

## **VERSATILE APPLICATIONS OF BAMBOO RESOURCES AMONG THE ADI, APATANI AND GALO TRIBES OF ARUNACHAL PRADESH AND ITS LIVELIHOOD POTENTIAL**

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**Abstract:** The state of Arunachal Pradesh in northeastern India is rich in bamboo resources, occupying the 3<sup>rd</sup> place in terms of area under bamboo cover in the country, after Madhya Pradesh and Maharashtra. Bamboo forms a part of the daily life of the indigenous inhabitants of the state and is a source of food, raw materials for construction, handicrafts, agricultural implements and other items of daily use. Due to its versatile uses, bamboo is closely associated with the livelihood of the people, especially in rural areas. This study presents the utilization of bamboo for different purposes by the *Adi*, *Galo* and *Apatani* which are among the major tribes of Arunachal Pradesh. The study also highlights the future prospects of bamboo for rural livelihood, food and nutritional security and prescribed some recommendations for development of bamboo based industries through sustainable utilization of bamboo resources and skill development of the local communities of the state.

**Keywords:** Rural livelihood, bamboo-based industries, food security, conservation.

### **Introduction**

Bamboo is one of the fastest growing plants on earth. It belongs to family Poaceae and sub-family Bambusoideae. Bamboos are distributed naturally in abundance in East and Southeast Asia and Islands of Pacific & Indian oceans. As per an FAO report (2007), there are about 1,200 species in 90 genera worldwide. India is reportedly home to about 125 indigenous and 11 exotic species of bamboo from 23 genera. The North Eastern States and West Bengal account for more than 50 % of the bamboo resources of the country. Arunachal Pradesh (1.49 m ha) occupies a third place in terms of bamboo cover area in the country after Madhya Pradesh (2 m ha) and Maharashtra (1.52 m ha) (ISFR 2019).

Bamboo is closely associated with the livelihood of people of Asia, Africa and Latin America due to its versatile uses. Bamboo poses great potentiality for making environmental friendly, low cost, sustainable house to meet the need of people (Terai and Mnam, 2012). The consumption of steel and cement can be reduced significantly by using bamboo as construction material. It is a worthy alternative for making eco-friendly and economic friendly house. A study conducted by a group of scientists has shown that bamboo elasticity

and tensile strength is equal to that of steel in building material (Bhardwaj *et al.*, 2014; Bhagal *et al.*, 2013; Xiao *et al.*, 2010). Bamboo as a building material has its drawback, despite being highly efficient, that is they are susceptible to termite attack. The demand for the bamboo furniture has increased in the last few years. The bamboo furniture industry holds a great potential due to its aesthetic designs and cost effectiveness. Many well-designed and elegant products made out of bamboo are available which includes sofa, chairs, tables, dining tables, cots. Bamboo boards are also used to make table tops and school, office and showroom furniture. Another feature of the bamboo furniture is its light weightiness. Besides furniture, many stylish handicrafts such as lampshades, standing lamps, baskets, showpieces and decorative corners has been seeking a great attention of crowd.

Bamboo shoots have low content of fat, high in potassium, carbohydrate, vitamins and dietary fibers. It serves as delicacy in several part of the world. Edible shoots are found in many of bamboo species but very less of them are utilized (Chongtham *et al.*, 2011). *Bambusa balcooa*, *B. bambos*, *B. kingiana*, *B. nana*, *B. vulgaris var. vulgaris*, *Bambusa hookeriana*, *Dendrocalamus asper*, *Denndrocalamus giganteus*, *D. membranaceus*, *D. sikkimensis*, *D. strictus*, *Gigantochloa strata*, *Melocannabaccifera*, *Phyllostachys bambusoides*, *Schizostachyum capitatum*, *Teinostachyum wightii*, *Thyrsostachys siamensis*, *T. oliveri*, *Schizostachyum dullooa* are the Indian species used for their shoots (Bhatt *et al.*, 2005; Tamang, 2008). These young bamboo shoots have been considered as gourmet items in the west world where these are available only as imported canned products (McClure, 1996; Baiyi *et al.*, 2006). Value addition has been observed in most of the countries for consumption with their own traditional and non-standardized manner. Hence there exists a great market opportunity for food based industries to process bamboo in an organized manner. Bamboo juice, bamboo tea and processing bamboo leaves although they are not as much commercialized as were bamboo shoots (Bhatt, 2005; Choudhary *et al.*, 2012; Lu *et al.*, 2005; Qiu, 1992).

