

The term grassland is applied to a landscape dominated by grasses. Champion (1936) doubted the existence in India of any example of climax grassland, yet grasslands are very common in India and may be a very stable preclimax under the influence of fire and grazing. An important aspect of habitat management in Kaziranga is to maintain the seral stage of grassland by preventing invasion of tree forest. This is achieved primarily through annual burning of grasslands so as to discourage the growth of tree sapling. The operation also helps in enhancing the nutritional value of coarse grasses by facilitating growth of new shoots, which attracts herbivores.

The park area comprises of a

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considerably large area of healthy tropical alluvial grassland, which can also be referred as *Imperata* Grassland, as *Imperata cylindrical* is the major and dominant species with *Phragmites karka* and *Saccharum spontaneum* as the associated species. The tree cover is as a result of secondary succession.

This important grassland supports a wide range of biodiversity and is a subsistence resource for the local community in the form of cane and thatch for house building. It appears from the grassland utilisation that *Imperata cylindrica* is an economically important species which has a good market demand and, therefore, value.

Grassland management is one of the prime objectives at the park especially when it supports a large concentration of various species of herbivores. The fact that the grasslands at Kaziranga are at seral stage makes it even more essential to have management interventions so that the process of natural succession is arrested at that stage. One such important management tool as mentioned earlier is prescribed burning. The burning is mainly done to arrest the successional stage from grassland to tree forests, which is known to have increased as per vegetation mapping by Survey of India. The burnt grassland areas with new shoots provide sufficient food for grazing herbivores, which mainly depend on short grasses in open areas and near water bodies. The short grass areas reduce extensively just before burning and many incidents of rhinos and other animals straying are reported which come to a halt after new shoots appear in the tall grassland areas. The burning also enhances visibility and facilities anti-poaching surveillance. The following strategies are followed for prescribed burning in the grasslands.

- Range wise burning schedule for different blocks is prepared to provide sufficient areas for movement, shelter and food for various animals. The possibility for converting the existing blocks into uniform grids (1km x 1 km) is explored and executed where ever possible for effective management of burning.
- The shoots of *Imperata cylindrical* resprout generally in three to seven days after burning. The mean shoot height is 0.9-1.7 m during full growth period.
- The habitat management pattern is not always strategic. It appears that management does not involve cutting except for utilisation by local people which is especially patchy.
- Management only involves controlled burning irrespective of cut or non-cut areas and hence all areas are not burned after cutting.
- The growth of *Imperata cylindrica* is significantly dominant in disturbed and managed areas. On the contrary, in unmanaged and undisturbed areas, growth pattern of this species is slower and the assemblage pattern is dominated by other grass species along with the forbs.
- *Imperata cylindrica* rapidly colonises only the disturbed area. It has high root ratio of rhizome and shoot which provides a source of dry matter for regeneration after cutting and burning.

- *Imperata cylindrica* is shade-intolerant; shading reduces both shoot and rhizome biomass. It is, therefore, possible that a build-up of litter and increased shading on the unmanaged area might result in a decline in the abundance of this grass species and an increase in the abundance of shade tolerant grasses.
- *Imperata cylindrica* dominated grasslands are often described as a fire climax community and are considered to dominate following fire, cutting and grazing, being the first stage of degradation of *Phragmites – Saccharum – Erianthus* community.
- Burning thatch grass areas known to be prime habitat for breeding of the Bengal Florican is completed before January 15 every year. Grassland improvement techniques such as planting with *Imperata cylindrica* in case of loss of natural habitat is being done in the recent years. Any area remained unburnt will be taken up for burning only in the next year.
- Clearance and maintenance of fire lines along the forested areas to be done annually.

Despite being a source of fodder for herbivores, especially the one-horned rhino, thatch grass can also be used as building material in the rural areas. Sustainable harvesting of this grass prior to control burning may be a source of livelihood generation for the forest dwellers. This grassland is a typical habitat for the pigmy hog. In present day context, grasslands management is an integral component of management of protected areas. Thus, the ecologically sensitive grasslands need to be mapped and appropriate amelioration models/ protocols developed, given priority and implemented.

GUMLA / JHARKHAND

Inclusive lac livelihood model

Empowering tribal women from socially excluded communities has not only given them additional income but has helped in the conservation of biodiversity

Mahamuda Begum

Lac is a resinous secretion from the lac insect (*Lacciferlacca*). The lac insect feeds on host trees like *Kusum, Palash* and *Ber* that are found in abundance in the forests of central India. The secretion of the lac insect is biodegradable, non-toxic, odourless and tasteless**.** It is a valuable natural product, used widely in the food, furniture, cosmetics and pharmaceutical industries with a huge international market potential. India is the largest producer of lac in the world and contributes to about 70 per cent of the world's need. However, there is currently a gap of 21 per cent between demand and supply. Within India, the state of Jharkhand has the largest number of host trees. However, in Gumla district of Jharkhand, not even 20 per cent of lac host trees are in use. Many of these trees are on land owned by tribal groups. With annual incomes for lac producers being over Rs 29,000, there is a huge opportunity for tribal groups to benefit from this livelihood.

Gumla is primarily a rural district in the southwest portion of Jharkhand with 95 per cent of the total population living in remote hilly, rural terrains. Scheduled tribes and castes constitute 75 per cent of the total population, of which scheduled tribes hailing from 32 different indigenous tribes account for 70 per cent and the scheduled castes account for the remaining 5 per cent. Both the scheduled tribes and castes practise subsistence agriculture for a brief part of the year and seek daily wage labour in the remaining months.

Livelihood opportunity

Lac farming is easy and very profitable. Lac has the potential to serve as a sustainable source of employment and subsistence for farmers, besides playing a vital role in environmental conservation. Women's role in lac has traditionally been restricted to post-harvest work like preparing bundles and taking them to local markets. Despite contributing to over 50 per cent of the labour, women's work has always been undervalued as they are only peripherally involved when it comes to final quality of produce. Gumla is the third leading district in Jharkhand in terms of the number of trees and production potential. This presents a unique opportunity to revive lac as a livelihood means for socially excluded communities and

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women producers. This can be done by establishing a wholly integrated inclusive value chain in an area where cultivation stopped more 10 years ago due factors such as climate change, un-sustainable production practices, lack of scientific knowledge and access to profitable markets.

Women lac farmers faced some initial challenges like exclusion from social activities; they were introvert in nature and hesitated to come out in the open and speak for themselves. They were also hindered by lack of exposure, lack of scientific knowledge, low awareness on how to operate in and negotiate markets as well as the absence of organising structures.

Implementation model

The project in Gumla works based on a partnership between PACS *(Poorest Areas Civil Society)* and Udyogini, a social organisation with over two decades of experience in providing business development services to poor women in backward and remote regions of India along with experts from the Indian Institute of Natural Resins and Gums (IINRG). IINRG is a nodal institute at the national level for research and development on all aspects of lac and other natural gums and resins and brings their expertise to train women producers in better cultivation practices. Udyogini facilitates the development of agriculture, non-timber forest produce, artisan and service retail micro-enterprises where women are not only producers but also managers and entrepreneurs involved in a variety of value-added tasks. The project focuses on working with 8,000 tribal women, helping them to earn a

sustainable income from lac farming. To revive lac in the region and to ensure participation of women, a five-step model has been implemented that encompasses the entire value chain– from skill development for women to helping them assume strategic positions through service provision and entrepreneurship.

Creating skilled women producers

Introducing scientific lac cultivation: One of the foremost innovations in the lac programme has been the Package of Scientific Cultivation of Lac (PSCL) developed with the help of scientists from the IINRG to overcome uncertainties due to climate conditions and ensure uniformity of cultivation through Standard Operating Procedures (SOPs)

Accessible tools for women: Earlier the women could not participate in pruning due to a heavy, blunt axe. They have now been provided with secateurs or medium-sized scissors that they can handle deftly.

