

# BAMBOO SHOOTS FOR FOOD IN NORTH-EAST INDIA: CONVENTIONAL AND CONTEMPORARY



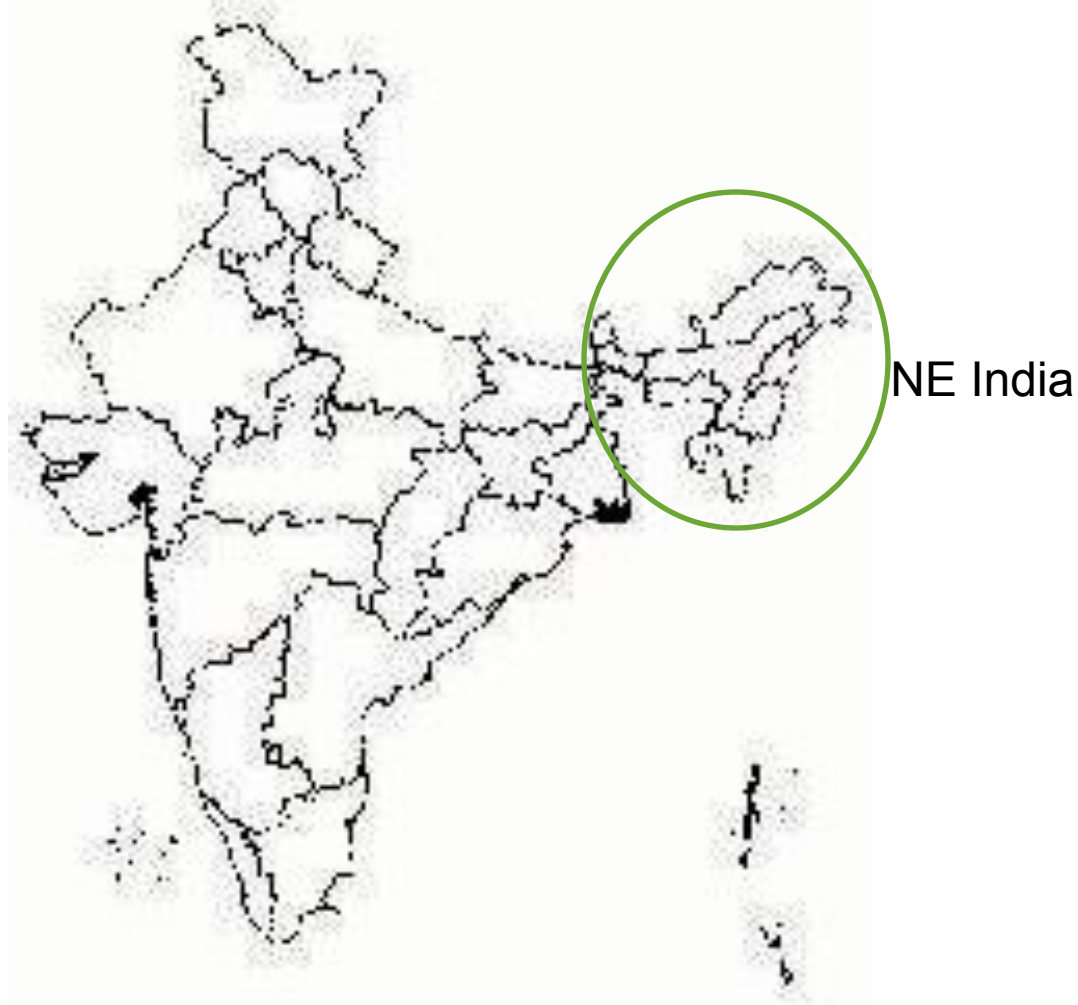
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# India