Since ancient times bamboo extracts have been used to treat human illness. Many studies have reported the usefulness of bamboo extracts in controlling diabetes and cholesterol (Singhal *et al.*, 2013; Darmananda, 2004). *Tabasheer* (or *tabashir*); bamboo sapare, these bamboo extracts used in remedies for children's feverish disorders and epilepsy (Gaur, 1985; Yang, 2002). Burnt powder of roots was reported to be highly useful in bleeding gums and arthritis, leaf possess the property of antileprotic, anticoagulant and used in haemoptysis (Shukla *et al.*, 2012), *Lophaterum gracile* and black bamboo leaves are useful in urinary

retention with blood in urine while leaves of *Pleioblastus amarus* are useful in treating fidgeting and lung inflammation. Various studies had shown that bamboo extract possess anti-inflammatory, antioxidant and antimicrobial activity (Hu *et al.*, 2000; Jung *et al.*, 2005). *Bambusa arundinacea*, a popular ayurvedic medicinal plant, possesses variety of properties such as anti-inflammatory, antiulcer, anthelmintic, antioxidant etc. (Lu *et al.*, 2005). Seeds of bamboo plants are considered as laxative and are useful for constipation and urinary discharge. Buds of *Bambusa bambos* are reported to have estrogenic activity.

High diversity of bamboo resources in North-eastern states of India plays a significant role in the food and nutritional security of the ethnic community residing in this area. Bamboo is the lifeline of many tribal cultures and their way of life in the north-eastern Indian. In rural economy, it has provided with a very viable means of livelihood through handicrafts, building materials, agricultural implements, furniture, fuel and food in the form of bamboo shoots. Bamboo craft is one of the oldest cottage industries primarily due to versatility, strength, lightness, easy workability of bamboo with simple hand tools. Young bamboo shoots have been a source of food for the tribal communities of Northeastern Region of India and other Asian countries for centuries. They can be consumed in fresh, fermented, dried and in many cases canned too. As a forest food, it is rich in crude protein, carbohydrates and minerals and almost free from fat. The present study was carried out to document the traditional knowledge and skills of the indigenous communities of Arunachal Pradesh in utilizing the rich bamboo resources of the state as well as highlight the potential role in livelihood enhancement, especially among the rural communities of the state.

### **Study Area**

Arunachal Pradesh, in north-eastern India lies in the Indian Eastern Himalayas and covers an area of 83,743 sq. km with an elevation range of 100-7089 m. It also forms part of the Indo-Burma biodiversity hotspot. The state is well-known for its vast ethnic diversity comprising of 26 major tribes and more than 100 sub-tribes. Each of these tribal communities possess unique traditional knowledge system in management and utilization of the rich biodiversity around them for their sustenance. This study was carried out among three major tribes of Arunachal Pradesh, viz., *Apatani*, *Galo* and *Adi* tribes. All the three tribes belong to the *Tanii* group which were descendants of Abo Tani, their first ancestor. The *Apatani* tribe main inhabit the Ziro valley (Ziro-I circle) also known as the *Apatani* plateau in Lower Subansiri district, situated at an altitude of 1564 m above sea level. The *Galo* tribe is one of the major tribes belonging to the *Tani* clan. They inhabit mainly in the district of West Siang and

adjacent part of the East Siang and Upper Subansiri of Arunachal Pradesh. The *Adi* tribe mostly inhabit the districts of East, West and Upper Siang, parts of Subansiri and Dibang valley.

