CHAPTER - 1
INTRODUCTION

The bamboo belongs to the family of Poaceae or Gramineae. In different parts of the world, the bamboo is known by different names as Kawayan (Filipino); Piao (Chamorro); Zhu (Chinese); Take (Japanese); Dae or Daenamu (Korean); Wa (Myannmar); Tre (Vietnamese); Baans or Vanoo (Hindi); Bambu (Indonesian), (Complete bamboo, 2008-2012). The bamboo family is divided into sub-families, tribes, sub-tribes, genera and species. Based on flower structure, the sub-family bambusoideae is considered as the most primitive, which comprises of woody culm bamboo (Chapman and Peat, 1992). Bambuseae, the largest woody bamboo tribe has several sub-tribes that comprise genera *Bambusa*, *Gigantochloa*, *Dendrocalamus*, *Arundinaria*, *Chusquea*, *Melocanna*, *Guadua*, *Schizostachyum*, *Phyllostachys*, *Nastus*, *Rhipidocladum* and *Merostachys* (Chapman and Peat, 1992; Clark and Pohl, 1996).

There are about 1200 to 1575 bamboo species from 50 to 60 genera worldwide, out of which, half of the bamboos are grown in Asia are mostly in the Indo-Burmese region which is their area of origin (Wang and Shen, 1987). The number of bamboo species around the world is mentioned differently by different authors. Vermah and Bahadur (1980) mention about 1000 bamboo species. Ohrnberger (1999) reported around 160 species from 25 genera herbaceous bamboo and around 980 species from 85 genera woody bamboo. The 1200 bamboo species from 70 genera were mentioned by Biswas (1988). Clyton and Reinvoize (1986) mentioned 840 species from 49 genera. The classification of bamboo made by Mc (1966) mentioned 700 species under 63 genera, but recent studies have shown increases in the number of species around 1000 to 1500 (Liese, 1987; Grewal, 2009; Laroque, 2007).

Bamboo grows naturally in all tropical, subtropical and temperate region of the world other than Europe (Liese and Kohl, 2015). Asia possesses total bamboo growing area with 10 million hectares which is concentrated mostly in South-Eastern Asia. China has total growing area of 5 million hectares. Brazil has total bamboo growing area of 18 million hectares concentrated in South-Western Amazonas, the biggest

bamboo growing region of the world (Judziewicz *et al*., 1999; Yuming and Chaomao, 2010). China, the Kingdom of Bamboo occupies the richest position in the species of bamboo by having about 500 species under 39 genera. The area of bamboo forest is increasing with the extension of 5 million hectares (Lei, 2001). India, China and Myanmar have 19.8 million hectares of bamboo growing areas which contributes 80% of world bamboo forest. India has 13.96 million hectares of bamboo growing area (Kumar *et al*., 2014). In East & Southeast Asia and African countries, bamboo forest plays a significant role. The role of bamboo is not only confined in industrial application but also in day to day articles. It has a critical role in environmental protection. The old saying "bamboo, the poor man's timber" has well established, as application of bamboo in many purpose is related to the living condition and alleviation of poverty of countryman residing in rural areas. Due to its economic potentials, the bamboo is now getting attention from researchers. Research on bamboo biology, technique of propagation and cultivation, management and utilisation are getting interest.

After China, India is the second richest country in bamboo species. In India, other than state of Jammu and Kashmir, bamboos are naturally distributed in almost all the states. Bamboo forms an important constituent of deciduous and evergreen forests in tropical and temperate regions from sea level to altitudes up to 3700 m in the Himalayas (Barooah and Borthakur, 2003). India has 136 bamboo species under 22 genera of which about 58 species under 10 genera are found in North-Eastern state (Sharma, 1987). Among the Indian bamboos, 26 bamboos are rare and endangered, out of these 12 bamboos are reported from North-Eastern region (Bahadur and Jain, 1981; Biswas, 1988). More than 50% of total bamboos in India are found in North-Eastern states of West Bengal (North Bengal, Himalaya), Sikkim, Arunachal Pradesh, Assam, Nagaland, Mizoram, Manipur, Meghalaya and Tripura (Biswas, 1988; Tewari, 1992). Eastern Himalayas, where there is heavy monsoon and topographically induced rain almost throughout the year minimised the water shortage and make suitable condition for growing of bamboo. In such condition, diversity of bamboo in terms of species richness can be found. Arunachal Pradesh recorded about 30 species under 12 genera. In

thorough studies, there is a chance of increase of this number up to 60 species and around 18 genera (Beniwal and Haridasan, 1988).