***Flemingia semialata*, the women-friendly tree:** Climbing trees that were more than 10-15 feet in height to inoculate and harvest lac has been a huge hurdle for women. They were forced to depend on men to harvest their produce. In Gumla, *Flemingia semialata*, a short bush (native to Assam) is being used for cultivation. It grows only to 6 feet in height, matures much faster and gives significantly more returns than Palash or Ber.

Creating an ecosystem for proliferation and scale

Ensuring a regular supply of brood through Brood Farms: While the PSCL helps increase the productivity of the lac crop itself, host trees take 3-5 years to be available for cultivation, necessitating the bringing in of brood farms to ensure long term sustainability. In Gumla, the PACS project has identified 40-50 trees of good quality close to each other and encouraged the households owning this land to develop 'brood farms.'

Business Development Service Provider (BDSP): Quality production requires constant followup and a trusted member of the local community who can promote the model, facilitate reliable supply and develop crucial linkages with the ecosystem. Business Development Service Providers (BDSPs) from the community are the key to proliferation of the model and scaling it across the region.

Development of fair markets: The lac market is fraught with price unevenness and a complete lack of platforms where women can negotiate their produce or make value-added products. To ensure fair returns, women are being taught in Gumla, through regular awareness sessions and *baithaks*, to refrain from distress sales, to keep back produce for subsequent seasons and to go only through trusted sellers. To enable business activity around lac, selected women have been trained in a standardised entrepreneurship curriculum and taught how to set up small service stores called Village Level

Service Centres (VLSCs). VLSCs are 'village level' market and livelihood hubs which serve as a one-stop local aggregation, value addition centre and fair-price shop for NTFPs and agri-products.

Women take the lead

Women have now become aware about the importance of lac and its significance. They now know the different strains of lac that can be produced year-round using different tree types, pruning techniques and application of pesticides. They have realised that lac cultivation doesn't need much time and labour and now find the process to be very easy.

Lac cultivation is revival of a traditional livelihood activity that women had been involved with since they were children. Lac farming has established a strategic role for women in the lac industry. **Earlier women used to do traditional lac farming just once in a year, now they do it twice with modern methods. Spraying of pesticides, pruning of branches and other new techniques have also been adopted. Traditionally they used to only do lac cultivation on *Ber* trees but now they are using the *Kusumi* variety of lac, which can be cultivated on *ber, kusum* and *semialata* trees.** As a result, the amount of lac produced has increased five-fold and the profit has increased 3-4 times. Women now play a strategic role across the lac value chain–as skilled agents of lac proliferation, BDPS and active managers of brood farms.

This is the first time that the lac income is controlled by women leading to better choices at home, for children and the community. Women can potentially invest their incomes for further growth by setting up small village shops, taking up work in the local crèche by undergoing training in skill building. Women have become independent, have gained confidence and are now inspired. The income they are earn from lac farming has given them independence and confidence. As women, they were never given the opportunity to take decisions on their own. Now however, the **men listen to their wives and take their opinions on family issues. With the extra income through lac cultivation, they can now educate their children and manage their families better.** This independence and confidence has also inspired other women in nearby villages. And with over 80 per cent of lac host trees not being utilised for production in Gumla, there's no shortage of opportunities for other tribal women to get involved. The communities are also involved in conservation, the host trees are conserved by the community that sees value in them as opposed to cutting them down for fuel, firewood or mining, leading to conservation of biodiversity in some of the most densely forested areas in India.

JAGDALPUR / CHHATTISGARH

Sustainable management of *Agave americana* by tribal co-operative society

This is one of the best examples of a successful cooperative model of sustainable NTFP management, providing sustainable livelihood support to the poor

Preeti Buragohain

Forests play an important role in socio-economy, culture and livelihoods of millions of forest-dependent rural people by providing subsistence income, employment, energy, nutritious foods, fodder, housing materials, medicines and a wide range of goods and ecosystem services. India has a huge population living in the villages close to forests with their livelihoods critically linked to the forest ecosystem. NTFPs collection, processing and sale is a major livelihood intervention for the people living in these forest fringe villages and income for households living in and around the forests constitutes 40 to 60 per cent of their total income.

In view of the recent global environmental issues, exploitation of the full potential of natural fibres is highly recommended. There are numerous sources of natural fibres obtainable from the plant kingdom – jute, banana, coir, etc. – which are abundantly available in many parts of the world. However, from the plant kingdom, one of the abundant sources of strong natural fibre is *Agave americana*. It is a NTFP that grows over extensive areas in Central India. The leaves yield a fibre used for rope making. The fibres are also called 'Pita Fibres' and are cellulosic in nature.

The article is about a successful project which started on April 1990 in Jagdalpur district of Chhattisgarh, aimed at providing sustainable livelihood support to the fringe forest area villagers through formation of a co-operative society which helps in the establishment of a primary processing centre for the processing of *Sisal* leaves.

The Co-operative society

The co-operative society was established on the initiative taken by local forest officers in 1990. The criteria of selection was that all the members would be chosen from among tribals and those living below the poverty line residing in the periphery of *sisal* plantations and should not be land owners or with means of sustained income. The co-operative society was registered under the Madhya Pradesh Co-operative Societies Act vide Registration No. AR/BTR/162, dated April 23, 1990.

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Initially, it had 38 members belonging to the Muriya, Mahara, and the Dhakad communities of Bharni, Kolchur, Takragud and Joldaguda villages. The by-laws of the society provided that the President and the Secretary of the society would be elected from amongst the members and a facilitator or advisor would be a local forest guard/ forester. This society then established the primary processing centre for the processing of *sisal* leaves. The total cost of the project was Rs 2.50 lakh and funds were drawn from the District Rural Development Agency (DRDA). Four electric decorticating machines, a shed and water tank were established.

Process adopted

The leaves are ready for harvesting from the third year onwards and the older leaves with length not less than a metre are harvested. Each plant yields 40-50 leaves/year. The life cycle of the plant is up to 8-30 years. The content of fibre varies from 2.5-4.5 per cent. The actual processing method adopted by the members was that each beneficiary went to the plantations in the morning to cut mature leaves for fibre extraction. All the lower leaves, standing at an angle of more than 45 degrees to the vertical are cut away from the plant by a sharp-cutting tool. They are then tied into bundles and transported to the processing unit site at Kolchur. Later, the leaves are decorticated in the electric decortication machine, wherein the leaves are crushed and beaten by a rotating wheel set with blunt knives, so that only fibres remain. Then the leaves are cured in the water for about four hours followed by cleaning, which is done by beating to free it from any powder clinging to it during decortication. The cleaned fibre is then hung for drying. Proper drying is important as the moisture content in fibre affects fibre quality. Artificial drying results in higher grade fibres than drying in the sun. The fibres are dried under a shade to avoid bleaching by direct sunlight. Dry fibres are then combed, sorted into different grades and packed into bales. The final product is weighed and tied in bundles of 50 kgs. The beneficiary is paid on the basis of the quantity in kgs of the fibre produced.

Each beneficiary cuts mature leaves from the plantations, cures and takes out the fibre and makes nearly 5 kgs of fibre each day. They are paid through society funds. The decorticated finished fibre was bought at a fixed rate to be decided by the committee. The society bears the cost of electricity and any repairs to the machines and sells the produce to the buyers or end users. The annual production of *Sisal* fibre from this unit was nearly 15-18 tonnes. The net income after wage payment and meeting expenses like repairs and electricity is redistributed annually to the beneficiaries as a bonus.

The average fibre production from 100 kgs of green leaf after decortication was around 4-4.5 kg. On an average, each active beneficiary produced around 125 kg of fibre per month. The processing unit was closed during the three monsoon months of July, August and September when annual repairs to the machinery was done and the society

members got employment elsewhere – in farmers' fields, plantation activity, etc. Thus, on an average, beneficiaries got employment in this processing unit for a period of nine months and earned a good income. It was noticed that not all members of the society were equally active in the working of the committee. Every year the number of active members varied. The number was around 9 in the initial years but has now swelled to 16 in response to the gradual stabilisation of the working of the society and its growing income.

