Indian Journal of Traditional Knowledge
Vol. 9 (2), April 2010, pp.231-241

Toko-Patta (*Livistona jenkinsiana* Griff): *Adi* community and conservation of culturally important endangered tree species in eastern Himalaya

Ranjay K Singh[1*], RC Srivastava[2], *Adi* Community[1] & TK Mukherjee[3]

[1]College of Horticulture & Forestry, Central Agricultural University, Pasighat 791 102, Arunachal Pradesh;
[2] Botanical Survey of India, Itanagar, (Present address Botanical Survey of India, Kolkata);
[3]National Institute of Science Communication And Information Resources (NISCAIR), CSIR, New Delhi 110 012
E-mails: ranjaysingh_jbp@rediffmail.com; rcs_bsi@yahoo.co.in; tkm@niscair.res.in

Arunachal Pradesh, being a largest state of Northeast India, harbours great number of plant species which are endemic to region. The diversity and endemism of state has kept it in the category of biodiversity hot-spot. Though, in recent past, numbers of plant species are being listed as rare, endangered and threatened because of increasing threats from anthropogenic and other natural factors. In the list of threatened species, *Livistona jenkinsiana* Griff- locally called, *Toko* by the *Adi* tribe has also been mentioned. Based on the village and forest survey, initially it was observed that *Toko* is good in numbers and conserved by the tribal communities of Arunachal Pradesh. This dichotomy of *Toko* being reported as threatened and actual large number of population maintained by tribes has necessitated conducting the study in the East Siang district of Arunachal Pradesh. The study was conducted during 2005-2008. East Sing and *Adi* tribe have been selected purposively. A sample of 303 male (138) and female (165) *Adi* members were chosen as the respondents of the study. The ecological attributes of the species, biocultural dimensions, gender role, institutional relation and conservation of species in varying habitats were studied. Using personal interview and PRA methods data were collected. Results indicate that *Toko* is conserved in *jhum* lands, *Morang* forest and home gardens at the larger scale. The women play a significant role in conservation of this species. Number of bioculturally important products is made out of the leaves and fruits of *Toko*. Indigenous institution has still great role to control overexploitation of this species and solve the dispute on *Toko*. This species is conserved at large scale on the individual ownership; however, the collective conservation of *Toko* in *Morang* forest by the *Adi* tribe is an appreciable effort. From six villages, total 33,026 numbers of trees were recorded in 2008 at the range of 110-180 m altitude.

Keywords: *Toko-Patta*, Endangered biodiversity, Biocultural knowledge, *Livistona jenkinsiana* Griff, Conservation, *Adi* tribe, Eastern Himalaya, Arunachal Pradesh

IPC Int. Cl.[7]: A01K, A01N3/00, D06P, D01H13/30

Plant/animal endemism is the principal indicator for determination of hotspot status, because endemic species are entirely dependent on a single area for their survival, and by virtue of their more restricted ranges, are often the most vulnerable[1]. These species, confined to highly threatened ecosystems, will almost certainly be the first to be exposed for extinction processes, and hence need sustainable conservation action[2]. The earth's 25 biodiversity hotspot regions collectively cover about 2% of the planet's land surface, yet claim more than 50% of all terrestrial species diversity. The top 11 hotspots for plant endemism harbour 5,000 or more species as endemics. It accounts for 93,214 plant species (37.3%) of the total global plant endemics[1,3]. Presently, much of the world's biological diversity is in the custody of subsistence traditional communities and farmers who possess traditional knowledge (TK) and follow age-old land use practices[4,5]. Indigenous knowledge is thus a key element of social capital of poor and tribal communities and constitutes their main asset in efforts to gain control of their own lives. A large number of indigenous peoples and tribal communities of India hold command over biodiversity and related resources. The India is rich in holding the diverse biocultural resources which has intrinsic correlation with biodiversity[6-8]. In India, Northeastern region is considered one of the biodiversity hotspots of the world and abode of Indian tribal cultural diversity[8-13]. Northeastern region including Arunachal Pradesh occupy 7.7% of the total geographical area of the country and harbours 50% of Indian flora (8,000 species) of which about 4% is endemic (2,526 species)[14,15]. Arunachal Pradesh being a largest state (83,743 sq km) of the region and has five climatic conditions (tropical, sub-tropical,

*Corresponding author

sub-temperate, temperate and alpine) provide habitats to three forest types namely, mixed wet evergreen, dry evergreen and deciduous forests[9-12].

Majority of traditional communities of state depend on forest resources and perform *jhum* cultivation (slash and burn cultivation) since generations[6,7]. These communities have diverse food habits, cultures (festivals) and languages[16]. Biodiversity and culture have been interwoven in a unique manner here that has formed a bio-cultural diversity. Thus, communities have accumulated rich body of TK about bioresources. Almost every festival and social occasion of these tribes is linked with the forest resources and *jhum* cultivation. TK and social institutions of tribal communities of state play pivotal role in rational use of plants resources and maintain local biodiversity[6,7]. The paper deals with the biocultural dimensions of *Toko* tree (*Livistona jenkinsiana* Griff) and its conservational aspect. Past studies show that *Livistona jenkinsiana* Griff has become an endangered and threatened species[17-20]. From 2005 onwards, during the course of implementing various projects on biodiversity and conservation in Arunachal Pradesh, it has been noticed that *Toko* is available in considerable numbers in the East Siang district. Thus, it has necessitated to conduct the study and learn whether this species is endangered indeed.