The present study was focused on three districts, viz., Lower Subansiri (mainly Ziro valley), East Siang and West Siang (Fig. 1) which were majorly inhabited by the *Apatani*, *Adi* and *Galo* communities, respectively.

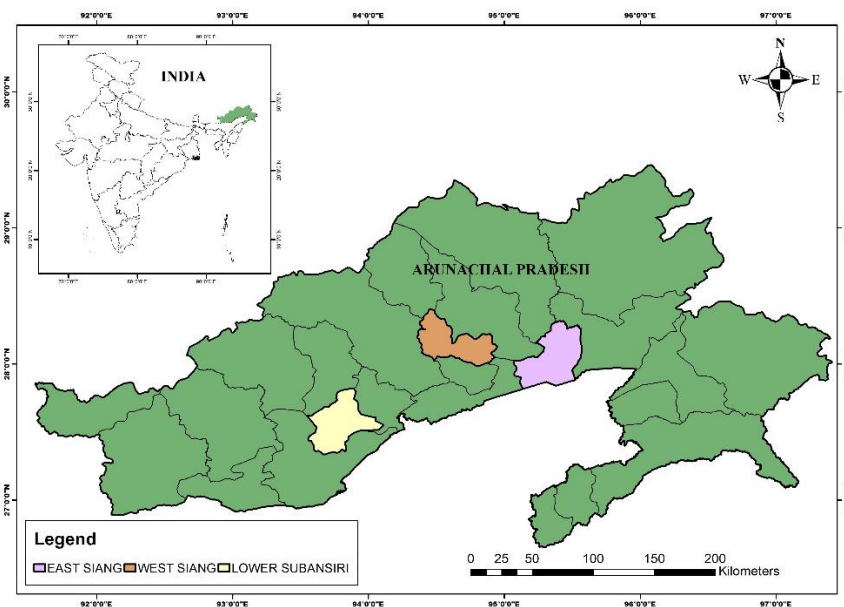


Fig. 1. Map showing the location of the study areas

## Methodology

Preliminary study was done through review of secondary information on bamboo resources diversity, utilization and market values from scientific publications including journal articles, reports, popular articles, books and other online sources. Primary field survey among the targeted communities was conducted through open-ended questionnaires, focused group discussion and informal conversation with knowledgeable persons. Market surveys were also conducted at main markets of the selected districts to obtain information about the types of bamboo products sold and their market rate.

## Results

### *Utilization of bamboo as food*

Bamboo shoot is a popular delicacy among the three targeted communities. Bamboo shoot is consumed either in fresh, dried or fermented form. However, its mode of consumption and preparation slightly varies from one community to another. The main species found in the Ziro plateau is *Phyllostachy bambusoides*, locally called '*Bije*' which is a reed-like bamboo

with long creeping rhizomes. It is primarily cultivated in the bamboo groves (Fig. 2) and is used for various purposes in the community ranging from food source to religious rituals.



Fig. 2. Bamboo garden of *Apatani* plateau

Tender bamboo shoots, called as '*Byapu*' in *Apatani* dialect, have been used as a source of food for generations. They are consumed freshly or fermented products are prepared for either household consumption or selling in the market. Different fermented products are '*Hirring*', '*Hikhu*' and '*Hithyi*'. Study shows that the average consumption of shoots ranges between 6 kg to 15 kg/household. Category-wise, consumption of shoots was recorded 5-15 kg/household as vegetable, 13-15 kg/household as dry fermented and 8-10 kg/household as wet fermented. The market availability of shoots was recorded 98-175 kg/ week during mid-July to September for fresh shoots, 20-31 kg/week for wet fermented and flattened whole shoots and 1-1.2 kg/week for pieced dry product (Melkania, 2008).

*Hirring*: For its preparation, sliced bamboo shoots are put inside an airtight bamboo cylinder sealed by banana or *ekkam* leaves (*Phryium capitulum*) and the fermentation process is allowed to take place for a week.