The society also made forays into value addition to the fibre produced. It started to make rope from the fibre that has its demand in the Electricity Board where it is used by linesmen. The rope was sold at Rs 30 per kg whereas the fibre was sold at Rs 20 per kg. The making of rope costs Rs 4 per kg and there is wastage of 10 per cent during processing. That leads to a net value addition of Rs 4 per kg. Another innovation was manufacture of handicraft items from the fibre that has very good demand. The society was efficiently managed by the members with the Forest Department playing a facilitatory role. They have been successful in regularly marketing their produce and also limit their expenses. This has resulted in regular profit to the society each year. The society regularly pays all its electric and machine repair bills and has earned the rare distinction of being a co-operative society that has got its accounts regularly audited and submitted to the co-operative department.

Sustainable Management

Since the fibre percentage is higher in older leaves, the younger leaves are not harvested, resulting in sustainable harvesting. Also, the members replant the areas with suckers and bulbils after harvesting, so that perennial supply of leaves is ensured. In certain areas, there is need for improvement of harvesting techniques as the local population tends to pluck immature leaves which yields less fibre content, resulting in loss. Improved harvesting techniques should be adopted so that the collection area could be subjected to cutting over a periodic cycle, like coupes (standard yearly working areas) working in forestry working plans.

Conclusion

The community-based sustainable management of NTFP *Agave americana* is one of the best examples of a successful cooperative model of sustainable NTFP management, providing sustainable livelihood support to the poor. The co-operative society established at Kolchur had managed not only to survive but grow and make the members stand on their own feet and ensured sustainable employment to its members. This had been made possible by constant facilitatory approach of the Forest Department that had resulted in development of skills in the local communities and had developed confidence amongst them to not only manage a small processing unit, but also bring in further value addition to the primary product for their own economic development.

ASSAM

Muga silk: A successful NTFP

The Muga silk industry has not only strengthened the traditional association between culture and economy in Assam,but also offers a way to reclaim land classified as wastelands

Ritu Paban Borah

Muga Silk", the rare golden silk interweaves the culture and economy of Assam. According to the Central Silk Board, the state contributes to 95 per cent of the country's Muga silk. The remaining 5 per cent is from the north-eastern States adjoining Assam and West Bengal. It is the second costliest fibre in the world after Pashmina due to its uniqueness. It has natural shine and lasting golden colour, the fabric is strain free, durable, lustrous and can absorb ultraviolet radiation up to 85 per cent. Moreover, it has highest tensile strength amongst all other natural fabrics; it is resistant to acid and is thermostatic in nature. Apart from its use as a glamorous fabric, there are other uses as well. It is used in making parachute rope, aircraft tyres and the unused part of cocoon finds use as a layer in bullet proof jackets.

Muga silk is produced from the cocoon of aLepidoptera, *Anthereaassamensi*. The caterpillar feeds primarily on the leaves of Somtree (*Perseabombycina*). The other trees are Soalu (*Litseamonopetala*), Dighlati (*L. salicifolia*) and Mejenkari*(L. citrate*). The rearing of the silk worm takes place outside. The trees are infested with the larva where they feed where on the tree leaves and moult. Adequate protection is given from natural predators like wasps, crows, monkeys and bats and diseases like Pebrine, Grasserie, Flacherie and Muscardine. When the time for pupation approaches, the larvae stop feeding, change their colour to yellow and crawl down the trunk of the tree. They are collected from there, taken inside and provided with substratum for pupation. Some of the cocoons are kept aside for raising eggs, rest of the larvae which are good are used for generation of silk. The cocoons are stifled, processed and reeled. The reeled threads are woven by experts with their magical touch.

The silk worm is polyvoltine in nature having six broods in a year with four moults. The trees which the Muga larvae feed on thrive well in slightly acidic alluvial, sandy loamy, clay and lateritic red loam soil. These trees grow almost throughout entire Assam.

Muga silk makes a significant contribution to the rural economy. "Sualkuchi", a village historically renowned for silk weaving is well

ACF Trainee

known throughout the world. The Muga silk industry has flourished on its own due to its cultural demand for silk. There are now various Government Schemes for the promotion of Muga silk. The Central MugaEri Research and Training Institute, at Lahdoigarh, Jorhat,has been assisting with research in augmentation of Muga cultivation. The Central Silk Board, under the Ministry of Textiles, Government of India, looks after the trade and provides financial assistance.

Rearing of Muga silkworm is by and large is done in farms where suitable host trees are grown. Since plantation forests are considered as open forests by Forest Survey of India, Muga from such farms can be considered as private Non Timber Forest Products (NTFP). Rearing in conventional forests although rare can be used for livelihood generation, providing economic boost and for forest conservation.

According to Department of Land Resources, nearly 18 per cent of geographic area in Assam is classified as wasteland. Where ever possible and feasible, the wasteland can be reclaimed and afforested. Plantation of host plants may be beneficial as it will serve the interest of the stakeholders -the Forest Department and the local people. Thus Muga silk offers the possibility of Joint Forest Management.

There are many schemes through which funds may be availed for implementation of projects pertaining to sericulture. The North East Textile Promotion Scheme (NERTPS) of Government of India is developing and modernizing the textile sector in the North East Region by providing the required Government support in terms of raw material, seed banks, machinery, common facility centres, skill development and design and marketing support.

Under NERTPS, various sericulture projects have been approved under two broad categories viz., ISDP (Integrated Sericulture Development Project) and IBSDP (Intensive Biovoltine Sericulture Development Project).In the past few years under NERTPS, the Government of India has approved 14 sericulture projects with a total outlay of Rs 521.94 crore (GoI share Rs 421.45 crore) for implementation in north-east states viz., Assam, Bodoland Territorial Council (BTC), Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura, including a Silk Printing and Processing unit for Tripura for a period of 3 years from 2014-15 to 2016-17. Other than the above initiatives, eight new projects on Intensive Bivoltine Sericulture Development for all north-east States (except Manipur) at a total cost of Rs 236.78 crore (GoI share Rs 210.41 crore) have also been taken up for production of bivoltine silk of international quality. Under this project, 500 acres of land will be brought under under mulberry plantations in two blocks at each cluster involving nearly 1,100 women beneficiaries per State including weavers. In the long run, it aims to bring 4,000 acres of land under mulberry plantations and will reach out to 9,000 women beneficiaries across the eight north-eastern States. Social mobilization and creation of women's groups along with interventions

for plantation development and infrastructure creation are an integral part of the project. These projects are currently under implementation in the respective States.

One of the challenges facing the silk industry, including Muga silk, is the dumping of low quality or fake silk in Indian markets. In order to protect the consumers, the Ministry of Textiles, Government of India, initiated the concept of 'Silk Mark' which is being implemented by 'Silk Mark Organisation of India' (SMOI). SMOI promoted by 'Central Silk Board, Government of India', not only protects the interests of the consumers of pure silk, but also helps protect the interest of the millions of stakeholders involved in the production of pure silk, such as sericulture farmers, reelers, rearers, twisters, weavers and a host of other skilled and semi-skilled workers and artisans. SMOI is being managed by a team of textile technologists spread across the country who are engaged in servicing the 'Authorised Users' of Silk Mark. The authorized users are enrolled after a thorough background check. Silk Mark also verifies the credentials of the suppliers of the pure silk products from India for the benefit of buyers from foreign countries. Therefore, one can be reasonably sure of a hassle free purchase when buying the products with 'Silk Mark'.

The Forest Department with the help of non government organisations can expand more area under Muga cultivation and safeguard the interest of cultivators and traders. With the support of already established gateways like the Silk Mark Organisation of India, the prospect of Muga silk is golden as ever.