It is studied that 10% of bamboo found in North-East India are rare and endangered (Biswas, 1988). Bamboo plays an important role in day to day life of the people of Assam. It is an integral part of cultural, social and economy of the state. Assam has a large numbers of bamboos in natural forest, and in cultivated private plantations. The people of Assam have traditional knowledge on growing and utilisation of bamboo (NMBA Assam, 2014). Kokrajhar district has a good bamboo resource in terms of species diversity, the district has occurrence of 16 bamboo species under 5 genera (Brahma *et al*., 2014).

Today, bamboo is an emerging and focused sector. Studies on its biology and applied aspects are getting momentum. Many researches on bamboo have been carried out by gathering sufficient knowledge relating to its gross wood quality and other characters. This knowledge helps in understanding of its suitability for new avenues of applications. Bamboo based industries are now one of the industries which create an important impact on country's economy. At present, there are many bamboo related industries with varieties of products. Bamboo is now getting its advance application, beginning with traditional handicraft and conventional composite to advanced polymer bio-composite.

The use of bamboo as a traditional construction material is century old. Its availability around the world makes it more suitably sustainable replacement to conventional designed construction activities. The increasing demand of construction materials with increasing population by 2050 will be met up by bamboo as an alternative resource (Dickson, 2002). It is experienced that, as compared to the houses built with conventional building materials, the bamboo house has better survived in seismic incident that occurred worldwide (Kaushik *et al*., 2006a; Kaushik *et al*., 2006b; Murty and Sheith, 2012). The importance of bamboo plant for rural community people is immense and incomparable. There is no other plant that can replace the utility of bamboo. In rural areas bamboos are used to prepare different equipments and article for

their day to day life, starting from agricultural implements to building materials. Many article and equipments of day to day uses are prepared from bamboo, say making of handles of umbrella and different tools, fishing rods, tent poles, ladders, yokes, baskets of different size, toys, hand-fans and many other domestic articles. Bamboo is now one of the most abundant, versatile raw materials for many wood based industries. In India, bamboo is now selected as one of industry innovation clusters, by National Innovation Council.

Viewing the present trends of decreasing forest cover and shortage of timber supply, the finding of forest based wood alternative is an important inventory which can relate the analytical study of bamboo species. Substitution of timber base wood uses with bamboo can minimise the injudicious use of natural forest resources. Being fast growing plant species, the bamboo has certain advantage. Bamboo plants become ready for various uses within one year to one and half year.

It is understood that the gathering of knowledge on different physico-chemical content of bamboo helps in its appropriate uses. Such knowledge also provides scope of extension in its application from traditional to industrial uses. The documentation of information regarding the utilisation of bamboo has been done only for less number of bamboos. Studies on physical and mechanical properties of some regularly used bamboo species have been carried out by many workers around the world (Li, 2004; Rafidah *et al*., 2010). The lesser known and lesser used bamboos need intensive study to promote those species as a possible replacement for regularly used species. The structural, chemical, physical and mechanical properties are needed to be analysed. (Celso *et al*., 1985)

Searching of forest based wood substitute is the broad objective of this study. As the judicious application of bamboo may reduce the most exploited timber based wood uses from natural forest, the present study on **'Comparative studies of physico-chemical properties of selected less utilised bamboo species of Kokrajhar district of BTAD, Assam, India'** has been carried out with the specific objectives:

(i) Understanding and documentation of gross quality for utility of selected bamboo species *viz.* 1. *Bambusa garuchokua* Barooah *et* Borthakur., 2. *B. assamica* Barooah *et* Borthakur., 3. *B. pallida* Munro., 4. *Melocanna baccifera* (Roxb.) Kurz., 5. *B. polymorpha* Munro. and 6. *B. bambos* (L.) Voss., growing in Kokrajhar district.

(ii) To study the physico-chemical and anatomical properties of selected bamboo species growing in Kokrajhar district.

(iii) To determine the fiber length, fiber diameter, vascular bundle concentration, vascular bundle length and vascular bundle diameter and to understand their relation with chemical content.

(iv) To determine the chemical properties including alcohol-toluene solubility, hot water solubility, ash content, Klason lignin content , holocellulose content and α-cellulose content of studied bamboo species and to understand their relation with physical properties including specific gravity, shrinkage, modulus of elasticity (MOE), modulus of rupture (MOR) and compression.

The understanding of physical, chemical, and anatomical quality of bamboo is the pre requisite criteria for its utility. Although, the study on this aspect of certain regular used bamboo have been done by several workers, but such study on present selected bamboo species have not been done before in Kokrajhar district. The results of the present study may be the solution of most important question regarding criteria for bamboo utility. The findings of this study may be the key for recommendation of these selected bamboo species for different applications.