Arunachal Pradesh lies between 26° 28' to 29° 30' N latitude and 91° 30' to 97° 30' E longitude and has borders with Bhutan on the West, Tibet and China on the North, Myanmar on the East and the Indian States, Nagaland and plains of Assam on the South. The topography is characteristically rugged due to lofty, haphazardly arranged ranges and deep valleys criss-crossed by a number of rivers and streams spreading along the southern slopes of the eastern Himalayas to the western slope of the Potkoi hills and around the huge valley of mighty river Brahamputra. The study was confined to East Siang district. The district is spread in 3,655 sq km and located between 27.30-29.420 North latitude and 94.420-95.350 East longitudes. It is surrounded by Upper Siang district in North, Dhemaji district (Assam) in South, Dibang valley district in East and West Siang district in West side. The altitude variations of different topography and villages of districts vary from 110 m MSL (Pasighat & Bilat mountain) to 752 m (Riga mountain) MSL. The mean altitude level is 324.66 m of entire district. The rainfall in this district is 618.7 mm in Jan-May and 2,334.0 mm in June–July. The forest cover of district is 78.58% which constitute 1,955, 4,224 and 1,615 sq km as very dense, moderately dense and open forest, respectively. The tribal population in East Siang district is 69.21% in which *Adi* is a major dominating community. The *Adi* community comprises four major ethnic groups namely, *Minyong*, *Padam*, *Pasi* and *Pangi*. Other than the East Siang district, *Adis* are found in sub-tropical and sub-temperate regions of West Siang, Upper Siang, Upper Subansiri and Dibang valley districts also. Living in remotely located villages, *Adi* tribes practice *jhum* cultivation and depend heavily on forest resources. The shifting cultivation practices are intimately connected with the entire range of cultural, social, spiritual and religious lives of *Adi* tribe[6,7]. Their survival is generally subsistence. Rice, meat of wild animals and large number of ethnobotanicals collected from forest and *jhum*-land serve their staple food. They practice trapping and hunting in nearby forests[16]. The male and female partners have separate role and responsibilities in the *Adi* communities[16].

Methodology

Several visits were made to East Siang, West Siang, Upper Siang, Papumpare and Lohit districts of state to get acquainted with *Toko* tree distribution. Finally, East Siang district was selected as the site of study. The *Adi* tribe, who dominates in population in this district was selected purposively on the basis of availability of *Toko* tree, its conservation by *Adi*, variability of *Toko* geographical location and overall dependency of *Adi* tribe on this tree. Out of five, Pasighat subdivision of the district was further selected for study. Several reconnaissances of area were done and using random sampling method, six villages namely, Sibut, Napit, Yagrung, Miram, Berung and Balek were selected. The list of male and female *Adi* members conserving *Toko* tree was prepared with the help of *Kebang* Chief (head of customary institution)-*Gaon Burha* and village *Panchayat* secretary. Thus, total 303 *Toko* conservators (165 female and 138 male) were selected randomly. Therefore, from Sibut 60 (female 35 and male 25), Yagrung 40 (20 male and 20 female), Miram 60 (female 40 and male 20), Napit 13 (8 male and 5 female), Balek 40 (30 female and 10 male) and Berung 85 (30 male and 55 female) *Toko* conservators were chosen as the respondents of the study. The *Gaon Burha* holds control over the community forest with the help of his 2-3 *Co-Gaon Burhas.* They devise

rules and norms to accesses and ensure the conservation of plants resources from community forest. They also hold considerable knowledge about types of vegetation found in community forest. They keep oral records about the size of lands and related resources under *jhum* land, home garden and *Morang* forest (forest managed collectively by a clan or group). The team of *Goan Burha* acts as jury of village court and is consulted by the villagers on the matter of dispute related to land and plants resources. Therefore, considering *Gaon Burhas* as the local resource persons, *Goan Bruha* and his 2 *Co-Gaon Burhas* (total 3) - total 18 from 6 villages, were selected. This set of respondents helped in cross checking information on general pattern of *Toko* conservation and size of land holding of each village; and also to enlist general practices on *Toko* tree. These *Gaon Burhas* have assisted in organizing focus group discussions (FGD, one in each village) to understand use of *Toko* and related practices of conservation. The team further helped in conducting field transects (one in each village) in *jhum* land, home garden and community forest to observe the types of plants species used in *Adi* foods. To enhance reliability of data and reduce biasness in inferences, the study was conducted in two steps (2005-2006 and 2007-2008. In the first step, the transect walking with *Toko* conservators in selected six villages (Fig.1) were made to record the plants population and explored the inventories about package and practices of *Toko* conservation. In the second step (2008), interview was held with the selected respondents about the functionality over *Toko* tree and solving any dispute, was measured at the continuum of fully functional, partially functional, least functional and not functional. The knowledge of male and female respondents was measured using three point continuum full knowledge with score 3, partial knowledge with score 2, least knowledge with score 1 and no knowledge with score 0. Scores were averaged and tested with 'Z' test to know the difference of knowledge among male and female. The prior informed consent (PIC) was obtained from customary chief *Gaon Burha* and the respondents too about publication of information recorded for *Toko* use.

Results and discussion

Toko tree (*Livistona jenkinsiana* Griff) palm belonging to family *Arecaceae* has been declared as threatened species[17-20]. This beautiful palm is found only in the northeast region of India. It is distributed in the tropical and subtropical belts and grown in lower plains and on hill slopes (Fig.2). The tribal people (*Adi, Galo, Nyshi, Mishing*, etc.) of Arunachal Pradesh have been using this species since time immemorial. This is a multipurpose tree species and provides different utility items like leaves, fiber and fruits. *Livistona jenkinsiana* Griff. is known with various named with local tribals such as, *Toko*, *OW / Yoak* by *Nyshi* people; *Taa-ck* by *Adi* tribe; *Tokou* by Assamese; *Talai nyom*, *Purbong* by *Lepchas* of Sikkim. It is commonly known as Assam Fan Palm. Amongst *Adis*, *Toko* garden is considered as an immovable property. In the course of family property sharing, it is taken into account and is inherited as an ancestral property.