MEGHALAYA

Domestication of Wild Pepper

The initiative has improved the socio-economic wellbeing of the War Khasi tribe and has played an important role in the conservation of this species

Saumitro Das

Non Timber Forest Products (NTFP) now play an important role in rural poverty alleviation and forest conservation programmes. The rural poor depend on a wide variety of plants, animals and fungi for their own direct use and for sale. Some of these products have important commercial markets and generate substantial revenues. It is estimated that in India about 50 million forest dwellers rely upon NTFPs for their subsistence and cash income. Most of the agricultural produce in tribal households is used for subsistence consumption; the cash from the sale of NTFPs can play an important role by allowing the households to use the same for vital cash-dependent transactions, namely for buying tools and assessing health and education facilities. NTFPs are vital and much needed for enhancement of rural livelihood *vis a vis* biodiversity conservation.

Globally the harvesting of non-timber forest products from natural forests is a customary subsistence activity of communities inhabiting forests. However, several researchers have claimed that promoting NTFP harvesting does not necessarily lead to forest conservation, because the extraction of NTFPs can cause significant ecological impacts. In that sense, domestication of important NTFPs is suggested as a measure to mitigate negative impacts.

Piper peepuloides (Roxb.), also known as wild pepper, is an evergreen climber belongs to the family Piperaceae. Its distribution is very sparse and it is found exclusively in bio-diverse rich zone of Eastern Himalaya – forests of Goalpara, North Cachar Hills, and on southern slope of Meghalaya including part of Jaintia Hills, Khasi Hills, and West Khasi Hills districts. In Meghalaya, it grows at an elevation of 100-800 m mean sea level. It is a highly valued NTFP among the War Khasi Tribe and has high demand in local markets. Wild pepper is not a dominant species in its natural habitat and thus is restricted in its distribution. Thus, harvesting it from the wild can never be sustainable. Due to its high demand in local market, the Khasi tribe adopts another method to deal this problem. They started domestication of this valuable NTFP. They started to cultivate them in arecanut and betel leaf agroforests. It has been found

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that mean density of wild pepper in natural forest is 85 stems/ha, while in the arecanut agroforest, it is 585 stem/ha. This implies that domestication of wild pepper in arecanut agroforest ensures greater densities and greater production. From the conservation point of view, domestication limits human interference on wild population, thus minimising disturbance of biodiversity. According to some researchers, NTFP extraction in natural populations even at moderate levels may change floristic composition and erode species diversity and affect population structure. The reason leading to its domestication in Meghalaya is attributed mainly to high market demand, less production in natural forests, and high profit from cultivation.

The wild pepper is planted under the betel nut trees during the monsoon season (July and August). The soil is dug without removing the shrubs and herbs growing in the vicinity of the trees to prevent wilting of the young stem especially during dry spells. After one month of planting, the cultivators do cleaning and lopping of tree branches to help the plant get enough sunlight. When the plants become old (>3 years), it does not require much weeding and tree lopping. Wild pepper starts producing fruits from the first year of cultivation itself, and the production increases from second year onward. No artificial fertiliser is needed for the cultivation of wild pepper. The plants obtain their nutrients from decomposing litter and weeds which people dump at the base of this wild pepper during weeding and tree lopping.

The harvesting of wild pepper is done during the months of March-December. During harvesting, all the household members including children are involved. After plucking, the fruits are sun dried for four to five days till they turn light black in colour. Precautions should be taken to prevent the fruit from over drying as it will lose its desired black colour. Also care should be taken to maintain optimum humidity while drying as wetness attracts fungus which deteriorates its fruit quality. After drying, the cultivators sort out and discard the fungal infested fruits. Wild pepper has been notified as a forest product, and therefore it attracts royalty and taxes. The traders have to pay royalty to the District Council. The prevalent rate of royalty is Rs 100 per quintal). It has been also reported that alleged illegal collections from the transporters also do occur at various check points.

The growers usually sell the produce to the local trader at the local market. A small number of growers sell it directly to the dealers in Shillong, which is the largest regional market in the state. The local traders then sell these products to the regional traders also known as dealers. From Shillong, it is transported to other metropolises, Kolkata, Bangalore, Hyderabad, and Chennai via regional traders (wholesalers) based in Guwahati. The dealers sell a small quantity of produce to the retailers in Shillong.

Usually the regional traders (the business men who supply the goods outside the state) have a monopoly over the market and they often determine

the price at which growers' sell their produce. The growers generally do not have any say in deciding the price. Market demand and price depend upon the quality of fruit and availability of goods. A well-dried and uninfected product fetches best price.

The value chain of wild pepper has developed due to its high demand and economically viable cropping pattern. The farmers are getting good returns because of low investment and quick and good returns as the produce from the plant may be harvested after one year of plantation. Also, the trade benefit goes to all sections of the society as the landowners benefit from the cultivation, the landless benefit by working as daily wage labour, and the traders and the transporters earn their livelihood by marketing the produce.

It can be concluded that the domestication of wild pepper is essential in terms of economic enhancement and from a conservation point of view. The expenditure incurred on the management of wild pepper in agroforest is minimal. It also highlights that domestication of non-timber forest products such as wild pepper could become an effective instrument for rural development and less impact on natural habitat, because its cultivation needs minimum input and labour and generates very attractive economic return.

Acknowledgement

I am grateful to Prof. B.K. Tiwari, Department of Environmental Studies, NEHU, Shillong, for providing me valuable information about important NTFPs of Meghalaya. I am also thankful to Dr. Hero Tynsong and Mary Marbakor, NEHU, Shillong, for their kind suggestions regarding this article.

ANDHRA PRADESH

Sustainable management of Gum Karaya

The scientific method of tapping not only ensures survival of the trees but also a substantial increase in the yield

S.L. Niangthianhoi

Gum karaya is a dry exudate tapped from *Sterculiaurens, S. villosa* and *Cochlospermum gossypium* in India. The bulk of gum karaya used locally and also exported is tapped from *S. urens*. *Sterculiaurens* (also called India tragacanth, Gum Karaya, Tabsi gum), a medium-sized deciduous tree native to India. It forms an important Non Timber Forest Product (NTFP) which is vital for tribal economy and has a substantial trade value. The major gum karaya producing states in India are Chhattisgarh, Andhra Pradesh, Maharashtra, Madhya Pradesh, Jharkhand and Gujarat. In 2013-14, about 258 tonnes were produced in India. About 35.7 per cent of the production was from Andhra Pradesh alone. In the same year, minimum support price for collection was set at Rs 120 per kg by the Pricing Cell at the Tribal Cooperative Marketing Development Federation of India Limited (TRIFED), Ministry of Tribal Affairs, Government of India.

Gum karaya has many local as well as industrial applications which makes it very valuable. The gum is traditionally used by various tribes as a treatment for oligospermia and diabetes. The stem bark ground with turmeric is administered for rheumatic pains and ulcers. It is also used in pharmaceutical, food, paper, textile and cosmetic industries. The superior grades are used in food industries asa binder, emulsifier and stabilizer and in ice-creams. Some of the applications include inks, rubber, linoleum, oil cloth, paper coating, polishes, lower grade in varnishes, engraving processes and in oil drilling operations. It also acts as mucilage so it is used in bulk laxatives.

It also has high demand for export to developed countries mainly France, Japan, United Arab Emirates and the United States. This is the main driving force behind the disappearance of this species from many forest areas caused by the crude and unscientific method of gum extraction where excessive injury leads to the death of the trees. *S. Urens* trees become capable of producing gum when they attain a girth size of more than 41cm which probably means that harvesting of karaya gum is done even on young trees, which will compromise

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seed production and thus natural regeneration in the natural forest. An average tree can be tapped about five times during its lifetime, with a total yield of up to 5 kg per season. It can be collected throughout the year (except during the rainy season) but best season to collect quality material is from January to June.

In Andhra Pradesh, these trees are found in Adilabad, Khammam, Warangal, Karimnagar, Mahabubnagar, Kurnool, Vishakhapatnam, East/West Godavari and Chittoor districts. Areas rich in forests are dominated by tribal populations, which constitute 6.3 per cent of the total population of the state. *S. urens*is is listed as 'vulnerable' in the medicinal plant species of conservation concerns identified for Andhra Pradesh. This necessitates that each extraction should be of highest yield, and good grade, and that sustainable harvesting methods be adopted wherever it is collected. The post-harvest purifying and cleaning technologies also need to be very efficient. Another option is to plant *S. urens* as an NTFP tree in forest fringes and initiate Aided Natural Regeneration (ANR) or Artificial Regeneration (AR) in areas where the regeneration status is poor or nil. In the scientific methods of harvesting, the blazing should be confined to main stem above 90 cm from the ground level with a girth of at least 90 cm.