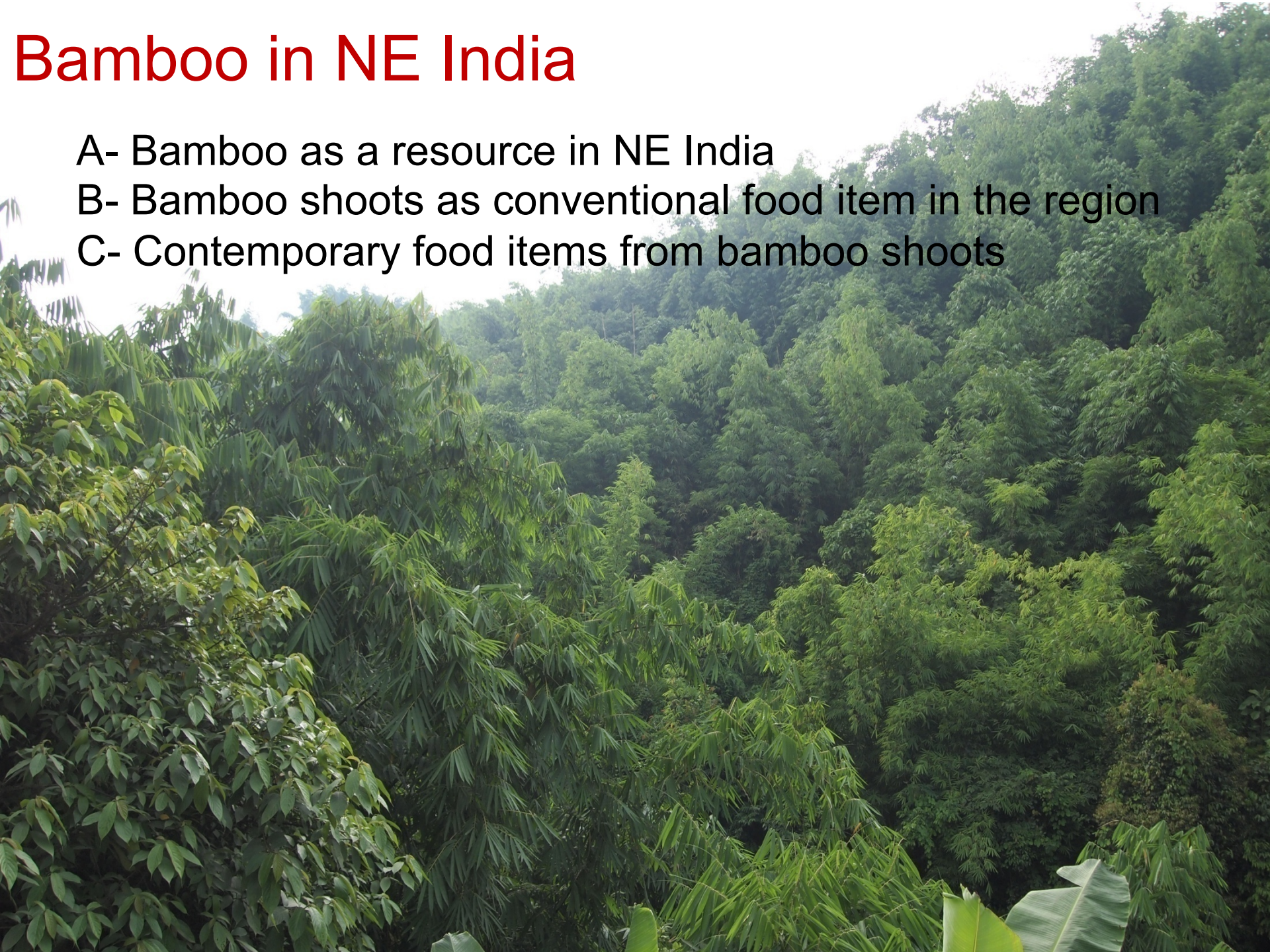


# Bamboo in NE India

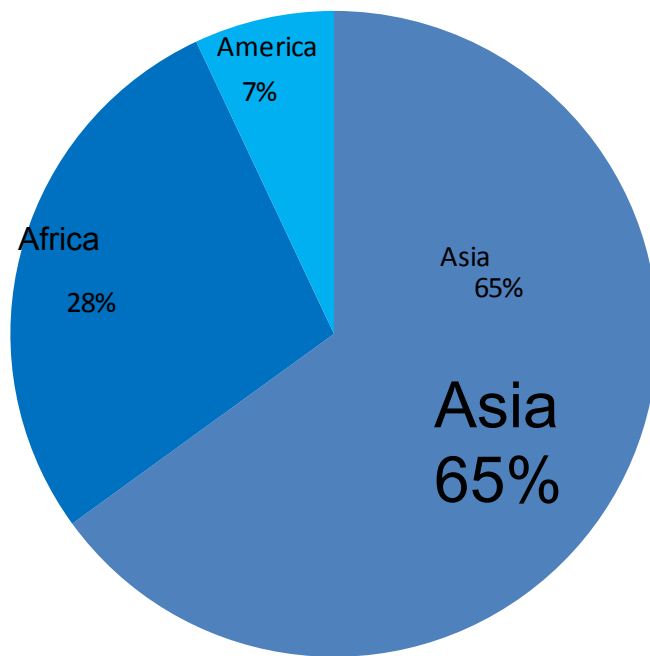
A- Bamboo as a resource in NE India

B- Bamboo shoots as conventional food item in the region

C- Contemporary food items from bamboo shoots

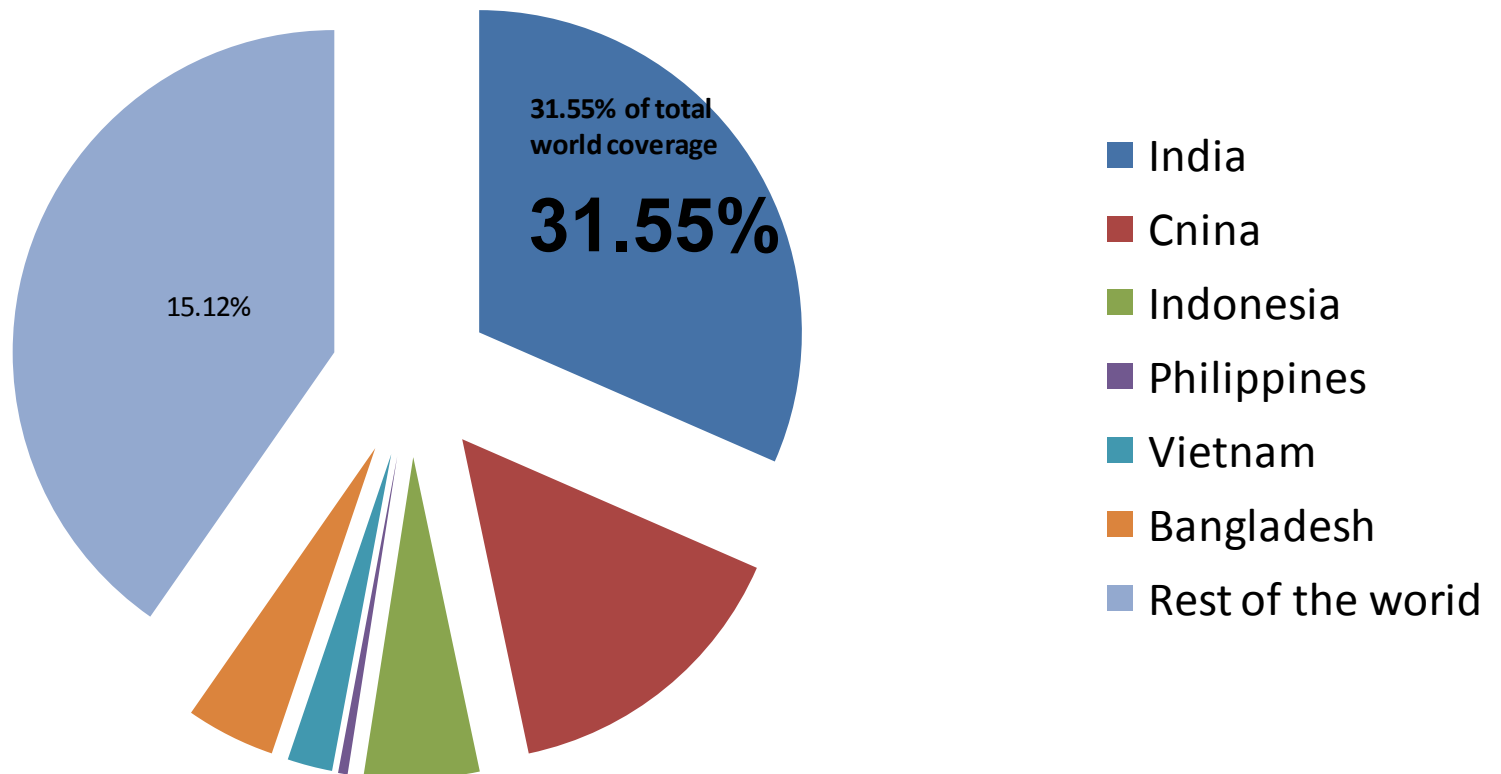


## Bamboo Coverage in Percentage





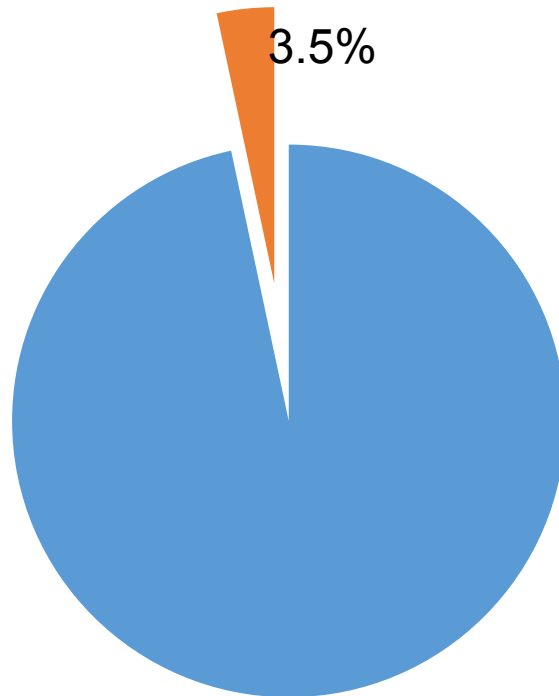
## Bamboo Acreage in Some Important Bamboo Growing Countries



| Bamboo diversity |        |                                  |                   |
|------------------|--------|----------------------------------|-------------------|
| Country          | Genera | Species                          | Acreage (1000 ha) |
| China            | 26     | 300                              | 5,444 (15.12 %)   |
| India            | 23     | 125                              | 11,361 (31.56% )  |
| Indonesia        | -      | 65                               | 2,081             |
| Malaysia         | 7      | 44                               |                   |
| Philippines      | -      | 54                               | 172               |
| Singapore        | 6      | 23                               |                   |
| Sri Lanka        | 7      | 14                               |                   |
| Vietnam          | 16     | 92                               | 813               |
| Korea            | 10     | 13                               |                   |
| Bangladesh       | 8      | 20                               | 1612              |
| Myanmar          | -      | 90                               |                   |
| Madagascar       | 11     | 40                               |                   |
| South America    | 20     |                                  |                   |
| World            | 75     | 1250 (Soderstrom and Ellis 1987) | 36, 000           |



