Multidimensional Scope, Current Status, Uses and Contribution of Bamboofor Sustaining Livelihood: A Comprehensive Review

ABSTRACT

Bamboo is a versatile group of fastest growing plant which is capable of providing ecological, economical, environmental and livelihood security to the people. Itis one of the most common plants in tropical and subtropical areas, belonging to the Poaceae family and the subfamily Bambusoideae.Bamboo is India's most popular non-wood commodity, sometimes known as "poor man's timber. India has the highestbamboo followed by China. There are 136 different species of bamboo which are reported to be occurring in India which consists of 125 indigenous and 11 exotic and worldwide, a total of 1662 species have been recorded under 121 genera. Because of the growing population and rising living standards, the impact on natural forest resources is increasing every day. Over the last 15-20 years, bamboo has evolved into a highly valuable and superior substitute for wood and timber. Bamboo-based products have the potential to replace wood in a variety of industrial uses while also helping to save and restore the world's forests. In this review various multidimensional scope of bamboo in form of its greatest potential is being discussed.

Comment [D1]: Rewrite the abstract with the following structures: background, the aims of study, method, result, and contribution to the field

Keywords: Bamboo, Economic, Livelihood, Resources.

1. INTRODUCTION

Bamboos constitute fastest growing tall woody grass with joined stem and are versatile plant on the earth, which have been closely associated with mankind since ancient times. Bamboo belongs to subfamily of Bambusoidaeof the grass family poaceae[1]. Bamboo is a self-regenerating renewable raw material which serves for rendering many ecological services like erosion control, protecting riverbanks, preventing

Comment [D2]: Include the previous studies to see the gap of this study

landslides, soil moisture retention, land rehabilitation, biodiversity conservation, carbon sequestration, etc. [2]. They have one or the widest habitats with more than 75 genera and 1500 species worldwide and can thrive inhot, humid rainforest to cold resilient forests. They can tolerate as well as grow in extreme low temperature of about -20°C and precipitation ranging from 800 mm to 1300 mm annual rainfall [3]. As it has wider availability, application and characteristics such as fastest growing nature, strength, light weight, flexibility and potential of technological advancement for value addition bamboo serves as a greatest alternative to timbers.

India has third richest bamboo genetic resources after Brazil and China. Several reports have been found regarding the species richness of bamboo. In India [4] reported about 113 bamboo species, whereas report on number of bamboos varies from 102 [5]. Latest (ISFR2019)data suggests that India has 125 native and 11 exotic bamboo species. In India 12.8% of the total forest area which is about 9.57 million hectare is covered by bamboo plantation [6]. The distribution of bamboo is greatly influenced by human interventions[7]. The alpine region comprises of *Arundinaria* and *Thamnocalamus*, whereas these two also grow in the temperate region along with the *Phyllostachys,Arundinaria,Bambusa* and *Dendrocalamus*grow in the subtropical region whereas in the tropical moist region *Bambusa,Dendrocalamus,Melocanna*,*Ochlandra*and *Oxytenanthera*on the on the other hand in the dry tropical region, *Dendrocalamus*and*Bambusa*aispredominant[8].

Table 1: Genera and number of species of bamboo naturally occurring and cultivated in India

SR No.	Genus	Naturally occurring	Introduced/Cultivated	Total No. of species
1	Arundinaria	2	0	2
2	Bambusa	12	14	26

3	Chimonobambusa	1	0	1
4	Dendrocalamus	7	8	15
5	Dinochloa	5	1	6
6	Gigantochloa	2	5	7
7	Melocanna	0	2	2
8	Ochlandra	9	0	9
9	Oxytenanthera	1	1	2
10	Phyllostachys	2	3	5
11	Pleioblastus	1	0	1
12	Pseudosasa	0	1	1
13	Pseudoxytenanthera	4	0	4
14	Racembambos	3	0	3
15	Schizostachyum	17	1	18
16	Sinarundinria	18	3	21
17	Thamnocalamus	3	0	3
18	Thyrostachys	0	2	2
Total		87	41	128

Source: Bamboos of India a Compendium (K.K Sheetalaxmi)