Some of the important sustainable management strategies adopted in Andhra Pradesh include value addition of gum karaya in the form of powder, granules, cream and gel. Training programmes were organised for tribals in improved tapping processes. With the increase in quality of the gum, there was substantial increase in prices of the gums as reported by UNOPS Supervision Reports (1996-2002). Many plantation drives were also done by the collectors with the help of many government agencies like Tribal Development Department and NGOs like the Kovel Foundation in Vishakhapatnam. This is done through the formation of grass-root level *Samrakshana Samitis* or Village level Forest Conservation Committees. In this process, the Forest Department acted as the main mobiliser for capacity building and the Regional Forest Research Centre extended support.

The Kovel Foundation estimated in 2009 that more than 10,000 families across Andhra Pradesh were involved in gum picking. The Foundation also developed and promoted scientific tools and techniques of gum harvesting to gum pickers which was successful in preventing the death of the tapped trees. Post-harvest processes were also successfully promoted and led to reduction in loss and better grades of the gum. All the women Self Help Groups (SHGs) involved in NTFP collection from different villages were also brought together.

The organisation has also set up nurseries for NTFPs including karaya gum since 2005-2006. Other than the safe and sustainable procedures now adopted by the gum pickers for gum tapping, saplings were also planted with the help of many government departments to ensure availability of the gum tree for future. Thus the successful conservation and

management of *Sterculia* in Andhra Pradesh depends on adoption of scientific methods, promotion of best practices through training, promotion and strengthening of people's institutions, strategic collaboration with Government agencies and departments and emphasis on resource regeneration. This is a good lesson to be learned which can be attempted in various parts of the country with certain modifications suitable for the region and conditions.

ARUNACHAL PRADESH

Traditional conservation of Tek

The strong biocultural association of the Adi people with the use of Tek palm has played an important role in the conservation of this species

Martha Ratan

Locally called Tek or Toko by the Adi tribe of Arunachal Pradesh, *Livistonajenkinsiana*, a palm tree is an important NTFP. Studies reveal that Tek has become an endangered and threatened species. The good news however is, that it has been conserved by the communities of Arunachal Pradesh. This article explores the bio-cultural dimensions Tek or Toko and its conservation by the Adi community of Arunachal Pradesh. As the demands made on forests change and evolve, it has also become important for foresters to help and facilitate the local communities in tasks of conservation and sufficiently acknowledge this commendable work. Tek is conserved in *jhum* lands, Morang (forest) and home gardens. The women of the Adi community play a significant role in conservation of this species. A variety of bio-culturally important products are made out of this palm. Indigenous social institutions (Kebang) still play a great role in curbing overexploitation of this species and in solving disputes related to it. This species is conserved at large scale on individual ownership as well as in collective conservation in Morang (forest).

Tek – the tree

Tek belongs to the Arecaceae Family (Palmae). It is endemic to the north eastern region of India. It is a tropical plant and grows in lower plains and hill slopes. It is an unbranched tree and reaches a height of 20-30 m. The crown is globose and is borne at the tip of the solitary stem. This palm, unlike other palms does not show the persistent leaf scars. However, it has a rough surface and is brownish grey in appearance. Leaves are palmate and dissected partly. In general, the leaves have a size of 1.8-2.5 m X 1.5-1.8 m and are borne on a long petiole with stout spines along the petiole margins. Inflorescence is axillary and interfoliar, 1-1.5 m long, the peduncle strong and flattened and is 4-6 m long. The spathe (bract) is reddish brown in colour, boat shaped, hard and striate. The inflorescence is much a branched panicle with numerous lateral branches. Flowers are creamy white/yellow, small, clustered. Fruit is a drupe, 1.8-2.5 cm in diameter, globose, bluish in colour when ripe, with a leathery and fleshy pericarp. Flowering takes place during February to March and fruiting occurs from September to December.

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Adi – the community

The term Adi refers to a conglomeration of various ethnic subgroups of the Tani race living in Arunachal Pradesh. It includes the following tribes – Bokar, Palibo, Ramo, Bori, Karko, Komkar, Millang, Minyong, Padam, Pangi, Pasi, Shimong and Ashing. All the ethnic groups recognising themselves as 'Adi' believe themselves to be descendants of the AboTani. Geographically they are found in the temperate and subtropical regions in the districts of East Siang, Upper Siang, West Siang, Lower Dibang Valley and Lohit. The literal meaning of Adi is 'hill' or 'mountain top'. Primarily agriculturist, the Adi people live in hill villages, each traditionally keeping to itself, under a selected chief (Gam or Gaon Burha) who moderates the village council, which acts even as the traditional court, referred to as a Kebang. The olden day councils consisted of all the village elders and decisions were taken collectively in a Musup/Dereor, the village community house.

Cultural values in conservation

The Adis make good use of Tek by using it in different articles and items in their day-to-day life. The tender leaves are used to make Ebong (used to cover the back during rainy season), Botari (a cap worn during ploughing of fields) and baskets. Tek leaves are an important part of special occasions like Solung, Etor and Aran festivals of Adi as they are used to pack the meat, which is an integral part of the festivals. The leaves are also used as roofing material for Ekum (houses) and Ippos (small hut in *jhum* land). Leaves are used after proper drying as a roofing material .The leaves of kitchen room are said to last for 10 years or so, while for other rooms' leaves last for 4-5 years.

Leaves also find use in the making of palanquins, boats, hand fans, coarse brooms (midrib), overhead shades; for covering burial places and as the store bin of community grain banks. The fibrous sheaths are used for making ropes and for making water resistant shields for Tali (shoulder bags). The petioles are used in making mats. These palms are also planted as ornamental and avenue plants. New soft shoots are consumed as vegetables. Pericarp of ripe fruits, which are blue in colour are eaten raw or as a salad. Fermented fruits are used as *chutney* – a side dish in cuisines in India. Women dry the peel of fruits and after making its powder it is sold in the market. The dried peel of fruits contains a good amount of oil and thus the powder is used as a mixing agent with leaves of onger (Zanthoxylumrhetsa), ongin (*Clerodendrumcolebrookianum*) and bangko (*Solanum spirale*) for use as chutney. The nuts of Tek are edible and are used as a masticator, as a substitute for areca nut. Nuts are also used for making buttons. The cut stems are used as temporary log bridges to cross over small village streams and as posts for temporary structures. Owing to these many biocultural values, the need for conservation of this species is also felt by the community.

Spiritual concept in conservation

In Adi mythology, it is said that the Tek

plant originated from Mirang Gabo, an evil spirit. The leaves are said to be the feet of Mirang Gabo, while thorns on the leaves are his nails. Adis believe that wherever Mirang Gabo travelled, the Tek plant has grown. They need to take permission from this spirit before harvesting and using it. This mythology shows how closely tribal ethnicity and biodiversity are interlinked and it has helped in conservation of this species.

Role of indigenous institution- Kebang- in conservation

Nobody can harvest Tek without prior permission of the owner. Without consent, if someone does harvest Tek leaves, the owner of the Tek tree may report it to the Kebang. The case is heard by jury members led by the Gaon Burha. A fine is imposed on guilty person depending upon the type of case. The person, who is guilty is liable to pay it individually. In case, if he is unable to do so, his close relatives pay the fine for him. The fine is paid either in cash or in kind. If paid in kind, the payment is usually of Mithun (*Bos frontalis*) – a valued and sacred animal, pigs, traditional utensils like Arem-Peking (iron pots), Ekung (bronze plates), given as compensation to the Tek owner. The Kebang also decide and demarcate the land size, boundary and location of Tek land to an owner if it is disputed. In each village, the Kebang has resolves disputes and issues around Tek. Thus, the Kebang has a direct and powerful function in controlling the overexploitation of Tek by the non-owner and therefore contributing greatly towards the conservation of this species.