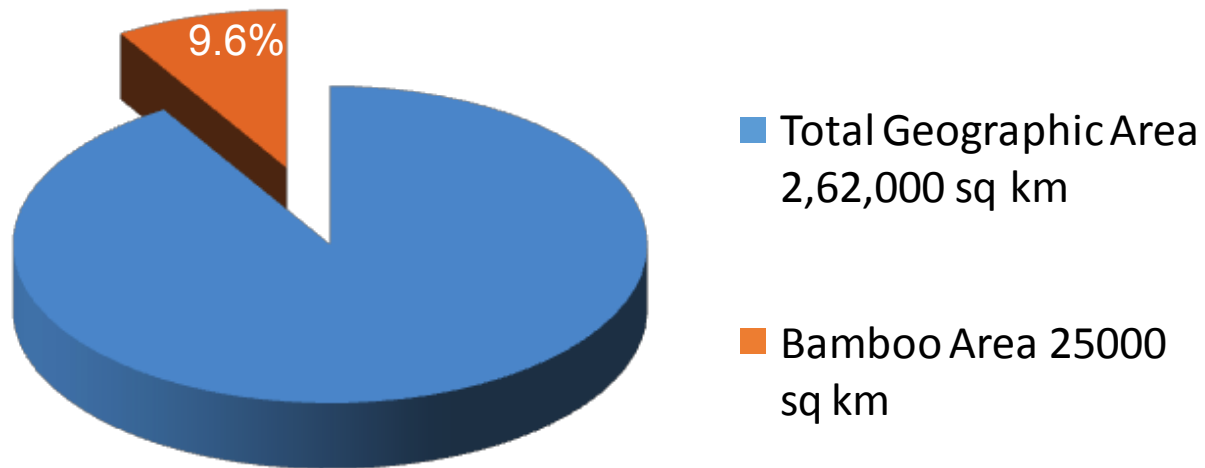
## Bamboo Area in India



■ Total Geographic Area  
32,87,000 sq km

■ Total Bamboo Area  
1,13,000 sq km

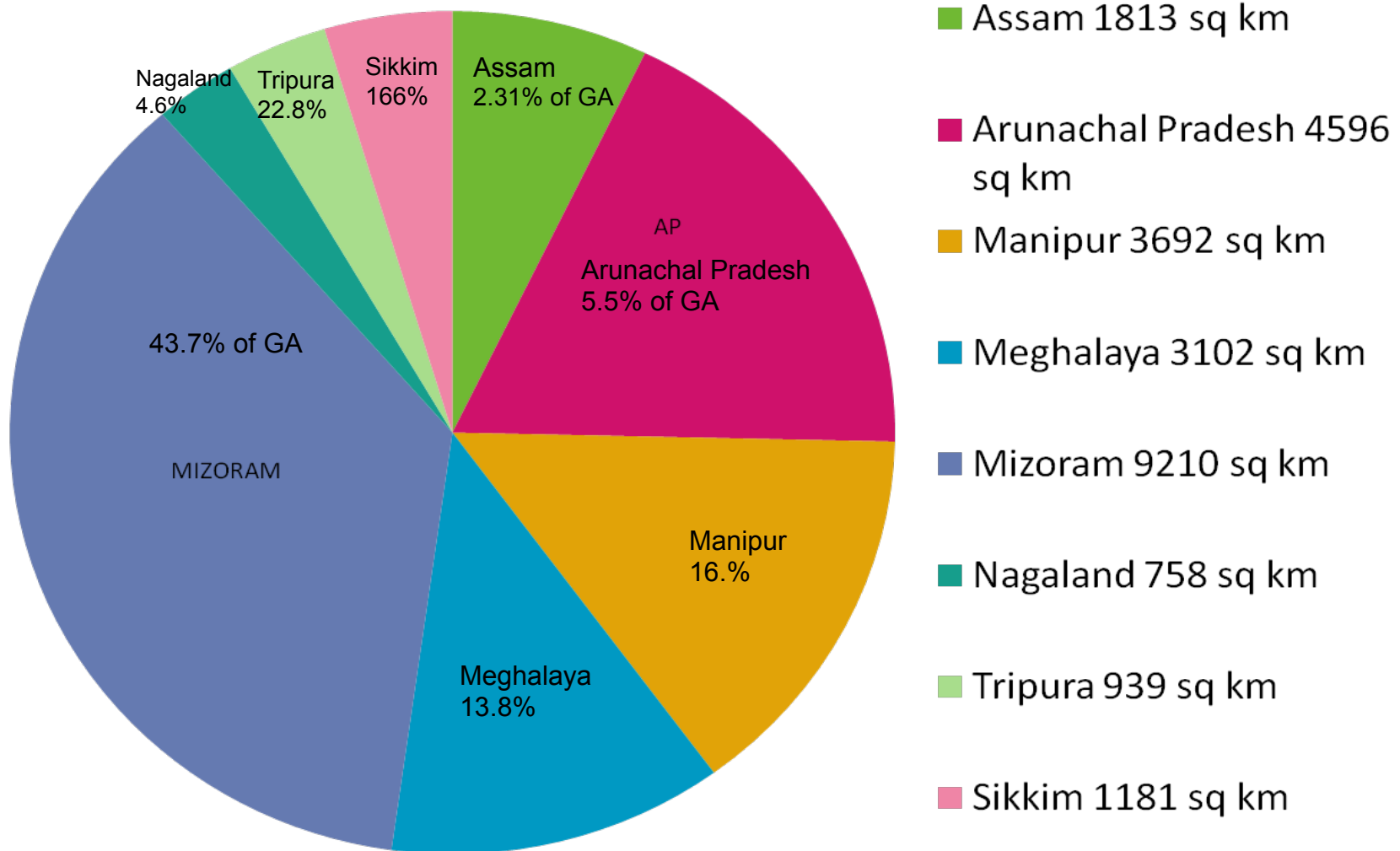
### Bamboo Area in NE India



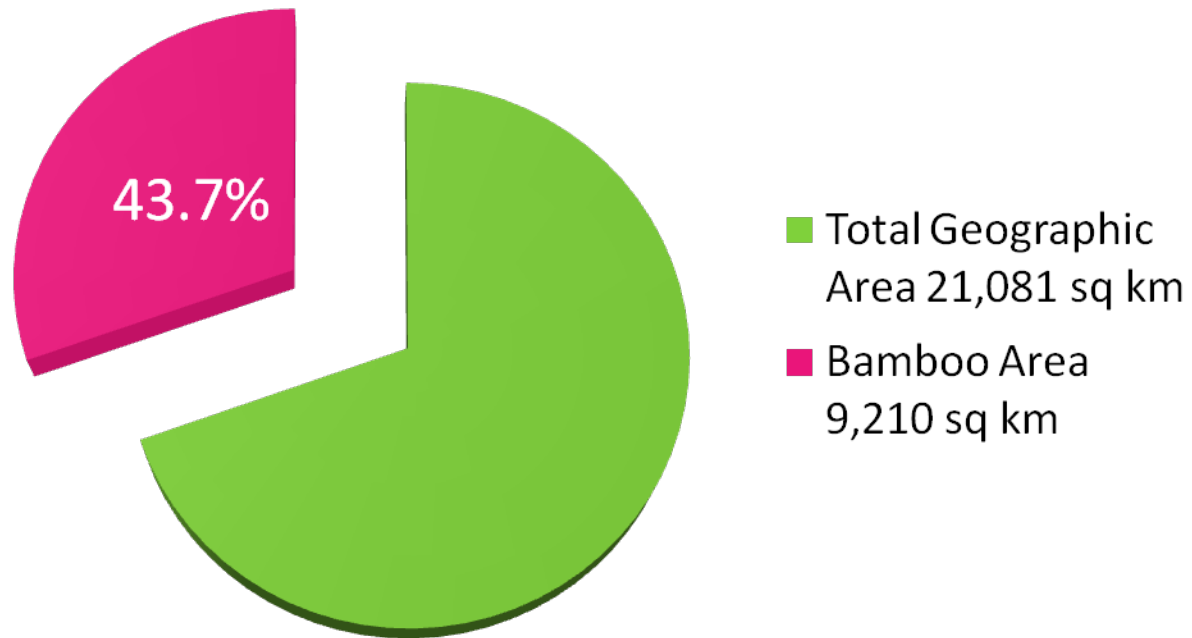
**Around 23 % of total bamboo area of India**



