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Bamboo diversity, distribution and utility in forest fringe villages of Manipur (India)

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Abstract
An extensive field study was carried out during 2017-18, to explore Bamboo diversity and their utility in different forest fringe villages of Manipur. The fringe villages were selected at random from different districts of Manipur based on maximum availabiltiy & literature survey. For documenting utility of different bamboo species, the "transect walk" method of participatory rural appraisal (PRA) were adopted. The result indicated that, bamboo grow luxuriantly from hills to valleys of Manipur and form an important component of rural landscape. In total 16 bamboo species were documented from 19 forest fringe villages, which in turn situated in 5 different Districts of Manipur. The Use-value data indicate that there is a high degree of consensus among informants regarding utility of bamboos. A survey on the use of bamboo revealed that, availability of bamboo in fringe villages mainly depends on its utility to the natives. Besides that, impact of altitudinal variation on species availability has also been noticed clearly in the study areas. The most commonly grown and used species of bamboo in forest fringe villages were *Bambusa nutans, B. tulda, Schizostachyum pergracile, Dendocalamus hamiltonii, Melocanna bambusoides* and *Thyrsostachys oliveri.*

Keywords: bamboo diversity, utility, fringe village, manipur

1. Introduction
Manipur, the state of North East India, known as 'The Land of Jewel or Switzerland of India' due to its breathtaking blue hills, charming scenery and natural endowments. Its assorted topography and distinctive climatic conditions fashioned diverse forest types in the state i.e. Tropical Semi-evergreen, Dry Temperate Forest, Sub-Tropical Pine and Tropical Moist (FSI report, 2018) [3]. By virtue of these speckled climatic surroundings, various species of bamboos are found flourish here, both in the hills and in the valleys. In Manipur approx. 3268 km^2 area is under pure bamboo brakes, which is 18.6% of the total forest area of the state and nearly all the bamboo species of north-eastern India are found nurturing here (Sharma, GJ. (1996) [6]. Hollow woody culms, widespread rhizome system, elaborate branching, and erratic flowering are some of the unique characteristics of this Poaceae family member (Biswas, S. 1998) [1]. In Manipur, it is an ethnicity to raise bamboo in homesteads, as they provide vital uses for subsistence of rural livelihood (Devi & Devi, 1995) [2]. The want for bamboo subsists from childbirth to death as they are use in house construction, fuel, fodder, food, tools, religious ceremony etc. (Singh *et. al.* 2003) [7]. In forest fringe villages of Manipur, dependency on bamboo is much more than any other part of the state not because of its multipurpose uses only but because it is associated with their legends also (Singh and Singh, 1996) [9]. Due to that, foremost species of bamboo have been selected and preserved by dwelling ethnic and tribal communities and thus it is rightly to say that, they are the real protectors of the forests biodiversity. Although, the bamboo species conserving and protecting in forest fringe villages by them have not been received proper attention, in term of diversity, distribution and utility pattern. Also, due to indiscriminate exploitation, annihilation of forests and changing scenario of rural standard of living, the bamboos of Manipur is in the process of continuous degeneration. Thus there is an urgent need to document and determine the present status of bamboo species growing in forest fringe villages so, that measures can be taken well in advance to conserve this Green Gold of Manipur. With this aim the extensive field surveys were undertaken to provide a comprehensive account on:

1. Diversity and distribution of bamboo species in forest fringe villages of Manipur.
2. Their utility pattern among ethnic people of the forest fringe villages.

2. Material and Methods

2.1 Study area

The study has been conducted during 2017-18, in different forest fringe VILLAGES of Manipur. The Manipur state lies between 23º 50' N to 25º 42' N latitudes and 92º 58' E to 94º 45' E longitudes, on the laps of Himalayan ranges having an area of 22,237 sq km. The topography of the State is undulated with an elevation of 790 meters above sea level. The climate of Manipur is highly influenced by the topography of this hilly region. The maximum temperature in the summer months is 32 °C (90 °F) and in winter the temperature often falls below 0 °C (32 °F), bringing frost. The coldest month is January and the warmest July. The state is drenched in rains from May until mid-October (State of Env. report, 2014).There are around 29 ethnical communities in fringe villages of Manipur comprises of mainly Nagas and Kukis (i. e. 29.9% of the state). Although each tribe has its own dialect but they majority of them speak Manipuri/ Meiteilon while communicating among themselves (Horam and Rizvi, 1998) [5].