*Hikhu*: Sliced bamboo shoots are put in a basket with a lining of banana leaves inside for its preparation. Sealing is done by banana and *ekkam* leaves. The fermentation is allowed for 6-8 days.

*Hithyi*: These are sliced bamboo shoots dried in sun.

Similar to the *Apatanis*, the *Galo* tribe also possess different varieties of bamboo shoots products known by different names depending on their mode of preparation as follows:

*Kupe*: Tender bamboo shoots are fermented directly or sliced vertically before fermentation. After the fermentation the product obtained is called *Kupe*. Fermentation is done by two methods, first where the fresh tender bamboo shoots either whole or sliced are wrapped around with *Phryinium sp.* locally called as *ekkam*, then put into basket, covered with the same leaves and left in a pit near a stream. The second method is where the whole or slice

bamboo shoots are stuffed into matured bamboo with one node remaining at one end and the other open to give a cylinder like container. Water is added and the container is made airtight with the help of *ekkam* or banana leaves and kept in a moist pit. Fermentation takes about 15-30 days, after which *Kupe* is ready. The shelf-life is 1-2 years within air tight containers. These are being sold in the local markets and are a viable livelihood for the tribal communities.

*Eepe*: *Kupe* after being sun-dried for 7-10 days makes *eepe*. It is dark brown in color, bears more pungency and has more shelf-life than *kupe*.

*Eeku*: The more mature portion of the bamboo shoot that was removed for *kupe* preparation is used for *eeeku*. The internodes are cleaned and sliced and chopped into small pieces. Fermentation and storage is similar to *kupe*, just it takes more time than *kupe* because of the mature fibres in the raw material.

Among the *Adi* tribe, the most common bamboo species used for edible purposes is *Dendrocalamus hamiltonii*. The different types of bamboo shoot products of the *Adi* tribe, their mode of preparation and local name are given below:

*Iku*: Young shoots of *Dendrocalamus hamiltonii* is ground and dried (Sharma and Borthakur, 2008). It is used as chutney or flavoring agent in *dal*.

*Eup*: Fermented bamboo shoots which are prepared by putting fresh bamboo shoots in baskets and covered with leaves; stones are put on top of the baskets to make it airtight. Fermentation is completed in 2-3 days. *Eup* is made by drying and grinding. It is used as a flavoring agent in vegetable (Sharma and Borthakur, 2008).

*Ekku*: Juice drained from fermented bamboos shoots stored for 50-60 days. It is also used as flavoring agent in vegetables (Sharma and Borthakur, 2008).

*Kupe*: Shoots boiled and cut into pieces. It is used as vegetable (Sharma and Borthakur, 2008).

### ***Bamboo handicrafts***

Bamboo has been widely used as a raw material for making various types of handicraft items (Fig. 3). The items include a variety of baskets for storage and carrying goods such as paddy, firewood, etc., according to the needs. These baskets are also sold in the local markets which becomes a source of income for the rural community. Different novelty items made out of bamboo also fetch a very good price in the market. Bamboo cups and plates are also very viable options for bamboo handicraft artisans as far as the livelihood is concerned. Bamboo is used for making hunting, such as bow and arrow, traps for the small birds and small rodents,

fishing equipment such as poles and baskets are also made from bamboo. Other household items such as mats, shoulder bags, hats, vessels, mugs with carvings can also be seen being made out of bamboo and canes. The communities have mastered the technique of basketry, and the designing of such items among the villagers has been found to be entirely based, practical and are aptly suit to their socio-cultural and geographical landscape (Singh *et al.*, 2008).