## Bamboo coverage in NE States



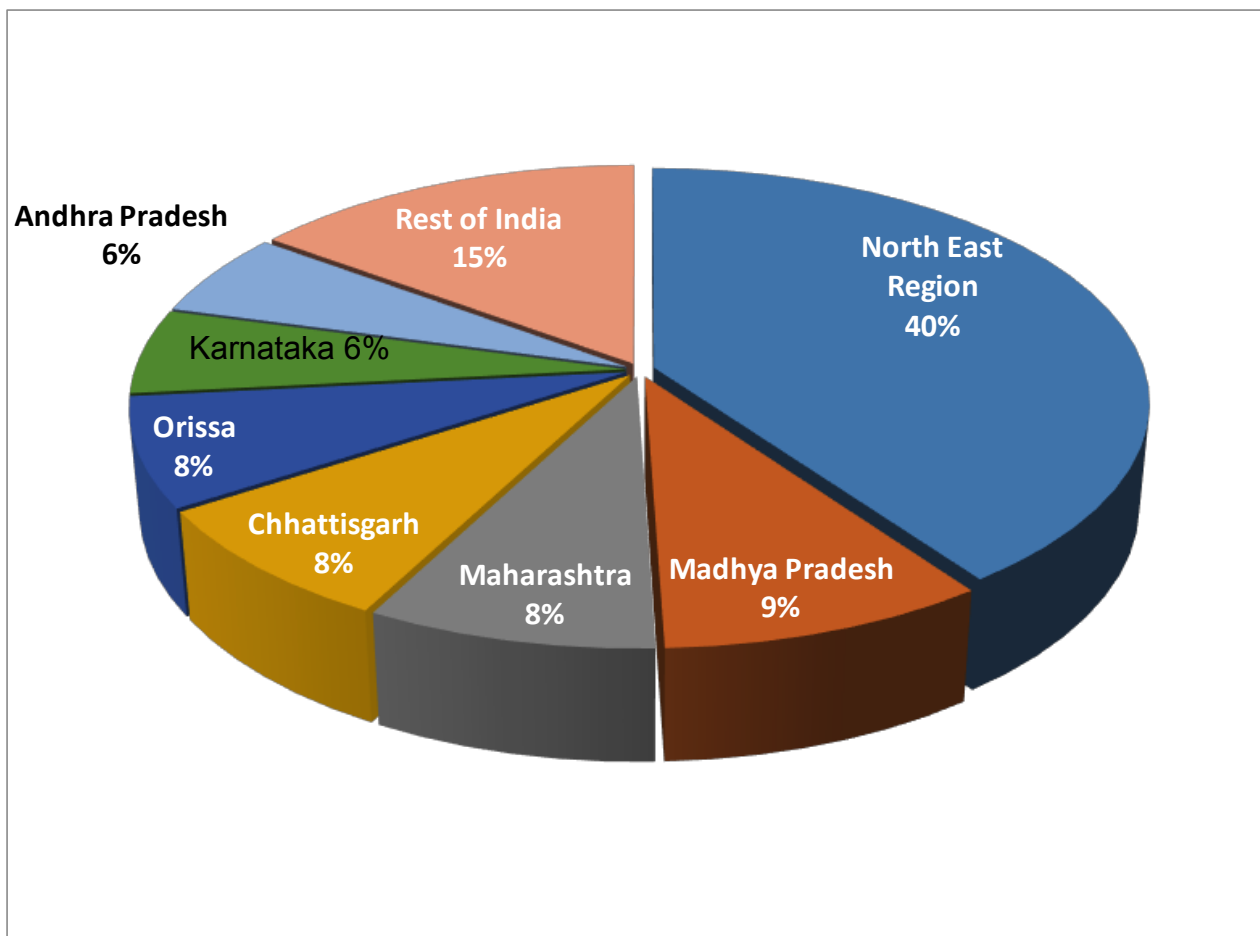
## Bamboo Area in Mizoram





| Bamboo in North-East India |                             |                         |                                 |                             |
|----------------------------|-----------------------------|-------------------------|---------------------------------|-----------------------------|
| States                     | Geographic area<br>(Sq. km) | Forest area<br>(Sq. km) | Bamboo area Sq. km<br>(% of GA) | Bamboo stock<br>(1000 tons) |
| Assam                      | 78,438                      | 27,692                  | 1,813 (2.31)                    | 9844                        |
| Arunachal Pradesh          | 83,743                      | 67,353                  | 4,596 (5.5)                     | 1616                        |
| Manipur                    | 22,327                      | 17,280                  | 3,692 (16.5)                    | 11470                       |
| Meghalaya                  | 22,429                      | 17,321                  | 3,102 (13.83)                   | 4407                        |
| Mizoram                    | 21,081                      | 19,240                  | 9,210 (43.7)                    | 1089                        |
| Nagaland                   | 16,579                      | 13,464                  | 758 (4.6)                       | 3657                        |
| Tripura                    | 10,486                      | 8,073                   | 3,246 (30.9)                    | 860                         |
| Sikkim                     | 7096                        | 3,357                   | 1,181 (16.6)                    | -                           |
| India                      | 32,87,266                   | 6,90,899                | 1,13,610 (3.5)                  | 1,69,312                    |