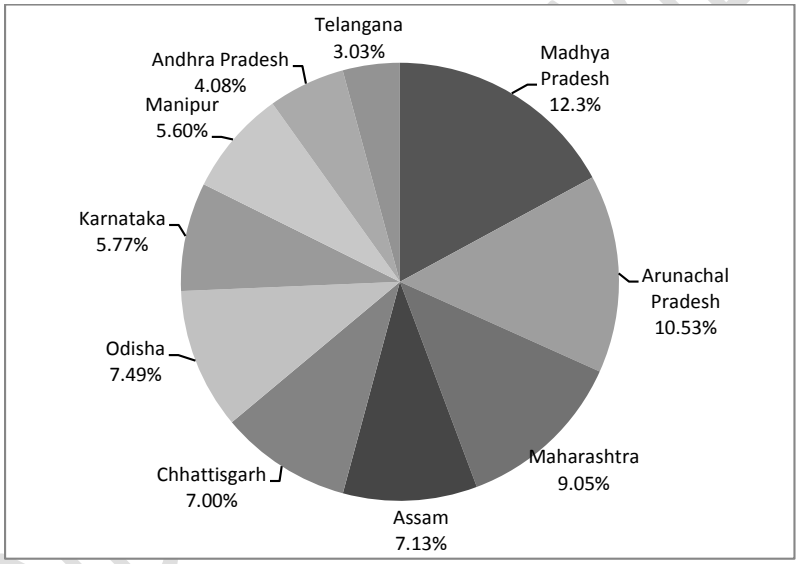
Table 2: Top ten states in terms of bamboo bearing area (%)

State	Percentage coverage of bamboo (%)
Madhya Pradesh	12.30
Arunachal Pradesh	10.53

Maharashtra Assam	9.05
Assam	7.13
Chhattisgarh	7.00
Odisha	7.49
Karnataka	5.77
Manipur	5.60
Andhra Pradesh	4.08
Telangana	3.03

Source: Indian State of Forest Report, 2021

Fig 1: Percentage coverage of bamboo



Source: Indian State of Forest Report, 2021

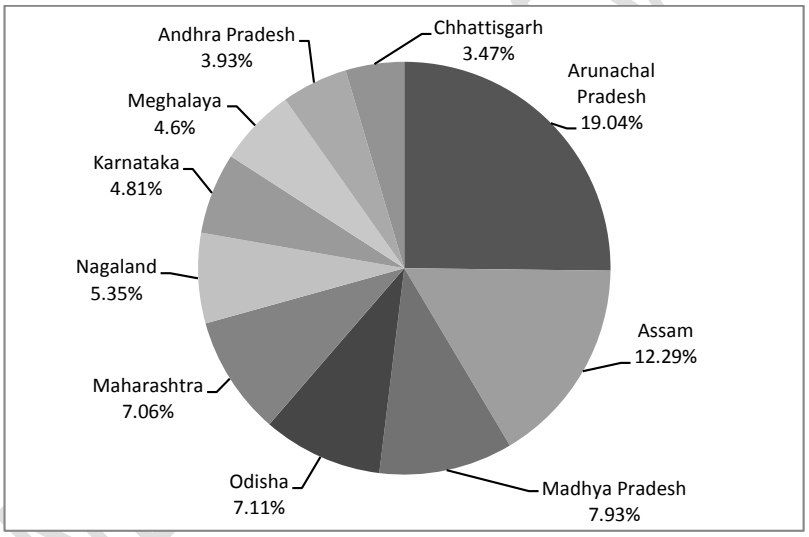
Table 3: Top ten states in terms of bamboo culms (%)

S. No.	State	% Coverage of bamboo culms
1	Arunachal Pradesh	19.04
2	Assam	12.29

3	Madhya Pradesh	7.93
4	Odisha	7.11
5	Maharashtra	7.06
6	Nagaland	5.35
7	Karnataka	4.81
8	Meghalaya	4.60
9	Andhra Pradesh	3.93
10	Chhattisgarh	3.47