Botany

The stem of an unbranched graceful palm attaining a height of 20-30 m at maturity (Figs.3a&b) is comparatively slender with 30-40 cm diameter at breast height. Its crown is globose. The palm, unlike other palms does not show the persistent leaf scars, however, has a rough surface and is brownish in grey appearance. Leaves are palmately dissected partly and are reniform or oval in shape, plicate, divided into 70-100 segments (2-15 segments during seedling stage). In general, the leaves have a size of 1.8-2.5m x 1.5-1.8m and are borne on a long petiole with stout spines along the petiole margins. Inflorescences are axillary and interfoliar, 1-1.5m long; peduncle is strong flattened, 4-6m long. The spathe (bract) is reddish brown, boat shaped, hard and striate. The Inflorescence is much branched panicled with numerous lateral branches (Fig.4). Flowers are creamy white/yellow, small, clustered on tubercles at base, solitary or paired on the distal parts of the branches (rachilla). Perianth lobes are 3 in number, hard and stout; stamens are 3 in number. Fruit is a drupe, 1.8-2.5 cm in diameter, globose, copper-blue in colour when ripe (Fig.5), pericarp is leathery and fleshy. Seeds are globose, shinning brown with broad raphae like line; endosperm is horny, whitish. Flowering take place during February-March and fruiting occurs during September-December.

Distribution

The tree endemic to Northeast India grows up to an elevation of 1,100m. It is usually encountered in nature in the tropical evergreen forests and sub-tropical broad leaved forests. Though the species is found almost throughout Arunachal Pradesh, the

larger concentration is towards the central and eastern parts of the state, particularly in Upper Subansiri, West Siang, Upper Siang and East Siang districts (study area). Apart from its natural occurrence (in *Morang* forest of *Adi* and other tribes too), it is largely cultivated by the local people in their *jhum* land/ community lands and around the home gardens. The palm is considered to be an endangered one and included in the Red Data Book of Indian plants[17-19].

Natural regeneration

Natural regeneration occurs by means of the seeds. Profuse regeneration can be seen (as in East and West Siang districts) in the vicinity of mature fruiting trees along partially open moist slopes. The seeds fallen over ground or carried over by birds and squirrel like animals or dropped on soil during winter months start germinating in good habitat with pre-monsoon showers in April-May and establish to form plants. However, survival percentage is very low due to cattle damage and adverse ecological factors. Despite this, natural regeneration is usually observed in *Morang* forest as gregarious patches.

Artificial regeneration

Propagation by seeds is the most easy, cheap and conventional method. Seeds can be gathered during November-December when they are fully ripe. Freshly harvested seeds are used for sowing. The seeds are extracted from fleshy fruits by depulping, or removing the peal. This can be done manually or fruits can be kept in water or in soak-pits for a couple of days by which time slight rotting of fruit peal takes place and then it becomes easy to remove the peals by gentle mashing and washing.

Seed treatment

Freshly collected seeds are kept in basket wrapped with banana leaves or *ekkam-pat* (*Phyrinum pubinerve*) for one month in order to loosen the tough impermeable seed coat. It can be otherwise eaten as *chutney*. Seed coats can be alternatively loosened by burying in soil wrapped with gunny bags. Generally, these seed coats are not eaten. The clean seeds are broadcasted in the *jhum* field in the month of April by using a digging stick (*Dao*), with a uniform spacing of about 4m. Approximately, 230 clean seeds weigh a kilogram. The seeds can be sown in mother beds or directly in the polythene bags. The seeds should not be sown too deep in the soil and sowing at 2-3 cm depth is found to be ideal. Germination takes place after about 50-60 days of sowing. Sometimes germination may get delayed depending upon the sowing month and winter severity. However, by the month of April germination will take place. Thus, if seeds are sown in December it may germinate only in April next. Seed germination is up to 90-95% germination. Seedlings can be picked up sufficiently early in one leaf stage for transplanting them into polythene bags without causing damage to roots or adjacent seedlings. After picking out, it is good to give profuse watering. The seedlings are initially kept under shade and watering is done as and when required. A single watering per day is sufficient. When seedlings get established in the polybags, after 2-3 months, they can be even kept in open beds. Usually, this will be the rainy months and can thus avoid watering. Seedlings are comparatively hardy and devoid of disease and pests. They can, however, be monitored for weed infestation and cattle (*Mithun*, goat and cows) browsing. The initial growth of seedling is slow and takes about 12-15 months in the nursery to attain plantable size. Similarly, seedlings can also be obtained and transplanted into polythene bags from the areas of gregarious regeneration, where otherwise the seedlings are destined to die.

Plantation technique

Planting is done when seedlings are about 18 months old at a spacing of 4m x 4m during May-June with the beginning of rainy season. *Adi* people use closer spacing (up to 2.5x2.5m) in hill slopes when they grow *Toko* as mono plantation. This helps in saving manpower for watering and also for assuring better survival rate. Seedlings can be transplanted in any other month provided the soil has enough moisture for its establishment. The pits of 45 x 45 x 45 cm size are made, weathered and filled with a rich mixture of soil, sand and Farm Yard Manure at the time of planting. After planting, it is better to prune some of the basal leaves which encourage leaf production and reduce transpiration loss. Obnoxious weeds like M*ikania, Eupatorium, Ageratum,* etc. tend to over topple the seedlings and hinder the establishment. Weeding ensure better survival and growth of plants. It has been observed that trunk formation starts after 4 yrs of planting and leaf production is at a rate of 1-2 leaf per month with an average of 10-12 leaves a year. The local practice of pruning the leaves and spliting the fibre cover helps in better growth and leaf production.

Traditional agroforestry

Toko can also be planted as an agroforestry or shade/nursery tree species with other crops. It does

not produce much shade as the stem is branchless and leaves occur at the top only, therefore, seasonal crops and vegetables can easily be grown below *Toko* trees. The *Adi* tribe in study areas was observed to follow the following agroforestry model with *Toko* tree: *Toko* + ginger, *Toko* + tea, *Toko* + orange (*Toko* is taken as living fence crop), *Toko* + tuber crops *engin* and *singe-engin* (sweet potato and tapioca) and *Toko* + maize (for initial 4-5 yrs). At the time of establishing *jhum* land, after the slash and burn of forest, the first plantations of *Toko* around the boundary of field and in between as intercrop is also made. Following these traditional models of agroforestry, farmers are able to utilize the available spaces in between the two trees of *Toko*. These models are adopted according to the slope of topography, nature of crops (shade loving) and the basic needs of farmers. Usually in first 6 yrs of new *jhum* land establishment, crops intercropping are followed more.