Conservation of Tek

The elders of the village have thorough knowledge related to Tek which helps in its conservation. However, this traditional knowledge has not been picked up to that extent by the younger generation in the village. This vacuum in knowledge can be filled in by the foresters. The foresters can facilitate the transfer of knowledge and minimise the generation gap.

The seeds of Tek are dispersed and spread by squirrels and birds. Due to the damage caused by animals to the seeds, the natural germination percentage is relatively low. However, germination is maintained by the Adi women through their traditional treatment after putting the seeds in Ekkam (*Phyrinumpubinerve*) leaves. Apart from monoculture, the conservation of Tek is encouraged by adopting traditional agroforestry models by Adi tribe. In *jhum* land, Tek density is more because of its good productivity and its preference by the cultivators.

Tek is conserved by the Adis to meet their basic needs in two major habitats *jhum* land and Morang forest. For sustaining Tek, the adjoining ecosystems must be also conserved equally. If the ecosystem is disturbed, the Tek species too will also be disturbed. Since Tek is endemic, the need for the conservation of this valuable species is urgent and important. The younger generation should be roped in as a stakeholder in this conservation mission. Training and research support should be given to the community and the efforts of the Adi community must be rewarded and recognised.

MEGHALAYA

Role of *Phrynium capitatum* in rural economy

There is ample scope and possibility of making this forest product as a livelihood-based resource to improve the income of the rural poor

Gopin Padu

Phrynium capitatum leaf is the most common wrapping and packaging material used by people of Meghalaya. The shelf life of these leaves is about 4-5 weeks. It has been in use since time immemorial for packing and wrapping of edible items, such as common salt, jaggery (*gur*), lentil, fresh and dry fish, meat, betel leaf, fruits, vegetables, lime, gram (*channa*) and the like. *Phrynium* leaf is one of the major sources of income for the rural poor of Meghalaya. The demand of leaves is high since local people prefer *Phrynium* leaf over polythene for packing food items because of its capacity in retaining moisture and keeping the packed edibles fresh. Since most produce is used locally, the price remains almost stable year after year.

Phrynium leaf, commonly known as packing leaf, is found throughout eastern Himalayas, Malay Peninsula, Malabar and Sri Lanka. In Meghalaya, *Phrynium* leaf grows wild at an altitude of 100-800 m above mean sea level in the

***Phrynium capitatum* growing in the forests of South Meghalaya**

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forests and valleys along the streams. It is popularly known as *patta* in Hindi and the local tribes of Meghalaya call it by different names – *Sla Met* by the Khasi and *Bolgota* by Garo. It is an undergrowth shrub belonging to the family *Marantaceae*. It is a fast growing evergreen plant and grows well in forests with sparse tree cover.

Management

Although it grows widely in wild but it is not enough to meet daily demands. Therefore, due to its high market demand, it has also been domesticated in areca nut agro-forests as well as in betel leaf agro-forests. In agro-forests the plant is semi-domesticated and its growth is promoted by pruning of tree branches for enhancing light conditions and weeding of forest floor. The plant grows naturally through seeds in natural forests as well as in agro-forests.

Harvesting

About 80 per cent of the people involved in the collection of packing leaf are landless and poor. A mature plant has 6-7 leaves. From the agro-forests, collection is done in a sustainable way where the older leaves are collected by cutting from the base, leaving at least two younger leaves for regeneration. In about three month's time, the plant produces again the same number of leaves which become ready for collection. In one year, people could harvest three times from the same plant. In natural forests however, the collection of leaves is done in an unsustainable way where people collect leaves without the petioles by hand.

Mostly women and children were involved in harvesting of the leaves. On an average, women collect about 35 kg/day and children about 15 kg/day. After collection from the forest, the

Table 1: **Mean annual expenditure/ha incurred by producers in management, harvesting, processing, transportation and marketing of 480 qt *Phrynium* leaf**

Activity	Worker	No. of worker	Wage (Rs.)	Number of days/hours	Total cost (Rs.)
Weeding	Women Children	2 2	40 20	2 days 2 days	80 40
Harvesting	Women Children	2 2	40 20	4 days 4 days	160 80
Packing	Women Children	1 1	40 40	½ day ½ day	20 10
Head load from village to road	Women	13	25/35kg*	-	343
Transport from road to market	Motor car		10/35kg*	-	137
Grand Total		23	-	-	870

***Average total production per ha=480 kg/annum**

product is loaded and carried on the head to the village. Eighteen leaves are arranged and tied together in vertical rolls, locally known as *shi song*. Then 35 rolls are packed together, forming a large bundle locally known as *shi kit*, weighing about 35 kg. Both women and children are involved in this task. A woman takes about one-and-a-half hour in arranging and packing of 35 kg leaf. Packed leaves are then transported to the market. From May to December, the market is flooded with this product. But during winter, due to slower regeneration of the leaves, the availability of this product was found to be minimal. The cost incurred by the growers in management, harvesting, processing, transportation and marketing of 480 kg leaf collected from 1 ha area is given in Table 1.

Market and pricing

The *Phrynium* leaf has got a very good market in Meghalaya. Moreover, there is a small inter-State trading with Assam and a small quantity is traded to Bangladesh via Dawki market. The growers bring the product to the local market where they sell it to the traders, who, in turn, directly sell it to the consumer at different local and regional markets. This product fetches good price in Shillong, the most important market of Meghalaya. It is from here that traders of different districts buy the leaves and sell it in different towns of the State. The market channel of the produce is shown in the Figure 1.

In 2008, the prevailing price of *Phrynium* leaf was Rs 6/kg at the local market where the traders purchased the leaf from the growers.

Economic impact

A total of 2,940 quintals of leaf were marketed annually from Nongkwai village, which was equivalent to 14.7 quintal/ annum/ household. Therefore, the annual gross income was Rs

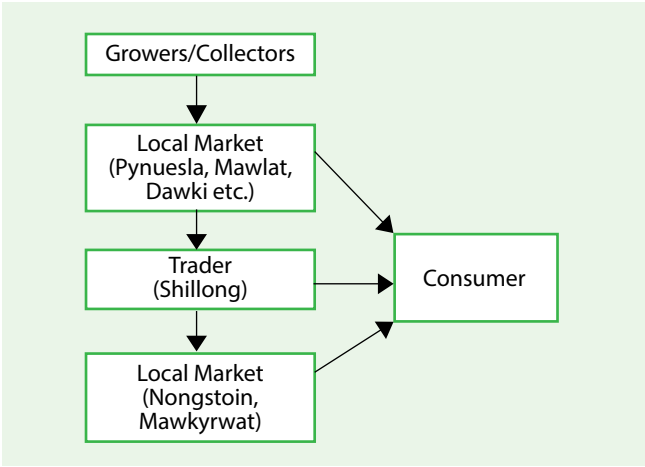

Fig .1 **Marketing channel of *Phrynium* leaf in Meghalaya**

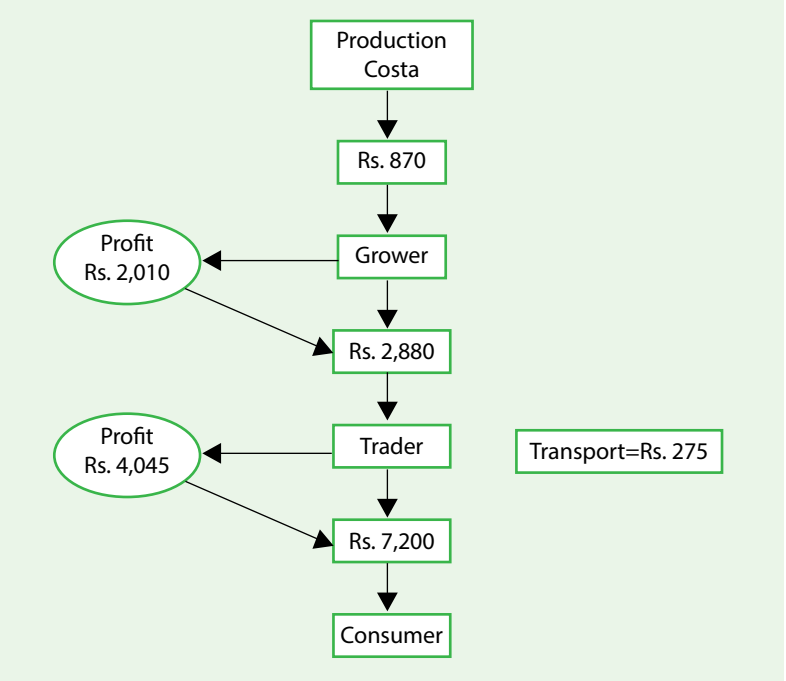

Fig. 2 ***Phrynium*** **leaf pathway from grower to consumer depicting price appreciation at various stages of movement of 480 kg leaf collected from 1 ha area**