**Fig. 3.** Different types of bamboo handicraft items from the study areas. (a) *Dueng* (carrying basket), (b) *Yokpur* (Sword carrier), (c) *Chuga* (carrying basket), (d) *Edung* (liquid storage container), (e) *Hokiap* (bag for carrying fishes during fishing), (f) *Abong* (rain shield) and (g) *Epo* (winnowing tray)

### ***Bamboo as construction material***

Bamboo as a housing material has been very common among the tribal communities of northeastern India for generations (Fig. 4). In an *Apatani* traditional house, almost all the raw material used is obtained from bamboo. Bamboos are split vertically along its axis, then bamboo is unrolled along its axis and a flattened bamboo culm ply is obtained called ‘*Yamyo*’. The walls, the floor and the entrance doors, all are made out of flattened bamboo bamboo ply. In modern times, many are adopting the semi-traditional type of house, where bamboos can be used in different twists for aesthetic looks. Bamboos are also a very common material used by the *Apatanis* as a fencing material to surround the kitchen garden and bamboo and pine groves. Bamboos with very vigorous branching from the nodes are used as a fencing material against cattle and fowl birds try to break in through the fences as the branches would poke the animals on their sensitive parts of their head.



The *Galo* tribe also utilizes bamboo as a key raw material for the construction. Bamboos are made into flattened bamboo culm ply called '*Nyope*' in *Galo*, which are then used for various construction purposes such as of houses, sheds for livestock, etc. Bamboo and cane as a raw material are also used for the construction of suspension bridges, built across the rivers or canals.

Bamboo species *Dendrocalamus hamiltonii*, *Dendrocalamus hookeri*, *Bambusa pallida* and *Bambusa tulda* are mostly employed in a traditional house construction by the *Adi* tribe (Singh *et al.*, 2008). The walls, floor and ceiling of the traditional house is made out of bamboo. The leaves of *toko-patta* (*Livistona jenkisiana* Griff.) are used after proper drying as a roofing material for local houses (Singh *et al.*, 2008). Bamboo is also a popular choice for fencing material to cover the boundaries of house, kitchen gardens and fields. Bamboos are used in making shed for the livestock, poultry and piggery.



**Fig. 4.** Use of bamboo in house construction (left) and fencing (right)

#### ***Other uses***

Dry and old bamboos which can no longer be used for any other purposes such as construction or fencing, are collected and sold in the market as firewood. The green peel of culm of bamboo species *Dendrocalamus hamiltonii* has been used as an effective treatment of cuts and wounds.

#### **Discussion**

Bamboo plays an important role in the life of people of Arunachal Pradesh, and in rural areas 50-70% works are performed by using bamboo. Bamboo is preferred for used in day to day works, like house construction, furniture, agricultural equipment, transportation, irrigation, water carrying and storage, musical instruments, edible, fuel, fodder etc. It not only provides the rural communities with their day to day essential needs but also can be used as an income source by producing different value-added products.



***Livelihood potential of bamboo as a food source:*** As a food source, the bamboo shoot products are available in various forms in the study areas. These forms were fresh, fermented and sundried. From the above study one can come to a conclusion that the scope of livelihood in bamboo as a food source is viable. The sales of fresh bamboo shoots were recorded second highest in Arunachal Pradesh (Bhatt *et al.*, 2004). From the study areas we have observed that the bamboo shoots as fresh provides a healthy seasonal income as seen in study done by Melkania (2008). And when it comes to value added products, which can be stored for significant periods of time, it can be turned into a reliable source of income throughout the year. The fermented bamboo shoots were a real delicacy among all the tribes studied with each tribe having their own nomenclature for the fermented products and methods of fermentation as seen by Roy *et al.* (2017). Since, the household consumption of bamboo shoots has a high demand in the northeastern region; the market for the bamboo food products is ever expanding. The entrepreneurial potential in the value added products of bamboo shoots holds a great future, especially in the tribal communities where the traditional knowledge can be channeled into the value addition process. The international demand for the bamboo food items is big in the far-east and the south-east Asian countries. The traditional knowledge applied can be used as a unique selling point (USP).