Manure and fertilizers

Application of organic manure like oil cake dust, bone meal and fish meal are useful for hastening the seedling growth. It decomposes slowly in the soil releasing the essential nutrients to growing plants for longer periods. Well rotten cow dung is also good manure but too much use of this manure is harmful as it invites termites and other pests. The manure should be applied before the growing season, i.e. at the end of colder months or just before the monsoon.

Pests and diseases

Generally, no serious pests and diseases have been observed in *Toko* plant. However, some insects attack the green leaves and fruits of the plants sporadically in some localities. Sometimes, borer attack is seen in older stems which can be controlled by spraying insecticides. The major problem faced in establishing the plantation is cattle grazing/ brouzing particularly by *Mithun*.

Harvesting

The fan shaped leaves are harvested from mature tree. Generally, while harvesting, only 2-3 leaves are left in the palm excluding the tender leaves (Fig. 6). It is harvested after the full moon to avoid termite and pest attack. There is a popular belief among *Adis* that the pre full moon days are not good for harvesting as those harvested will be vulnerable to pest attack and cause damage to the trees. The leaves are harvested on every alternate year. Generally, harvesting of *Toko* at large scale is done by the indigenous institution called *Mila*. Male harvests the leaves, while female after making the bundles skillfully carry it (Fig.7). In this institution, male members of close relatives assemble together and help to *Toko* plants owner for harvesting leaves and carrying it. Owner of *Toko* tree offer traditional foods made of rice, culturally important boiled foods of ethnic vegetables, dried local fishes and *Mithun* meat (dried or fresh). At this occasion offering of traditionally prepared alcoholic beverage called *Apong* (white and black, made of rice and millets) is considered delicacy.

Drying and curing of leaves

After harvesting, the petioles of leaves are cut off leaving a small portion intact with the leaf blade then both the right and left flanks are folded to the same side of the leaf, arranged systematically, and stacked to dry. Over each stack some weight is given at the top to cure it and to prevent from crumpling during drying (Fig.8). It is kept as long as the leaves turn completely brown only then it is used for roofing.

Marketing and trade

The leaves are bundled and traded. Generally, each bundle has 40 leaves and sold or bartered with other tribes. In the villages, 40 leaves of *Toko* are sold in Rs 20-30, while same numbers after trading in nearby local market (like Pasighat), the *Toko* owners sale it in Rs 150-200. A single leaf may vary from Rs 2-6 depending upon conditions of market and season of leaves availability. For commercial purpose, the leaves are sold at a rate of Rs 4-5 per leaf as in Itanagar (state capital).

Economic value

Good yield can be obtained up to 35-40 yrs. The older palms bear small sized leaves and it becomes difficult and risky to climb older trees for the collection of leaves. Therefore, older trees are removed by felling. The observations on mean leaves appearance in 5 yrs old *Toko* trees in the year 1997 & 1998 were recorded (Fig.11). Results indicate that on an average, 10 number of leaves appeared from January to December. It is found that after 5 yrs, on an average 10 leaves can be harvested per plant/year. *Adi* community have experienced that productivity of *Toko* leaves is found always better in the *jhum* land than home garden and around the paddy field. In ideal situation, from 625 number of trees plant/ha, 10 leaves and total 6,250 can be harvested. After

deducting the labour and transportation charges, the net benefit is obtained in every alternate year which may continue for over 30 yrs. Additional income can be obtained by the sale of seeds and seedlings.

Biocultural values

A numbers of products are made out of *Toko* leaves and fruits, which has great cultural, food and livelihoods values for *Adi* tribe. Using tender leaves of *Toko*, *Abong* (Fig.9) is made. *Abong* is used to cover the back during rainy season while *Botari* (cape) is worn during ploughing of fields. The basket like item (Fig.10) is also made from the leaves of *Toko*. The leaves are an integral part of using them to pack the meat and wild games during the special occasions like *Solung, Etar* and *Aran* festivals of *Adi* (Figs.12&13). The petioles are used in making mat. Using leaves of *Toko* hut (C*hang Ghar*, Fig.14) and *Poyup* (small hut in *jhum* land) are made. Leaves are used after proper drying as a roofing material for local houses. The leaves of kitchen room are said to last for 10 yrs or so, while leaves of other rooms for 4-5 yrs. Leaves are used for covering tops of *doolies* (palanquins) and boats and making hand fans. Midrib of the leaves is used to make coarse broom. Plants are largely used in nursery as overhead shade. The leaves are also used as the item to cover the burial places, and the store bin of community grain banks (Fig.15). These palms are also planted as an ornamental and avenue plants. Fibrous sheaths are used for making ropes; for making water resistant shields for shoulder bags (*tali*). New soft shoots are sometimes eaten as vegetables. Pericarp of ripe fruits, which are blue in colour are eaten raw or as salad. Fruits are also used after the fermentation as *chutney*. Some of rural women like Mrs Orik Ralen, has now started to dry the peel of fruits and after making its powder it is sold in the market. Dried peel of fruits contain good amount of oil and thus powder is now being used as mixing items with leaves of *onger* (*Zanthoxylum rhetsa*), *ongin* (*Clerodendrum colebrookianum*) and *bangko* (*Solanum spirale*) to use as *chutney*. Nut is edible and used as masticator; as a substitute of areca nut. Nuts are said to be used for making buttons. The cut stems are used as temporary log bridges to cross over village streams and as posts for temporary structure.