2.2 Field survey and data collection and analysis of data

Field visits for documenting the diversity & distribution of bamboo species were undertaken in 19 different forest fringe villages selected from 5 different districts of Manipur (i. e. Bishnupur, Imphal East, Imphal West, Chandel and Churachandpur) Fig. 1. The local people were interviewed for documenting the utilization of bamboos in their day to day need by using the "transect walk" method of participatory rural appraisal (PRA) and then data were analyzed through Use-value valuation technique (Singh *et. al. 2017*) [8]. Bamboo specimens were collected, photographed and identifies with the help of BSI, Shillong herbarium and the voucher specimens were deposited at the Herbarium of RFRI, Jorhat (Assam).

3. Results

Wide variety of bamboo species were growing and cultivating in different region of Manipur rage form valleys to the hill top. In the pure forest, bamboos grow naturally and extensively but in forest's fringe villages, their geographical distribution is exceedingly influenced by human action. There people prefer to grow those bamboo species in their homesteads and farms which were having high utility to them and which can fetch good price in the market (Gupta, A, 2013) [4]. During the field survey in 19 forest fringe villages of Manipur, 16 bamboo species under five genera were reported. The main genus found in the fringe villages of the sate were *Bambusa sp*. and *Dendocalamus sp*. The most commonly found bamboo species in surveyed forest fringe villages were *Bambusa tulda, B. nutans, Dendrocalamus giganteus, D. hamiltonii, D. hookerii, D. manipureanus, D. latiflorus, Melaconna bambusoides, Schizostachyum pergracile, Thyrostachys oliveri* etc.

3.1 Diversity & distribution pattern in forest fringe villages

Among the district surveyed, highest bamboo diversity were discern visually from Imphal east (38.7%) followed by Imphal west (29%) and Churachandpur districts (12.9%), whereas, least diversity were noticed from Bishnupur and Chandel District of Manipur with 9.7% each (Fig. 2).

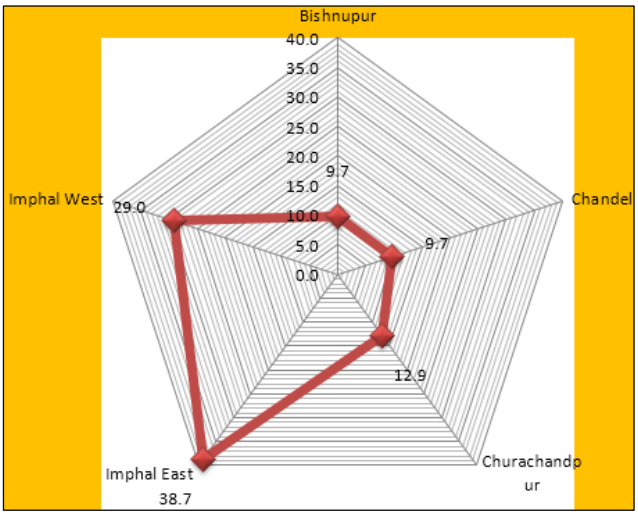

Fig 1: Bamboo species (in %) reported from Diffrent distrcits of Manipur

In term of forest fringe villages of Manipur, appreciable percentage of bamboo diversity were observed from Poiroukhongjil village (16%) of Imphal East district with *T. oliveri, B. nutans, S. pergracile, D. hookerii, D. manipureanus* and *M. bambusoides* as the dominant species; followed by Kairou village (13%) again of Imphal East district where *B. nutans, B. nana, B. kingiana, D. flagellifer* and D. *manipureanus* were the dominant kind. However, the least bamboo diversity (i. e. 3%) were perceived from Bishnupur-10, Terakhong & Sanbei village of Bishnupur; Khongampat, Saikmai Basti of Imphal West; Komlatabi, L. Chalwa and Mchano village of Chandel; Sekta & Sekta& Oang village of Imphal East district. Among these villages, *D. giganteus, B. nana, M. bambusoides, S. pergracile, D. strictus, B. nutans* etc. were the most flourishing species (Table 1 & Fig. 2).

Table 1: Different species of Bamboos recorded from Forest Fringe villages of Manipur State.