## Bamboo stock in different parts of India



| Distribution of bamboo in India <small>(Thomas et el 1985; Biswas 1988)</small> |                               |                          |                               |                             |
|---|-------------------------------|--------------------------|-------------------------------|-----------------------------|
| NE India  | NW India                      | Indo-Gangetic Plain      | Peninsular India              | Andaman and Nicobar Islands |
| G: 18; S: 80  | G: 8; S: 19                   | G: 3; S: 7               | G: 8; S: 22                   | G: 3; S: 6                  |
| <i>Arundinaria</i> (5)  | <i>Bambusa</i> (4)            | <i>Bambusa</i> (4)       | <i>Bambusa</i> (3)            | <i>Dendrocalamus</i> (1)    |
| <i>Bambusa</i> (23)   | <i>Dinochloa</i> (2)          | <i>Dendrocalamus</i> (2) | <i>Chimonobambusa</i> (1)     | <i>Dinochloa</i> (2)        |
| <i>Dendrocalamus</i> (12)   | <i>Dendrocalamus</i> (4)      | <i>Oxytenanthera</i> (1) | <i>Dendrocalamus</i> (1)      | <i>Schizostachyum</i> (3)   |
| <i>Schizostachyum</i> (11)  | <i>Drepanostachyum</i> (2)    |                          | <i>Dinochloa</i> (2)          |                             |
| <i>Drepanostachyum</i> (7)  | <i>Himalayacalums</i> (1)     |                          | <i>Indocalamus</i> (4)        |                             |
| <i>Phyllostachys</i> (4)  | <i>Phyllostachys</i> (2)      |                          | <i>Ochlandra</i> (8)          |                             |
| <i>Dinochloa</i> (5)  | <i>Pseodoxytenanthera</i> (3) |                          | <i>Pseudoxytenanthera</i> (1) |                             |
| <i>Gigantochloa</i> (7)   | <i>Thamanocalamus</i> (1)     |                          | <i>Schizostachyum</i> (2)     |                             |
| <i>Chimonobambusa</i> (3)   |                               |                          |                               |                             |
| <i>Neomicrocalamus</i> (2)  |                               |                          |                               |                             |



**Bamboo shoots for food**

**Traditionally bamboo is well known in India for its health benefits and nutrition**

Vans lochan, bamboo manna or tabasheer, a siliceous liquid collected in the culms of some species of bamboo is considered healthy and used in various forms for good health as 'Chavanprash, a type of tonic is the example

Bamboo shoots are also consumed in different parts of the country

But now bamboo shoot consumption is maximum in NE India, that to only in traditional cuisines

Shoots are consumed in various forms like fresh, dried and fermented

There are also few attempts to make bamboo shoots as a major health food

| Bamboo species most preferred for shoot consumption in NE India |   |                                       |
|---|---|---------------------------------------|
| States  | Bamboo species  | Approximate annual consumption , tons |
| Assam   | <i>Bambusa burmanica, B. pallida, B. tulda, Dendrocalamus hookerii, D. giganteus, D. sikkimensis, Gigantochloa rostrata, G. albociliata, Melocana baccifera, Phyllostachys bambusoids, Schizostachyum dullooa</i>             | -                                     |
| Arunachal Pradesh   | <i>B. nutans, B. pallida, Chimonobambusa calossa, D. giganteus, D. hamiltonii, G. albociliata, Pleioblastus simonii, Sinarundinaria elegans</i>   | 1978                                  |
| Manipur   | <i>Ch. calossa, D. asper, D. hamiltonii, D. longispathus, D. strictus, D. giganteus, D. latiflorus, D. flagellifer, M. baccifera, B. bambos, B. nutans, B. kingiana, B. nana, P. heterocycla, P. bambusoides, S. beddomei</i> | 2187.2                                |
| Meghalaya   | <i>D. hamiltonii, D. calostachyus, D. hookerii, D. sikkimensis, G. albociliata, G. apus, G. rostrata, S. dullooa, M. baccifera</i>  | 4418                                  |
| Mizoram   | <i>P. mannii, B. longispiculata, B. pallida, B. tulda, Ch. callosa, D. calostachyus, D. hamiltonii, D. hookerii, D. sikkimensis</i>   | 433                                   |
| Nagaland  | <i>B. pallida, B. tulda, Ch. callosa, D. calostachyus, D. gignteus, D. hamiltonii, D. hookerii, D. sikkimensis, S. elegans</i>  | 441.5                                 |
|   |   |                                       |



# Conventional ways





## Bamboo shoot processing in NE India





## Bamboo shoot business in NE India



## Fermentation and fermented products of bamboo shoots from NE India

| Products | Tribe and state            | Process of fermentation and drying   |
|----------|----------------------------|--|
| Pdam     | Khasi, Meghalaya           | Fermentation of shoot chips in glass or plastic containers submerged in water            |
| Pdam     | Khasi, Meghalaya           | Wrapped in banana leaves fermentation in bamboo basket                                   |
| Soibum   | Meitei, Manipur            | Sliced bamboo shoots fermented either in pot (black clay) or basket, exudate drained out |
| Soidon   | Meitei, Manipur            | Sliced bamboo shoots fermented in earthen pots   |
| Soijin   | Meitei Manipur             | Sliced bamboo shoots boiled and fermented in basket                                      |
| Hikku    | Apatani, Arunachal Pradesh | Chopped shoots wrapped in banana leaves for fermentation                                 |
| Hiring   | Apatani, Arunachal Pradesh | Sliced bamboo shoots fermented in bamboo cylinders                                       |
| Hithyi   | Apatani, Arunachal Pradesh | Sliced shoots sun dried and stored in baskets  |
| Ekung    | Adi, Aunachal Pradesh      | Sliced shoots wrapped in ekam ( <i>Phrynium pubenerve</i> ) leaves and fermented         |