Spiritual concept

According to mythology of *Adi* tribe, *Toko* plant originated from *Mirang Gabo*. Leaves are said to be the feet of *Mirang Gabo*, while thorns on the leaves are his nails. It is general believe of the *Adi* community that in ancient time- from wherever mountain and locality, *Mirang Gabo* has crossed in his journey, the *Toko* tree were originated there only. Though, *Mirang Gabo* is considered to be evil sprit, but through worship and pray, the community could take permission from him to use the *Toko* for the life support system. This mythology proves that how intense the tribal ethnicity and biodiversity is interlinked.

Ownership

In Sibut village, 40 households have *Ioko* on more than 2 ha of lands and 12 households have land under *Toko* between 1-2 ha. In 95.45% cases, the conservation of *Toko* is done through its plantation on the individual field, in remaining cases (4.55%) it is conserved in the *Morang* forest and managed collectively by the whole community. Earlier, about 40 yrs back, the plantations and conservation of *Toko* was done exclusively in the *Morang* forest, but with the changing time conservation of it has become individual affair and property.

History of genetic resource flow

Earlier, leaves of *Tase* and *Tara* plant species were used in making houses of *Adi* tribe, but after earthquake of 1952, the *Adi* community has switched over to *Toko*. The ancestors of *Adi* tribe brought seeds of *Toko* from the Upper Siang district and multiplied it in the foot hills of East Siang district (villages like Runne, Yagrung, Sibut, Miram, Balek, etc.). In an accident during 2006, more than 80 houses made of *Tara* and *Tase* with the wall made of fiber from wild banana was burned in the *Adi-Pasi* village (dominance of *Padam* and *Pasi* ethnic groups of *Adi* community, upper hills of East Siang district). Then *Adi* people realized that use of *Toko* leaves could be a better option. Looking to this accident and relatively less lasting age of *Tara* and *Tase* leaves in huts (also it absorbs more amount of water during rainy season- that destroy it sooner), now the *Padam* of Mebo and *Padam* and *Pasi* (ethnic groups of *Adi*) have started plantation of *Toko* tree. These groups started collection of seeds purchasing from their counterpart living in foot hills of East Siang district. Earlier, the *Toko* leaves was exchanged in barter system through the food material like millets, chilly, dried meat of *Mithun* (*Bos frontalis*), squirrels, rat, etc. but, now it is being sold with money.

Fig.1 An *Adi* farmer with newly planted *Toko* tree

Fig.2 *Toko* forest grove in the foot hill of Napit village

Fig.3a A 18 yrs old grove of *Toko* tree in Yagrunbg *jhum* land

Fig.3b A 14 year old grove of *Toko* trees with inflorescences in the jhum land

Fig.4 Branched inflorescence part of *Toko* tree

Fig 5 Ripe fruits of *Toko* tree

Fig.6 Six years old *Toko* tree with 4 leaves after harvesting

Fig.7 Bundles of *Toko* brought from *jhum* land

Fig.8 An *Adi* man curing Toko leaves in *jhum* land

Fig.9 *Abong* made of *Toko* leaves

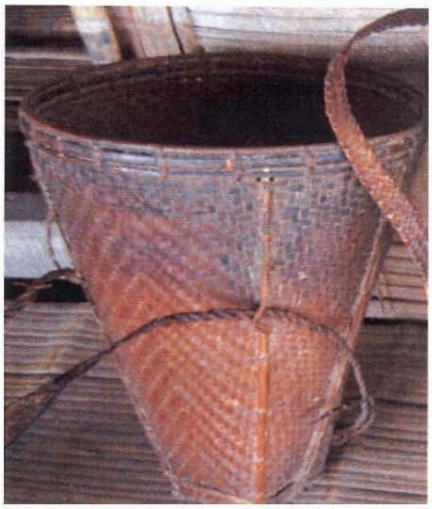

Fig.10 basket made of *Toko* leaves

Fig.12 The roasted pig kept in *Toko* leaf

Gender, conservation and knowledge variability

From seed selection (A) to plantation of *Toko* (G), women play a pivotal role and contribute 80-95.75%. Only those practices, where hard physical labour is required (H to K), male folk contribute from 60.5-82.25% (Fig.16). This shows that women of *Adi* community have a significant role in the conservation of *Toko* tree populations. Male harvest the leaves from *Toko* tree, while female carry the load of bundles of *Toko* leaves. It could be learned that except the practices of training & pruning of tree, harvesting skill of leaves and curing the leaves for use, women were significantly higher in all the *Toko* related practices (Table 1). Further, there was a difference in the knowledge of young, middle and old aged *Adi* community members on the conservation practices relating to *Toko* tree (Fig.17). It indicates that elders of *Adi* community have more knowledge about *Toko* tree which is helpful in conservation of this tree species.

Role of indigenous institution- *Kebang* in conservation

Without consent, if some body has harvested *Toko* leaves, the owner of *Toko* may report about it to *Kebang* (indigenous court of *Adi* tribe). The case is heard by jury members led by *Gaon Burha*. The fine is imposed to guilty person depending upon the types 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. The fine is paid either in cash or in kinds. In kinds, *Mithun*, pig, traditional utensils, etc. are given as fine items to the *Toko* owner, whose *Toko* leaves were harvested without his consent. *Kebang* also decide and demarcate the land size and location of *Toko* land to an owner, if it is in the dispute. Almost in each village, the *Kebang* has its control over solving depute and any issues around the *Toko*, because majority (> 50%) of the respondents of each village replied *Kebang* as a fully functional institution (Fig.18). Thus, *Kebang* has a direct and powerful function to control the overexploitation of *Toko* by the non-owner and therefore contribute in conservation.