Species Name	Local name	Site of Collection-Fringe vilage (Distrcit name)	Latitude	Longitude	Altitude (m)	Voucher specimen
Bambusa kingiana Gamble	Watangkhoi	Keirao (Imphal East)	24°44'21.5"	93°58'52.3"	781	RFRIBH-98
Bambusa nana Roxb	Khokwa	Thongju part II (Imphal East)	24°45'21.0"	93°56'23.36"	760	RFRIBH-25
Bambusa nutans Wall. ex Munro	Utang	Saikmai (Imphal West)	24°56'21.7"	93°52'49.4"	802	RFRIBH-06
		Thinungei (Bishnupur)	24°33'16.0"	93°45'16.0"	760	RFRIBH-80
		Terakhong Sanbei (Bishnupur)	24°27'31.5"	93°44'17.6"	776	RFRIBH-90
		Ngoiphai (Churachandpur)	24°19'28.4"	93°43'31.6"	797	RFRIBH-32
		Thongju part II (Imphal East)	24°45'14.1"	93°56'20.0"	776	RFRIBH-30
		Kairou (Imphal East)	24°44'47.0"	93°58'44.9"	772	RFRIBH-93
		Sekta & Oang (Imphal East)	24°53'43.3"	94°02'15.0"	784	RFRIBH-88
Bambusa tulda Roxb.	Saneibi	Thinungei (Bishnupur)	24°33'16.0"	93°45'16.0"	760	RFRIBH-17
		Thinungei (Bishnupur)	24°27'31.5"	93°44'17.6"	776	RFRIBH-31
		Ngoiphai (Churachandpur)	24°19'28.4"	93°43'31.6"	797	RFRIBH-21

		Ngoiphai (Churachandpur)	24°20'22.7"	93°42'51.4"	808	RFRIBH-52
		Poiroukhongjil (Imphal East)	24°41'07.7"	94°00'59.2"	829	RFRIBH-43
		Keirao (Imphal East)	24°54'00.2"	93°58'37.7"	767	RFRIBH-81
		Thongju part II (Imphal East)	24°45'21.0"	93°56'23.36"	760	RFRIBH-41
		Saikmai (Imphal West)	24°56'21.7"	93°52'49.4"	802	RFRIBH-35
Schizostachyum pergracile (Munro) R.B.Majumdar *syn. Cephalostachyum pergracile* Munro syn.	Pongshang	Komlatabi (Chandel)	24°18'26.9"	94°15'44.7"	594	RFRIBH-67
		L. Chalwa (Chandel)	24°18'48.5"	94°16'26.5"	484	RFRIBH-45
		L. Chalwa (Chandel)	24°18'44.6"	94°16'16.9"	504	RFRIBH-53
		Poiroukhongjil (Imphal East)	24°41'07.3"	94°00'58.5"	840	RFRIBH-54
Dendrocalamus brandisii. Kurz	Wamu	Tengnoupal (Chandel)	24°16'43.0"	094°16'36.6"	370	RFRIBH-75
Dendrocalamus flagellifer Munro Syn. D. asper (Schult. F.) Backer ex Heyne	Longwa	Saikmai Awang, (Imphal West)	24°56-15.3	93°52'49.41"	806	RFRIBH-76
Dendrocalamus giganteus Munro	Maribob	Keirao (Imphal East)	24°44'21.5"	93°58'52.3"	781	RFRIBH-73
		Saikmai (Imphal West)	24°56-15.3	93°52'49.41"	806	RFRIBH-99
Dendrocalamus hamiltonii Nees &Arnott ex Munro	Unap/Wanap	Bishnupur-10 (Bishnupur)	24°38'38.2"	93°38'38.2"	812	RFRIBH-53
		Ngoiphai (Churachandpur)	24°20'22.7"	93°42'51.4"	808	RFRIBH-12
		Tengnoupal (Chandel)	24°16'43.0"	094°16'36.6"	370	RFRIBH-30
Dendrocalamus hookerii Munro	Utangkhoi	Poiroukhongjil (Imphal East)	24°41'0.60"	94°00'58.9"	841	RFRIBH-13
*Dendrocalamus latiflorus*Munro	Wui	Poiroukhongjil (Imphal East)	24°41'07.7"	94°00'59.2"	829	RFRIBH-01
		Phunalmaring (Imphal East)	24°42'08.7"	93°58'29.8"	1036	RFRIBH-17
Dendrocalamus manipureanus Naithani & Bisht		Poiroukhongjil (Imphal East)	24°41'05.5"	94°00'57.7"	823	RFRIBH-49
		Keirao (Imphal East)	24°44'46.0"	93°58'45.5"	777	RFRIBH-99
Dendrocalamus sericeus Munro	Ooei	Saikmai Awang (Imphal West)	24°56'15.3"	93°52'49.41"	806	RFRIBH-91
Dendrocalamus strictus Nees	Unan	Thongju part II (Imphal East)	24°45'21.0"	93°56'23.36"	760	RFRIBH-94
		Saikmai Basti (Imphal West)	24°56'18.7"	93°52'51.9"	801	RFRIBH-75
Melocanna bambusoides Trins syn. *Melocanna baccifera* (Roxb.) Kurz.	Moubiwaa	Sekta (Imphal East)	24°53'40.2"	94°02'16.5"	794	RFRIBH-60
		Poiroukhongjil (Imphal East)	24°41'05.5"	94°00'57.7"	823	RFRIBH-42
		Khongampat (Imphal West)	24°53'48.5"	93°53'36.4"	767	RFRIBH-48
Thyrsostachs oliveri Gamble	Kabowaa/Burma Wa	Ngoiphai (Churachandpur)	24°20'26.4"	93°42'51.4"	809	RFRIBH-97
		Mchano (Chandel)	24°15'17.7"	94°17'34.9"	261	RFRIBH-15
		Phunalmaring (Imphal East)	24°42'22.2"	93°58'48.5"	966	RFRIBH-25
		Saikmai (Imphal West)	24°56'21.7"	93°52'49.4"	802	RFRIBH-5
		Poiroukhongjil (Imphal East)	24°41'07.7"	94°00'59.2"	824	RFRIBH-22