***Livelihood potential of bamboo handicraft:*** Bamboo craft is one of the oldest cottage industries primarily due to versatility, strength, lightness, easy workability of bamboo with simple hand tools. The bamboo has been used as a raw material for many handicrafts by different ethnic groups in the northeastern India for many generations. The knowledge of making bamboo handicrafts are mostly passed on from one generation to another verbally in most of the tribal communities. The craft making is an old tradition among the tribes of Arunachal Pradesh (Sharma *et al.*, 2015). One of the salient features on the bamboo handicrafts for the studied tribes were that the experts himself performed most of the activities involved from collection of raw material, preparation of finer workable material to the finishing of the final product (Ete, 2014). Ete (2014) also reported that the required labor hours for finishing a handicraft product depends on the expertness. Consequently, this influences the cost of production and subsequently to its market price. Traditionally, the older male members of the household of these tribal communities were engaged in making these bamboo and cane articles for home use. These bamboo and cane works are characterized by unusual shapes and intricately woven patterns in some very attractive designs. The potential of transforming these basic skills into a variety of new products for a larger market is

immense (Sundriyal *et al.*, 2002). From the study we found that the bamboo handicrafts made were almost similar but also differed from tribe to tribe based on the topography of the area and also the nature of requirements. Bamboo was used for making different kinds of baskets, household utensils, fishing and hunting traps, grain storage bins, musical instruments, etc. which are most important items in their daily life (Sharma and Borthakur, 2007) and also being sold in the market which gives them some additional income (Sharma *et al.*, 2015).

***Livelihood potential of bamboo as a construction material:*** In most of the traditional house of the tribes of Arunachal Pradesh, bamboos are used extensively, except for Monpas and Membas who uses stone and clay for housing material. All the three selected for the study utilized bamboo as a primary raw material for the construction when it came to traditional homes. The traditional agroforestry system of *Apatanis* appears to be chiefly the domestic supply of basic traditional housing material (Tangjang and Nair, 2016). Bamboo culms are chopped into flattened plies and these plies are used in walling and flooring of the traditional houses. These flattened bamboo plies as a refined raw material for housing can be observed in all the three tribes studied. Everyday bamboo poles used for construction and other purposes are being transported for sale in different markets located in urban areas, thus contributing to livelihood.

### **Recommendations and future prospects**

Having a potential economic status in market, bamboo needs a quality research (Gaur, 1985). Regarding handicraft industry, Minto (2014) pointed out the following problems as the main reason for handicraft industry not being a viable livelihood option: (i) lack of interest of craftsman; (ii) lack of working capital; (iii) lack of marketing facilities (iv) lack of capacity utilization, (v) lack of technical know-how (vi) shortage of organizational strength (vii) competition from other modern products, (ix) lack of entrepreneurial knowledge, etc. Further, Minto (2014) suggested ways to strengthen the handicraft industries in Arunachal Pradesh. Proper exposure of the artisans or entrepreneurs to different expo and fairs would help them in expanding the business in handicraft; this is the area where government could provide assistance especially for those getting organized outside the state. The bamboo handicraft industries will have to be attracted by means of various incentives and concessions. Bank may offer special scheme to the entrepreneurs so that they can take short-term interest free loan. The bank can detect the sickness of industrial units and draw up a nursing plan for their rehabilitation. Sundriyal *et al.* (2002) emphasized that there is a strong need to divert a part of the well managed bamboo resource towards income generation, such as bamboo ply

production and upgraded bamboo craft products with improved technologies. Bamboo ply flooring and boards would provide yet another building material alternative based on a local resource, which would have both a local and an outside market (Sundriyal *et al.*, 2002).

For conservation of bamboo in Arunachal Pradesh, a number of Programmes such as Nursery Development-Centralized nursery, Kisan nursery, Mahila nursery, bamboo plantation both in public and private sector have been taken up under NMBA, DST and NBM, Ministry of Agriculture, Govt. of India. The state of Arunachal Pradesh has two bambusetum, one at Van Vgyan Kendra, Chessa with 55 tropical Bamboo species and another at Bomdila with 12 subtropical and temperate bamboos species. Further training to local craftsmen and entrepreneurs in various scientific methods of bamboo cultivation, harvesting, treatment, processing and value-addition would be one way to help improve the quality of bamboo products from the state which are compatible at the national and global markets for sustained livelihood of the indigenous communities.

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