Table 1—Practices relating to conserve *Toko* tree

Practices relating to *Toko*	Mean knowledge score		'Z' Value
	Male	Female	
Seed selection	69.24	131.23	13.27**
Seed soaking	72.34	125.47	16.32**
Nursery preparation	36.97	89.58	11.98**
Seed sowing	32.39	84.23	9.84**
Nursery care	42.36	81.61	14.27**
Transplanting	37.98	98.24	17.32**
Plantations	27.92	108.47	7.89
Training & pruning	96.87	45.68	9.47**
Harvesting	110.24	37.21	11.67**
Curing the leaves for use	46.35	103.67	14.24**
Trading & marketing	31.28	97.34	17.49**

** Significant at 0.01 probability level

Conservation

An effort has been made to record the number of *Toko* plants in the study areas of six villages. Results revealed that in six villages, total plants conserved by community were 33,026. The village wise population status was Sibut 4,285, Yagrung 6,680, Miram 9,126, Napit 2,495, Balek 4,090 and Berung 6,350 (Fig.19). These plant population were recorded in four major habitats, i.e. *Jhum* lands (24,161), *Morang* forest (5,430), home gardens (2,035) and around the paddy fields (1,400). Thus, *jhum* land was the first habitat with its highest population of *Toko* tree. Form six villages, out of 33,026 trees, 63,609 *Toko* trees observed were of 4-8 yrs, 10,375 of 9-13 yrs, 9,121 of 14-18 yrs, 5,102 of 19-23 yrs and 2,119 of more than 24 yrs of age (Fig.20). Majority of *Adi* respondents (73.48%) were conserving *Toko* in their *jhum* lands. Further, the preference ranking of six villages indicates that (Table 2) majority of male (71.18%) and female (85.92%) *Adi* respondents have shown their interest to continue and plant the *Toko* in *jhum* lands followed by *Morang* forest (male 65.21% and female 76.42% responded) and home gardens (male 30.10% and female 35.13% responded). The reason being mentioned for first ranking to *jhum* land was the topography of *jhum* land and soil fertility, where productivity of *Toko* leaves are harvested more by the owners. Therefore, it is disapproved to the past references that *Toko* is endangered tree species. There is no dearth of plants population of *Toko* in the study areas as indicated that sufficient numbers are conserved at an altitude from 110-180m and 155 and latitude 28.06 and longitude 95.33.

Table 2—Preference ranking about the selection of habitats for *Toko* plantation

Ecological niches	Ranks	Response in percentage*	
		Male	Female
Jhum lands	I	71.18	85.92
Home gardens	III	30.10	35.13
Around paddy fields	IV	21.19	19.23
Morang forest	II	65.12	76.42

*Due to multiple responses of respondents, the total percentage could not make 100

Fig.13 Meat pieces of *Mithun* being kept in *Toko* leaf during *Solung* festival

Fig.14 The *Adi* members setting *Toko* leaves on the roof of *Chang ghar*

Fig.15 A grain storage of *Adi* community made of *Toko* leaves

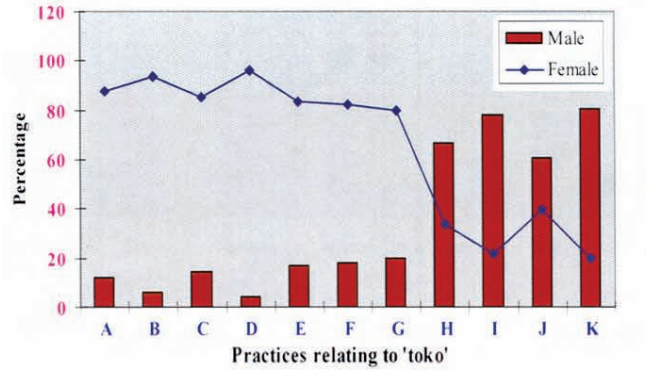

Fig.16 Gender role in conservation of *Toko* tree
A= Seed selection, B= Seed soaking, C= Nursery preparation, D= Seed sowing, E= Nursery care, F= Transplanting, G= Plantations, H= Training & pruning of tree, I= Harvesting, J= Curing the leaves for use, K= Trading & marketing of leaves

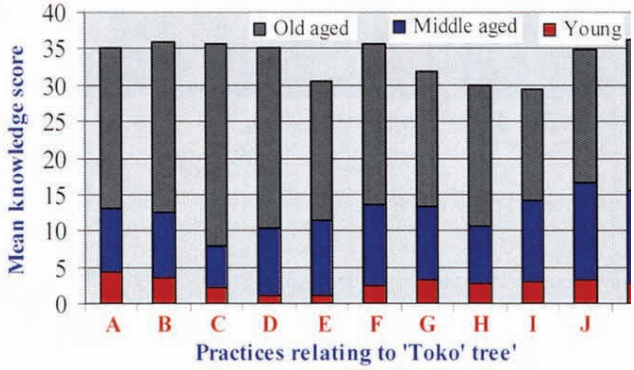

Fig.17 Age wise knowledge variations of *Adi* tribe on conserving practices related to *Toko* tree
A= Seed selection, B= Seed soaking, C= Nursery preparation, D= Seed sowing, E= Nursery care, F= Transplanting, G= Plantations, H= Training & pruning of tree, I= Harvesting, J= Curing the leaves for use, K= Trading & marketing;
Age: Young = 20-32 yr, middle= 33-45 yr, old= 46-85 yr