8,820/household. The average annual gross income of the people in this village was estimated to be approximately Rs 65,000 / annum/ household. Thus, *Phrynium* leaves contribute 13.56 per cent of household gross income. Out of the 480 kg *Phrynium* leaves collected from 1 ha area, the grower received a gross income of Rs 2,880/annum, out of which total production cost was Rs 870. Rs 2,010 was the net earning of the grower. The products are then brought by the traders to the market and are sold to the consumer. The final market price of Rs 480 kg *Phrynium* leaf collected from 1 ha area fetched Rs 7,200, which the consumer had to pay. Thus only 28 per cent of the money paid by the consumer goes to the grower. The rest was profited by the trader (56%), transporters (10%), and wage earners (5%). The maximum benefit accrued to the trader. The product pathway and cost from grower to consumer at various stages of movement and processing within Meghalaya is given in Figure 2.

Conclusion

Considering the adverse environmental impacts of polythene bags, it is desirable to continue and promote use of *Phrynium* leaf as packing material. All year round availability of the leaves has made it a suitable packing material

for meat, vegetables and fruits. Increasing emphasis of development agencies on production of leaves during recent times showed brighter future for this forest product. There was some scope of its export to Bangladesh from Dawki border and to the neighbouring State of Assam from Ri Bhoi area. Deforestation is the major threat for regeneration of the plant. Unsustainable harvest from wild is also causing damage to natural population of this economically important wild plant. Some degree of domestication has been initiated in the areca nut and betel leaf agro-forests of south Meghalaya region but greater attention is needed for conservation of wild germplasm of *Phrynium* in Meghalaya.

Phrynium leaf plays an important role in the livelihood of rural poor in this region. There is also ample scope and possibility of making this forest product as a livelihood-based resource to improve the income of the rural poor. Since *Phrynium* leaf grows wild in the natural forest, labour during collection is the only input that the farmers have to make. The expenditure incurred on the management of *Phrynium* in agro-forests is minimal.

MADHYA PRADESH

Integrating livelihood generation with conservation

The involvement of co-operative societies in the trade of tendu leaves has helped provide employment during the lean summer months and has raised rural incomes

Sujit N. Nevase

Forests are an important gift of nature for the wellbeing of mankind. India has a huge population residing inside or in the vicinity of forests, critically and intricately linked to forest ecosystems for their livelihoods. There are around 1.73 lakh villages located in and around forests. A large number of NTFPs are obtained from forests like edible products, grasses, fodder tree shrubs, bamboo, medicines, oil seeds, essential oils, tans, dyes, commercial leaves, etc.

The rural people depend upon for wide range of natural resources and ecosystem services and therefore more dependency leads to forests being potentially affected by degradation. This forms a vicious cycle of poverty and forest degradation so it is necessary to link forest conservation and poverty reduction.With this view, the National Forest Policy for first time envisaged people's involvement in conservation, protection and management of forest. *Tendu* (Diospyrosmelanoxylon Roxb.) leaves are one of the most important NTFP species in central Indian states, thus *tendu patta* provides a good opportunity for poverty alleviation and sustainable forest conservation through active community involvement.

The state of Madhya Pradesh is the major *tendu patta* producing state (25 per cent of the country's total production) followed by Chhattisgarh (20 per cent), Orissa (15-20 per cent) and Maharashtra (10 per cent). Due to exploitation of the collectors by traders, the Madhya Pradesh state has reserved the rights of collection and trade of the *tendu* leaves by declaring the product as a nationalised item, in 1964. After the Bawa Committee report of 1971, the states began efforts to improve condition of *tendu* collectors. After some initial failed attempts, in 1988-89, the state government brought the entire *tendu* leaf marketing process under co-operatives. The structure of the current *tendu* leaf co-operative marketing system is summarised in Table 1.

Governance structure

All adult pluckers are eligible to become members of the Primary Co-operative Society (PCS). These members elect 11 members to a *Prabandh Samiti*

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Table 1: **The three tier co-operative structure**

Level	Organization	Functions	Numbers
Apex level	Madhya Pradesh Minor Forest Produce (Trading & Development) Co-operative Federation (MFPFED).	• Conducts the auctions on behalf of all Primary Co-operative Societies (PCSs). • Handles security, deposits, advances and contractor payments. • Comes up with the annual accounts for each PCS. • Sets the 'collection' wage for the state as a whole and the 'incentive' wage for each PCS.	1
Secondary level	District Forest Produce Co-operative Unions (DU)	• Links the PCSs to the MFPFED	61
Primary level	Primary Forest Produce Co-operative Societies (PCSs)	• Conducts pruning and *tendu* leaf collection, and distributes the collection wage	1,066 PCSs and officially involving 32 lakh *tendu* leaf pluckers

(Executive Committee) for a term of five years, along with two members who are nominated by the Divisional Forest Officer (DFO). It is supposed to appoint the *Prabandhak* (Manager) and the *PhadMunshis* (collection centre clerk). It is also supposed to arrange for actual sale of the *tendu* leaves and decide on distribution of profits so obtained.

The 10-member board or *Sanchalak Mandal* of the DU is elected among themselves by the members of all *Prabandh Samitis* under one district or forest division and the corresponding Divisional Forest Officer is the *Prabandh Sanchalak* (Managing Director).

All DUs in turn elect nine members to the Board of Directors of the state-level Madhya Pradesh Minor Forest Produce (Trading & Development) Co-operative Federation (MFPFED), with another three being nominatedby the government and six being ex-officio from the Department of Forests, co-operatives, tribal welfare, etc. The Chairperson of the Board of MFPFED is usually appointed by the Registrar and may be a Minister of State or member of the legislative assembly (MLA). The nominees from the Forest Department handle day-to-day operations of the federation.

Collection and processing

There are several steps involved in the production process:

(i) Tendering: In November each year, i.e. six to seven months preceding the harvesting season, MFPFED calls for tender bids for each PCS (or 'lot'). Interested buyers have to fulfil certain conditions before they can bid. The highest bidder for a particular lot generally secures the contract, and 8

per cent of the bid amount is taken as security deposit.

(ii) Pruning: Pruning of *tendu* bushes is done in February-March, approximately 45-60 days prior to the harvest season, so as to encourage growth of tender leaves.

(iii) Plucking: Harvesting of *tendu* leaves starts in May. Pluckers, often the entire family, leaves early in the morning for leaf collection and returns home in the afternoon to sort and bundle the leaves (50 leaves / bundle) and gives them at the *phad* by the evening. The *Phad Munshi* (collection centre clerk), who is an employee of the PCS, receives and counts the bundles and enters the amount in the plucker's card.

(iv) Post-harvest processing: The contractor sends specialised labourers to dry and pack the leaves in the *phad*, after which the packed bags are taken to godowns (often owned by the federation but given to contractors on lease) and later sold in the market after being sorted and graded.