| Fermentation and fermented products of bamboo shoots from NE India |                             |   |
|--|-----------------------------|---|
| Product  | Tribe and state             | Process of fermentation and drying  |
| Edung  | Adi, Arunachal Pradesh      | Sliced shoots fermented in bamboo cylinders                                 |
| Eup  | Nyishing, Arunachal Pradesh | Shoots covered with ekam ( <i>Phrynium pubenerve</i> ) leaves and fermented |
| Ikung  | Adi, Arunachal Pradesh      | Shoots cut in small pieces, partially sun dried and bottled                 |
| Ib   | Adi, Arunachal Pradesh      | Shoots cut in pieces and sun dried fully                                    |
| Mesu   | Limbo, Sikkim, West Bengal  | Shoots fermented in green yellow bamboo cylinders                           |
| Rawtuai rep  | Mizo, Mizoram               | Bamboo shoots ( <i>P. mannii</i> ) sun or fire dried                        |
| Moiya-Kshak  | Debbarman, Tripura          | Shoots wrapped in banana leaves for fermentation                            |
| Miduke   | Chakma, Tripura             | Shoots chopped and wrapped in banana leaves for fermentation                |
| Melye-Amiley   | Chakma, Tripura             | Chopped shoots soaked in water and then fermented                           |
| Moiya-Pangsung   | Uchoi, Tripura              | Big pieces of shoots fermented in water for two days                        |



## Fermented Bamboo shoots on sale- Khasi





# Fermented bamboo shoots- Karbi





# Fermented Bambo Shoots







**Fermented Bamboo shoots on sale**



| Traditional bamboo shoot recipes from NE India |                 |   |
|--|-----------------|---|
| Shoot recipes                                  | Tribe, state    | Method of preparation   |
| Rawtuai-Bawl (non-veg)                         | Mizo, Mizoram   | Boiled bamboo shoots ( <i>P. mannii</i> ) mixed with fermented pork and spices  |
| Rawtuai-Bawl (Veg)                             | Mizo, Mizoram   | Shoots ( <i>P. mannii</i> ) boiled and mixed with green chilies, herbs, and small beans   |
| Rawtuai-Rep                                    | Mizo, Mizoram   | Sun or fire dried shoots ( <i>P. mannii</i> ) soaked in water mixed with either fermented pork or green chilies, leaves and small beans |
| Rawtuai-Kan                                    | Mizo, Mizoram   | Boiled shoots ( <i>M. baccifera</i> ) fried with spices   |
| Rawtuai-Bai                                    | Mizo, Mizoram   | Fresh shoots of <i>M. baccifera</i> chopped, soaked in water and boiled with some rice with a pinch of sodium-bicarbonate               |
| Usoi-Ooti                                      | Meitei, Manipur | Sliced shoots ( <i>B. nutans</i> ) and dried pea soaked in water for overnight and then boiled with a pinch of sodium-bicarbonate       |
| Usoi-Kangsu                                    | Meitei, Manipur | Overnight water soaked shoots boiled with potato and mixed with fermented fish and dried chilies  |
| Soijin-  | Meitei,         | Fermented shoots boiled with potato and mixed with  |



| Traditional bamboo shoot recipes from NE India |                        |  |
|--|------------------------|--|
| Shoot recipes                                  | Tribe, state           | Method of preparation  |
| Mia-Mweiborog                                  | Jamatia, Tripura       | Shoots boiled with vegetables, fish, chilies and onion                   |
| Moiya Koshak-Shidal                            | Debbarman, Tripura     | Fermented shoots cooked with fermented fish (shidal)                     |
| Chakkhoi                                       | Uchoi, Tripura         | Fermented shoots cooked with vegetables                                  |
| Moya-Chakhoi                                   | Tripura                | Shoots (non-bitter) soaked in water and cooked with vegetables           |
| Perok-Ikung                                    | Adi, Arunachal Pradesh | Fermented shoots cooked with chicken and spices                          |
| Yekdin-Ikung                                   | Adi, Arunachal Pradesh | Ikung (fermented) shoots boiled with pork and spices                     |
| Engo-Ikung                                     | Adi, Arunachal Pradesh | Ikung (fermented) shoots boiled with fish and spices                     |
| Itting-Oying                                   | Adi, Arunachal Pradesh | Small pieces of fermented shoots cooked with vegetables, pork or chicken |
| Ib-Oying                                       | Adi, Arunachal Pradesh | Dried shoots prepared with fish, chicken or pork                         |
|  |                        |  |

Kangsu





Uti



# Pickles







## Contemporary food products from bamboo





| Contemporary food items from bamboo shoots: Bamboo shoot paste |  |
|--|--|
| Food items   | Method of preparation  |
| Chapatti   | 20 to 25 per cent shoot paste with wheat flour to prepare dough and chapatti                               |
| Paratha  | 20 to 25 per cent shoot paste with wheat flour to prepare dough and paratha                                |
| Egg-curry  | Shoot paste according to requirement fried with all other spices and prepared egg curry                    |
| Mutton-curry   | Shoot paste according to requirement fried with all other spices for thick mutton curry                    |
| Bhujea   | Shoot paste around 25 to 30 per cent mixed with gram flour and prepared bhujea (a type of snacks in India) |
| Cookies  | Shoot paste around 10 to 20 per cent mixed with other ingredients of cookies                               |
| Bread  | Shoot paste of 10 to 20 per cent mixed with wheat flour for making bread                                   |
| Paneer (Fresh Cheese)  | Fine shoot paste boiled with milk and then coagulated for making paneer                                    |
| Curd   | Shoot paste 10 to 15 per cent mixed with the milk for making curd  |

| Contemporary food items from bamboo shoots: Bamboo shoot chips, chunks and shreds |  |
|---|--|
| Shoot-Rice  | Washed shoot chips cooked along with rice                          |
| Shoot-Fried Rice  | Fresh or fermented chips fried with cooked rice                    |
| Shoot-Omlette   | Small shoot chips for omelets                                      |
| Shoot-Noodles   | Shreds or chips of shoots for noodles                              |
| Shoot-Pakora  | Slices of shoots for pakora (a type of fried item) with gram flour |
| Shoot-Fingerlings   | Shoot of <i>P. mannii</i> for fingerlings along with gram flour    |
|   |  |
|   |  |