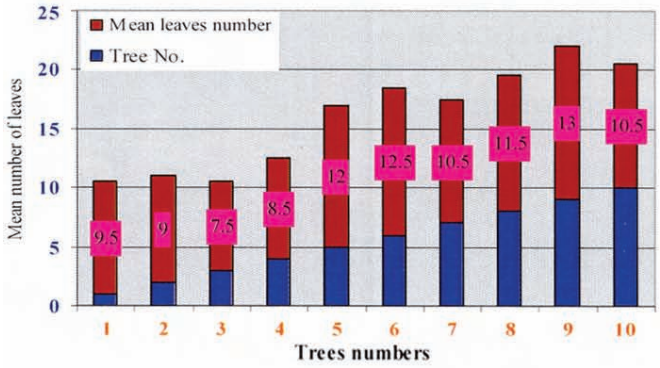

Fig.11 Mean leaves appeared in five year old 10 trees of *Toko*

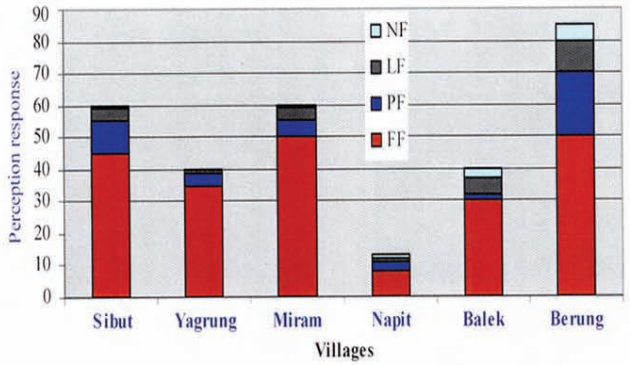

Fig.18 Perception of *Toko* conservators

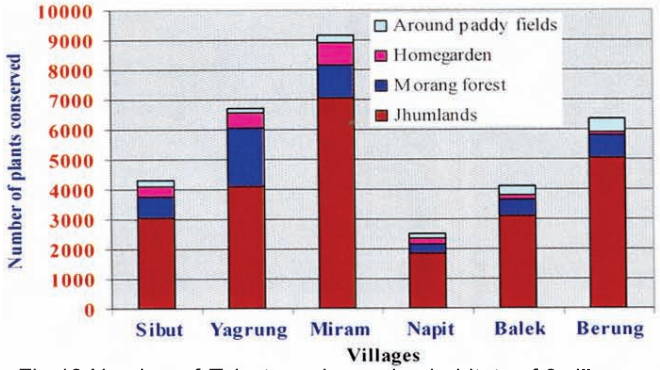

Fig.19 Number of *Toko* trees in varying habitats of 6 villages

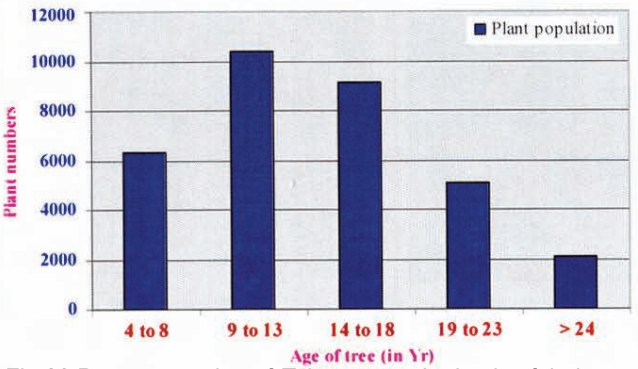

Fig.20 Plant population of *Toko* tree on the basis of their age

Conclusion

Toko's ecological adaptability varied from 110 to 180m in the study areas. It finds habitats in *jhum* land, *Morang* forest (broad leave forest) and some extent in the home gardens under subtropical climate. The seeds of *Toko* are dispersed and carried over by the squirrels and birds[21]. Due to the damage caused by animals in the seeds, the natural germination percentage is relatively low. However, germination is maintained by the *Adi* tribe through its traditional treatment after putting in the *ekkam* leaves. Apart from monoculture, the conservation of *Toko* is encouraged by adopting the traditional agroforestry models by *Adi* tribe. The higher plant population was observed in *jhum* land, because of its good productivity and people preference according to topography as well as use of available spaces during the first 5 yrs of crops establishment in *jhum* agriculture. *Toko* has been observed to be a cross-culturally important species and an integral part of *Adi* livelihood system. Leaves, stem and fruits are of great use to *Adi* tribe. Though, inputs required for conservation promotion of *Toko* are learned to be very less, however, the net income is of considerable percentage but not competitive in comparison to other cash crops. Because of the labour intensive job required for generating incomes from *Toko*, younger people do not prefer to plant the *Toko*. Therefore, more people are interested in planting the high cash crop such as orange, pineapple and others to have more economic gain. This discourages the conservation intensity of *Toko* tree. Other study also depict that conservation of plants biodiversity persist more in the areas where poverty is higher[22]. A spiritual attachment with the *Toko* and its historical perspective is a great source of learning that inculcates the idea of understanding the flow of genetic resource of a particular species. Cultural and spiritual attachment of plant biodiversity has the intrinsic correlation with conservation[23]. How an accident may cause compulsion to reduce the use of one species from other can be learned here in case of *Toko*.

The conservation of *Toko* on individual level and decreasing percentage of collective management are seems to be caused by the disintegration of joint family to nuclear family and aggravated by the privatization of natural resources among the *Adi* tribe. However, conservation of *Toko* in *Morang* forest provides a permanent reservoir for the use of its genetic resource to multiply later on in the emergency conditions. The conservation of *Toko* is primarily done by women folk and variability in the knowledge required for it was noticed across the ages. Many studies indicate that indigenous institutions, traditional knowledge (TK) and TK nurturing institutions play significant role in conservation of indigenous biodiversity[6,7,24]. In the study, it was observed that *Kebang*, as an indigenous institution, still play a considerable role in solving the dispute and management of *Toko* at the community level. Though, *Toko* is primarily conserved by the tribal communities to meet out their basic need in two major habitats (*Jhum* land and *Morang* forest), however, a healthy adjoining ecosystems have a great role to play in sustaining the *Toko* plant species. These adjoining ecosystems are also need a protection to provide ecological service to the plants communities of at larger scale. The natural virgin forests in the study areas are so complex, delicate and fragile that a minor imbalance could be detrimental to the interest of human and plant species that inhibit these natural environments[3]. Recently, tropical deforestation due to natural and anthropogenic factors has degraded the forest to a great extent. Low plant population density of endemism in degraded forests raises an alarm for appropriate conservation measures not only for the *Toko* but even for other species too[3].