(v) Payment to tendu leaf pluckers: Payment to pluckers for the collected leaves is made in two phases. A collection wage is declared by MFPFED before the starting of the plucking season, the decision actually being made by the state cabinet. This wage is a rate or price to be paid per Standard Bag (SB) of leaves (50,000 leaves/ SB) and is uniform across all PCSs. Payment as per this rate is made in cash within a few days of the plucker submitting the leaves at the *phad*. The second part of the payment formally called an incentive wage (bonus) is made much later, typically 14-18 months later.

Fig. 1 **New shoots after coppicing**

Fig. 2 **Plucking**

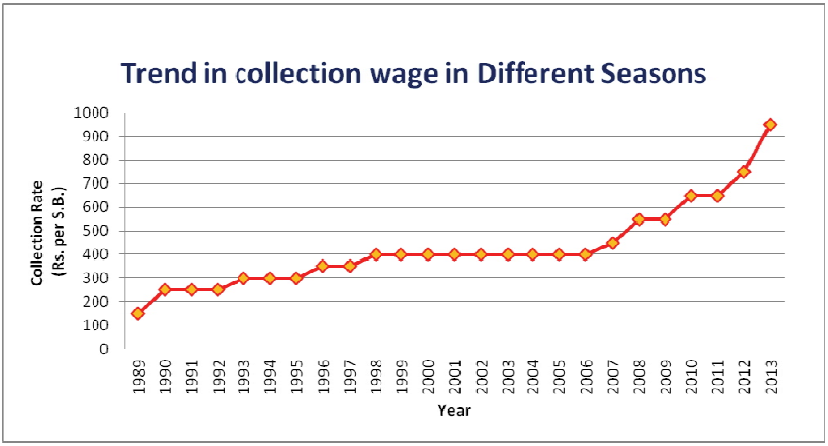
Fig. 3 **Whole family involved**

Fig. 4 **Leaves tied in small bundles**

Fig. 5 **Bundles spread on ground for drying**

Fig. 6 **Bundles spread on ground after drying**

Fig. 7 **Trend in collection wage in Different Seasons**



(1 Standard Bag=50,000 leaves)

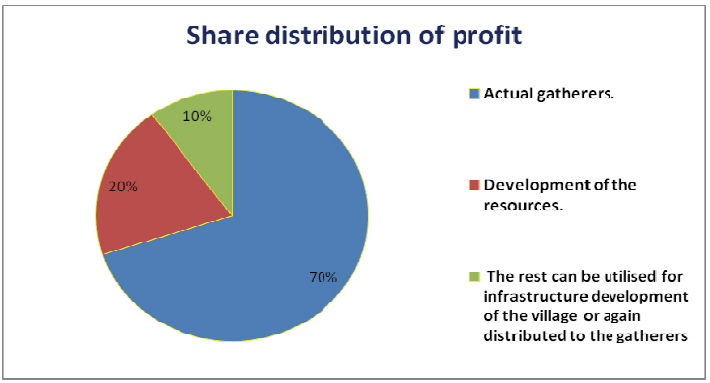


Fig. 8 **Share distribution of profit**

Trend in collection wage in different seasons shows that there is uniform growth in rate of collection of *tendu patta* indicating that government policy is working well towards poverty alleviation and fair benefit distribution

(vi) Share distribution mechanism: As a consequence of the 73rd Amendment to the Constitution, the State Government decided to pass on all the net income from the trade of NTFPs to the societies. The Government distributed 50 per cent of this net income to the *tendu* leaves collectors as incentive wages from 1998 season onwards. From the 2004 season, the proportion of incentive wages has been enhanced to 60 per cent and again enhanced to 70 per cent of the net income from 2011.

Co-operative System

From 1989-90, a three-tiered co-operatives federation is involved in the harvesting and marketing of *tendu patta* leaves and it has had some positive socio-economic impacts on society. Some community responses and some conservation issues are as follows:

(i) Socio-Economic Impact on Local community: The authorization of the local communities has ledto the sustainable management of *tendu* leaves as now the communities feel self assured that the effort they will make in its management is ultimately for their own benefit. It has led to an increase in rural incomes as it gives massive employment generation especially in summers, a season with chances of less employment. It also prevents the migration for work during summer months. Better returns due to share distribution has led to increased food security due to increasing agricultural production (increased input of good quality seeds, fertilisers and insecticides) and increased buying power, so ultimately this model is helping in achieving socio-economic growth with development of local community.

(ii) The Community Response: The community organised themselves, with government help, into a well managed cooperative structure with the freedom to choose the Chairman of the society from amongst themselves. This led to decision making at the society level and confidence building.

The low-income pluckers were, thus, made owners of the NTFP. This motivation also brought about an awareness of their rights and consequent empowerment. This structure of the cooperatives helped to get rid of exploitative practices and ensured weekly paymentof proper wages to collectors. The community took active participation in the implementation of the biggest social security insurance process in the country. The members took part in the participatory decision-making about establishment of infra-structural projects based on income generated from *tendu* leaves for the general good. The community thus became proud owners of the assets generated and this led to greater harmony within the community. This process ultimately helped to convert an open access resource to a community managed resource.

(iii) Conservation Issues: As the product is leaves, it does not cause much adverse damage on survival and growth of the plant as the harvesting period is limited to only two months in a year, hence the product has a very big potential for sustainable harvesting. Since the best leaves are obtained from pruned shrubs, there is a tendency to maintain it as such by constant pruning, leading to a prevalence of shrubby growth. This has a negative impact on seed production and future regeneration and also susceptibility to diseases. Nowadays, the tendency of setting fire to the forests to encourage growth of root suckers has been greatly checked due to active community participation. Since *tendu* leaves provide a major economic activity in the lean summer months, it indirectly helps in forest conservation. Otherwise,

the local population would have engaged in the most readily available economic activity, which is cutting down forests to sell for fuel-wood. This economic activity would then lead to destruction and degradation of forests. PCs help arrest the tendency of plucking immature leaves and also the tendency of stripping the whole branch. Reinvestment of income to improve this forest resource has resulted in increased income to the locals.

Conclusion

Forests play a vital role in the livelihoods of tribal people through employment in activities related to forest protection, collection, harvesting, processing of NTFPs. *Tendu patta* is an important NTFP and an integral part of day-to-day livelihood of tribals in central India. However even today, tendu leaf harvesting and processing is performed in the traditional way and inefficiently, so there is enormous scope for improvement. To get maximum benefit from *tendu patta* as NTFPs, some strategic approaches are suggested:

1. *Tendu patta* has no alternative use except for *bidi* making and the *bidi* industry is on the decline, so it is necessary that research should be done by the institutions /NGOS / Forest Department for alternate use of *tendu* leaves.
2. Traditional methods leads to wastage, so there is need for research on appropriate technology for reducing waste.
3. A uniform regional trade policy for *tendu* (sale, procedure, procurement rates, conditions, taxes and transportation norms) needs to be developed by all State Forest Departments and the MoEF&CC should make uniform legal procedures across all states in central India with respect to transit.

The community-based sustainable management of *tendu* leaves in Madhya Pradesh is one of the best examples of a successful cooperative model for sustainable managementof NTFPs. This model can be replicated in other states for harvesting and marketing of NTFPs. This will not only improve the economic status of tribals through fair sharing of profits, but also village infrastructure and development of NTFPs, as well as sustainable conservation of forests by reinvestment of a part of the profits earned from sales of the NTFP resource.

Acknowledgement

I express my sincere thanks to Hemant Yadav, SDO, Katangi Balaghat Forest Division (M.P.) andDhotare, ACF, Chandrapur Forest Division (M.H.) for providing information and photos about *tendu patta* practices in Madhya Pradesh and Maharashtra state, respectively.

Note: Articles may be sent at the following email ID:
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However depending on the response to this programme, arrangements can be made for translation of the magazine into the vernacular. A short note about the contributor and the reviewer shall accompany the article. The note shall contain name, age, postal and e-mail address, course, academic accomplishments, and important assignments held. The evaluation would be done on following criteria:

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    - Instead of an abstract the article will give information on the location, the period when the field work was carried out
    - Integration - the article organized in a coherent form and all ideas are clearly leading to a single main argument.

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