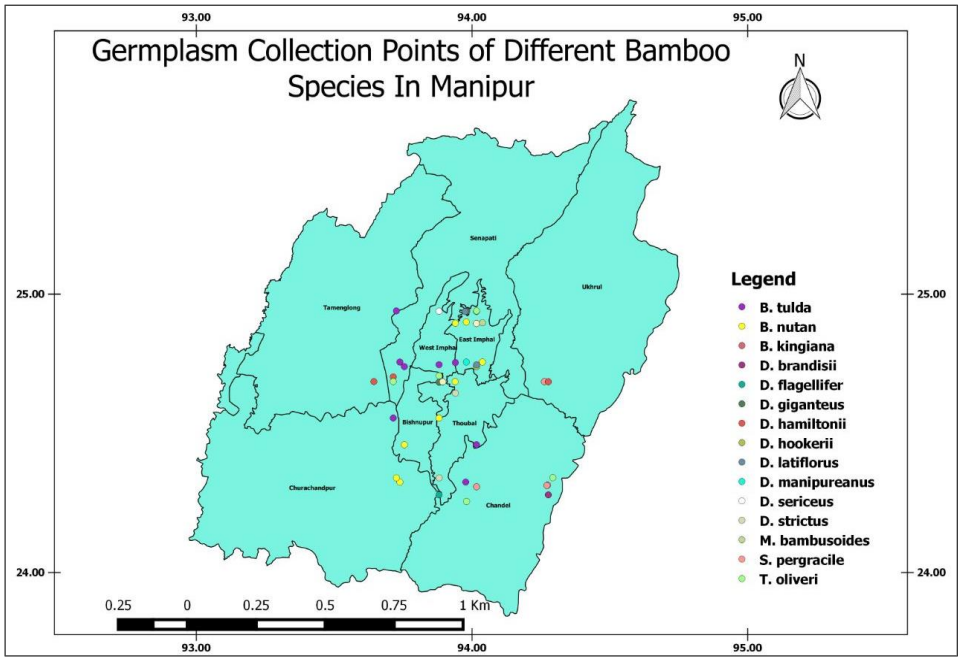

Fig 2: Germplasm collection Points of Different bamboo species of Manipur

Besides the people preferences, altitudinal variations were also having great impact on the availability and distribution pattern of different type of bamboo species at aparticular locality. Wide distribution range were reported for *T. oliveri*, it's distribution varied from 200 to 900 m asl followed by *D. hamiltonii* (range from 300 to 900m asl) and *S. pergracile* (range from 400 to 900 m asl). However, *D. latiflorus* were found growing at higher altitute i. e. 800-1100 m asl, whereas, *D. brandisii* (300-400 m asl), *B. nana* and *B. kingiana* (700-800 m asl), *D. hookerii* and *D. sericeus* (800-900 m asl) were having very narrow distribution pattern as observed from forest fringe villages (Table 2).

Table 2: Distribution pattern of different bamboo species across altitudinal range.