Toko is bioculturally important tree species and is being conserved across the habitats and cultures. There is no dearth of plants population of *Toko* in the study areas and thus urge to the scholars' who in their past work reported *Toko* as the endangered and threatened species- to seriously think about this species. It can be endangered and threatened in other regions like Assam, but not in Arunachal Pradesh according to the study. The community with their TK and indigenous institutions conserves this tree species at large scale since it is the integral part of their life support system. The *Adi* and other tribes conserving *Toko* must be rewarded and given due recognition for their role, as other study show that such approach could enhance the conservation of biodiversity[25]. Special attention is required to integrate younger generation of community with better incentives so that the conservation intensity of *Toko* could be improvised at the larger scale. Further, the community needs training and research support on *Toko* to enhance the plant population, but is only possible when *Toko* is well integrated with its rational use

through value addition in its products (handicrafts, houses construction material, food products from fruits, etc.), proper market channels and controlled harvesting. There might be few biological threats against this species that need to be studied further to understand the complete status and issues around *Toko* tree species in Arunachal Pradesh.

Acknowledgement

Authors are grateful to all the respondents, who were part of the study and have provided their valuable inputs. All the *Gaon Burhas* are dully acknowledged for their role played as the key communicators and establishing rapports with *Adi* community members. The financial support obtained for the project from Central Agricultural University, Manipur is thankfully acknowledged. Authors are also grateful to Director BSI, Kolkata for facilities.

References

1 Myers N, Threatened biotas: hotspots in tropical forestry, *Environmentalist*, 8 (1988) 1–20.

2 Heywood VH & Watson RT, *Global Biodiversity Assessment*, (Cambridge University Press, New York), 1995, 174–185.

3 Behera SP, Kushwaha S & Roy PS, High plant endemism in an Indian hotspot – eastern Himalaya, *Biod Conserv,* 11 (2002) 669–682.

4 Alcorn JB, Noble savage or noble state? Northern myths and southern realities in biodiversity conservation, *Ethnoecologica*, 3 (1994) 7-19.

5 Altieri MA, Agriculture, traditional, In: *Encyclopedia of Biodiversity*, Vol I, edited by Simon AL, (Academic Press, San Diego, California, USA), 2001, 109-118.

6 Singh RK, Srivastava RC & Mukherjee TK, Community based sustainable natural resources management and development in Northeast India, *Curr Sci*, 96 (1) (2009a) 19-21.

7 Singh RK & Srivastava RC, Biocultural knowledge and *Adi* community: conservation and sustainability in biodiversity hotspot of Arunachal Pradesh, *Curr Sci,* 96 (7) (2009b) 883-884.

8 Singh RK, Agrobiodiversity: conserving diversity and culture - Pem Dolma, *Honey Bee*, 15 (2004) 12-13.

9 Myer N, Muttermeier RA, Muttermeier CA, da Fornseca GAB & Kent J, Biodiversity hotspots for conservation priorities, *Nature*, 403 (2000) 853-858.

10 Kanjilal UN, Das A, Kanjilal PC & De RN, *Flora of Assam,* Vol III, (Government of Assam, Shillong), 1939.

11 Kanjilal UN, Kanjilal PC & Das A, *Flora of Assam*, Vol II, (Government of Assam, Shillong), 1938.

12 Kanjilal UN, Kanjilal PC, Das A & Purkayastha C, *Flora of Assam*, Vol I, (Government of Assam, Shillong), 1935.

13 Kanjilal UN, Kanjilal PC, De RN & Das A, *Flora of Assam*, Vol IV, (Government of Assam, Shillong), 1940.

14 Rao RR & Hajra PK, Fern allies and ferns of Kameng District of Arunachal Pradesh, *Indian Fort Reco Bot,* 106 (1980) 327-349.

15 Nayar MP, *Hotspot of Endemic Plants of India, Nepal and Bhutan,* (SB Press, Trivendrum), 1996.

16 Mishra S, Singh RK & Singh A, Dynamics of traditional foods and livelihood of *Adi* women in varying socio-ecological systems of Arunachal Pradesh: A source of learning and inspiration, In: *The New Cultures of Food: Marketing Opportunities from Ethnic, Religious and Cultural Diversity,* edited by Lindgreen, A & Hingley MK, (Gower Press, London, UK), 2009, 203-222.

17 Rolla SR & Joseph J, *Livistona jenkinsiana, Principes,* 6 (1962), 3, 103-106.

18 Anonymous, Red *Data Book of Indian Plants*, Vol I–III, (BSI, Kolkata), 1987.

19 Srivastava RC, The state-tree of Arunachal Pradesh, *Curr Sci*, 91 (7) (2006) 857.

20 FAO, Threatened South Asian Palms. FAO, Rome. < http://www.fao.org/ docrep/X0451e/X0451e06.htm > (Accessed on 02-02-2010).

21 Aparajita D & Rawat GS, Dispersal modes and spatial patterns of tree species in a tropical forest in Arunachal Pradesh, Northeast India, *Trop Conserv,* 1 (3) (2008)163-185.

22 Gupta AK, *Why does poverty persist in regions of high biodiversity?: A case for Indigenous Property Right System, Intl Conf Property Rights & Gen Res* (IUCN, UNEP and ACTS at Kenya, June 10-16, 1991), 1991.

23 Posey D, *Cultural and Spiritual Value of Biodiversity*, (Intermediate Technology Publications and UNEP, London), 1999.

24 Savita B & Ghildiyal JC, Sacred groves for biodiversity conservation in Uttarakhand Himalaya, *Curr Sci*, 92 (6) (2007) 711-712.

25 Gupta AK, *Empowering Conservators of Biodiversity and Associated Knowledge Systems: An Intellectual Property Based Framework* (Working paper No 2002-05-02, Indian Institute of Management, Ahmedabad), 2002, 3-19.