# Bamboo shoot paste puries (a type of Indian bread cooked in oil)





**Bamboo shoot rice**





# Bamboo shoot macaroni





**Bamboo shoot egg fry**





# Bamboo shoot paste egg curry





**Bamboo shoot omelet**





**Bamboo shoot haluwa (sweet meat)**





# **Bamboo shoot pakora (fried bamboo shoot chips)**





# Bamboo shoot paste gram flour bhijia (snacks)



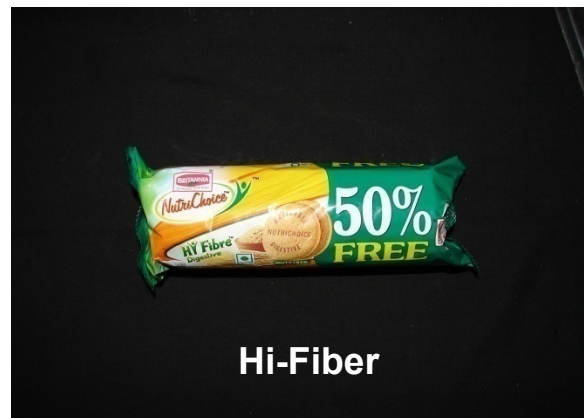


**Bamboo shoot paste cookies**





## Comparison of Dietary fiber and macronutrients of bamboo paste made and commercially available biscuits (gm/100gm)



| Sl. No. | Biscuit type               | NDF   | ADF  | Lignin | Hemicellulose | Cellulose | Carbohydrates | Amino acid | Protein | Starch |
|---------|----------------------------|-------|------|--------|---------------|-----------|---------------|------------|---------|--------|
| 1.      | Hi-dietary fiber biscuit   | 24.82 | 2.3  | 0.41   | 22.52         | 1.89      | 4.050         | 0.166      | 0.867   | 3.362  |
| 2.      | Common biscuit             | 19.08 | 2.7  | 0.45   | 16.38         | 2.25      | 4.086         | 0.151      | 0.864   | 3.323  |
| 3.      | Bamboo biscuit 300 micron  | 51.92 | 2.9  | 0.57   | 49.03         | 2.03      | 4.080         | 0.153      | 0.973   | 3.001  |
| 4.      | Bamboo biscuit 1200 micron | 68.14 | 0.98 | 0.58   | 67.10         | 0.40      | 4.119         | 0.215      | 0.967   | 3.308  |

| Macro-nutrients, vitamins, minerals and bioactive compounds in shoots of bamboo from NE India |                                      |
|---|--------------------------------------|
| Nutrient elements   | Quantity (range) /100 g fresh weight |
| Macro-nutrients   |                                      |
| Amino acids   | 3.01-3.98 g                          |
| Proteins  | 2.31-3.69 g                          |
| Carbohydrates   | 4.32-6.69 g                          |
| Starch  | 0.21-0.59 g                          |
| Fat   | 0.33-0.56 g                          |
| Vitamins  |                                      |
| Vitamin C   | 1.00-4.48 mg                         |
| Vitamin E   | 0.42-0.56 mg                         |
| Minerals  |                                      |
| Calcium   | 0.116-0.64 mg                        |
| Copper  | 0.16-1.08 mg                         |
| Iron  | 2.234-3.917 mg                       |
| Magnesium   | 3.486-10.14 mg                       |
| Manganese   | 0.16-0.878 mg                        |



| Macro-nutrients, vitamins, minerals and bioactive compounds in shoots of bamoo from NE India |                                      |
|--|--------------------------------------|
| Nutrient elements  | Quantity (range) /100 g fresh weight |
| Minerals   |                                      |
| Potassium  | 232-56 mg                            |
| selenium   | 0.0001-0.001 mg                      |
| Sodium   | 8-15.6 mg                            |
| Zinc   | 0.574-1.086                          |
| Bio-active compounds   |                                      |
| Dietary fibers   | 2.56-6.75 g                          |
| Phenols  | 191.3-443.97 g                       |
| Phytosterols   | 0.13-0.19 g                          |
|  |                                      |

| Comparison of Recommended Daily Allowance (RDA) with nutrients available in bamboo shoots |                 |   |  |
|---|-----------------|---|--|
| Components  | RDA for Indians | Quantity available in bamboo shoot (per 100 g fresh weight) | Per cent of RDA in bamboo shoots (in 100 g fresh weight) |
| Protein   | 60 g            | 3.69 g  | 6.17   |
| Fat   | 30 g            | 0.56 g  | 1.86   |
| Dietary fiber   | 30 g            | 6.75 g  | 22.5   |
| Calcium   | 600 mg          | 0.64 mg   | 0.11   |
| Potassium   | 2500 mg         | 576 mg  | 23.04  |
| Sodium  | 2092 mg         | 15.6 mg   | 0.75   |
| Phosphorus  | 700 mg          | 28.21 mg  | 4.03   |
| Magnesium   | 340 mg          | 10.14 mg  | 2.98   |
| Iron  | 17 mg           | 3.9 mg  | 22.94  |
| Zinc  | 12 mg           | 1.1 mg  | 9.2  |
| Manganese   | 2-5 mg          | 0.88 mg   | 17.6   |
| Copper  | 2 mg            | 1.08 mg   | 54   |
| Selenium  | 40 µg           | 0.8 µg  | 2  |



# Conclusions

**NE India is very rich in bamboo resource in terms of acreage, stock as well as diversity**

**Traditionally bamboo is used in the region for everything right from cutting the umbilical cord of a new born baby with bamboo sheath blade to bier (coffin) for the dead body (Blade to bier)**

**Traditionally bamboo shoots are considered as healthy and nutritious food item consumed in various forms by almost all (tribes) people of the region**

**Scientifically it has also been proved that bamboo shoots are very healthy and nutritious food item**

**But in the modern age bamboo shoot as a food is totally a neglected commodity in the region**

**New ways and means are required to promote the bamboo shoots in the region as health food as well as for food security**

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