	Altitudinal range (m asl)										
Species name	**0-100**	**100-200**	**200-300**	**300-400**	**400-500**	**500-600**	**600-700**	**700-800**	**800-900**	**900-1000**	**1000-1100**
B. nana								■			
B.kingiana								■			
B.nutans								■	■		
B. tulda								■	■		
S. pergracile					■	■	■	■	■		
D.brandisii				■							
D. flagellifer									■		
D. giganteus								■	■		
D. hamiltonii				■	■	■	■	■	■		
D. hookerii									■		
D. latiflorus									■	■	■
D. manipureanus								■	■		
D. sericeus									■		
D. strictus								■	■		
M. bambusoides								■	■		
T. oliveri			■	■	■	■	■	■	■		

3.2 Utility pattern of bamboos in forest fringe villages

Bamboos of Manipur have been in wide usage since ancient times and seen as a low-cost material for construction, handicrafts, equipment and ornaments preparation and even as consumables in raw or fermented form (Table 3). Out of the total species recorded from fringe villages, majority of them were used for construction, scaffolding, poles etc. like *B. tulda*, *D. brandisii*, *D. latiflorus*, *M. bambusoides* were used in various types of construction work, basket works, mats, water and milk vessels, furniture, scaffolding, toys, hats and wall hangerspreparations. Young tender shoots of *B. kingiana*, *B. nutans*, *B. tulda*, *S. pergracile*, *D. brandisii*, *D. flagellifer*, *D. giganteus*, *D. hamiltoni*, *D. hookerii*, *D. latiflorus*, *D. strictus* and *T. oliveri* were eaten in diverse form by inhabiting community in almost every fringe villages.

In Keiro village of Imphal west, Saikhmai of Imphal West and Poiroukhongjil & Phunalmaring fringe village of Imphal East- *B. nutans, D. giganteus and D.latiflorus* were much esteemed by local for growing for sundary uses and as ornamental bamboo. Similary, in Saikmai Awang forest fringe village of Imphal West, the long internodes of *D. flagellifer* were used as cooking pot for boiling and cooking rice, vegetables, meat and water; *T. oliveri* besides used for building purpose in many fringe villages it was also valued for making agriculture implements, broom handles, chick for doors and windows, fishing rods etc.

Some of the bamboo species were also having medicinal importance and were use local people in treatment of various human aliments like young shooty of *B. tulda* after crushed were appied to cure skin problem like dandruff and a decoction of *D. strictus* was taken to aid in parturition. In additiong to that, there was species like *D. giganteus* and *D.latiflorus* which were highly prized by local due to their high utility and high market value (i.e. Rs. 100-150 per bamboo) and thus are manily grown by tribal communities of forest fringe villages.

Table 3: Utility spectrum of some common Bamboo species in fring**e** villages of Manipur

Species	Construction	Food	Implements	Handicrafts	Ornamentals
i. Bambusa kingiana	✓	✓		✓	
ii. B.nana		✓		✓	
iii. *B.nutans*		✓	✓	✓	✓
iv. B. tulda	✓	✓	✓	✓	
v. *Schizostachyum pergracile*	✓	✓	✓	✓	
vi. Dendrocalamus brandisii	✓	✓	✓	✓	
vii. D.flagellifer	✓	✓		✓	
viii. D. giganteus	✓	✓	✓	✓	✓
ix. *D. hamiltonii*		✓	✓		
x. *D. hookerii*	✓	✓		✓	
xi. D. latiflorus	✓	✓		✓	✓
xii. D. manipureanus	✓				
xiii. D.sericeus			✓		
xiv. D. strictus		✓	✓	✓	
xv. Melocanna bambusoides	✓			✓	
xvi. *Thyrsostachy soliveri*	✓	✓		✓	

Thyrsostachys oliveri Bamboo

Schizostachyum dulloo Bamboo

Dendrocalamus giganteus Bamboo

Dendrocalamus latiforus Bamboo

Dendrocalamus miziriana Bamboo

Schizostachyum pergracile Bamboo

Fig 3: Some bamboo species documented from Manipur state

Conclusions

Bamboo is one of the most vital wealth of forest fringe villages of Manipur and the want of bamboo among the dwellers is tremendous, ranging from house construction to handicrafts preparation and from edible food stuff to preparation of various medications. In our study total 16 bamboo species belonging to 5 genera were documented, from 19 different forest fringe villages of Manipur. Majority of them were belongs to *Bambus* and *Dendocalamus* genus, which indicate their vast availability and utility inforest fringe villages. Bamboo species like *D. giganteus* and *D. latiflorus* which were having high utility and high market value (i. e. Rs. 100-150 per bamboo) were preferred and grown by tribal community in their homestead and field to generate income for livelihood. It is also concluded that, occurrence of bamboo at a particular location is also influence by altitudinal variation, some bamboo have narrow whereas other having wider range of distribution. Species like *T. oliveri* and *D. hamiltonii* which were having wide distribution range were reported from different forest fringe villages positioned at different altitude.

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