Source: Indian State of Forest Report 2021

Fig 2 : Maximum coverage of bamboo culms



Source: Indian State of Forest Report 2021

2. MULTIDIMENSIONAL CHARACTERISTICS AND USES OF BAMBOO

Bamboos are members of the Poaceae (Gramineae) family, and they are the family's fastest-growing and tallest species [9]. Bamboo is a fast-growing plant with a short growth cycle. Bamboo not only grows far more quickly than

A. UNIQUELY TALL AND FAST GROWING:

wood, but it also requires far less water. It has the fastest growing canopy of any eucalyptus species, growing three times faster than the majority of eucalyptus species. Species that are commercially valuable mature in four to five years (versus 10 to 25 years for most soft woods). Following then, annual harvests are conceivable.

B. PROTECTS OXYGEN AND CARBON DIOXIDE ON EARTH:

Bamboo plants, which occupy 40 million hectares globally, have a high biomass stock and carbon storage capacity, and hence play a critical role in reducing climate change [10]. Various research on the significance of bamboo forests in global carbon cycling have been published. [11],[12]. Bamboos are well-known for their ability to absorb wastewater from agriculture, industry, animal husbandry, and pollution, which can be linked to the neutral trait in stress resistance.

C. PHYTOREMEDIATION POTENTIAL:

Bamboos can clean up polluted soils and collect silicon in their bodies to alleviate metal toxicity, with a natural buildup of up to 183 mg•g1 SiO_2[13].The results of a two-year experiment on the efficacy of three bamboo species for wastewater removal revealed that the soil-bamboo system could remove 98 percent of organic matter and 99 percent of nutrients, respectively [14]. As a result, bamboo is an excellent choice for reducing the negative effects of climate change, as well as a large carbon sink in nature that aids in the adjustment and improvement of human ecosystems[15].

D. PROVIDES EDIBLES IN THE FORM OF BAMBOO SHOOTS:

Bamboo shoots have supplied nutrition to millions of people throughout the world as a food source. Bamboo shoots are a good source of dietary fiber, which is a type of fiber. Bamboo shoots that are low in fat and calories [16]. Bamboo also contains essential amino acids, potassium, antioxidants, selenium, vitamins, carbs, and protein [17]. However, the Bamboo Age Index is significant; in one study it is found that the amount of vitamins and minerals in

bamboo decreases as the age of the plant increases [18]. As a result, young bamboo culms can provide fiber and starch for culinary products such as bamboo flour, pasta, meat products, cheese, yoghurt, and bread.

E. PREVENTS SOIL EROSION:

Bamboo has a protective effect in reducing soil deterioration, such as biodiversity loss, soil nutrient depletion, and soil erosion [19]. Its anti-erosion characteristics act as a watershed, holding soil together along vulnerable river banks, deforested areas, and locations prone to earthquakes and mud slides. Bamboos help manage landslides, preserve flooded rivers on their natural path, and limit the speed of water flow by considerably reducing rain run-off and preventing massive soil erosion.

3. BAMBOO AS A SOURCE OF LIVELIHOOD:

For millions of people in India and around the world, bamboo is a tremendous source of income. There is a lot of literature on the diverse uses of bamboo, and emphasizes the importance of bamboo in terms of supporting livelihoods. Bamboo is used for building houses, making bamboo ply, agricultural implements, handicrafts, irrigation, brooms, medicine, food, fuel, fodder, paper & pulp, and many other things. Bamboo is also utilized as a perfect substitute for several wood-based items. Bamboo goods that provide livelihoods can be broadly classified as follows:

A. WOOD SUBSTITUTES AND COMPOSITES

- **BAMBOO FURNITURE:**

Natural round or split bamboo is used in traditional bamboo furniture. Glue-laminated bamboo panels are used in a new sort of 'pack-flat,' 'knock-down' furniture. Unlike traditional designs, this furniture can be delivered in flat boxes that can be built on-site. Traditional bamboo furniture has a number of drawbacks, including high labor and transportation expenses, low productivity, instability, fluctuating quality, and sensitivity to insects and fungi. It retains the physical, mechanical, chemical, environmental, and aesthetic characteristics of bamboo at the same time. Laminated bamboo furniture exports are continuously increasing. Due to the lack of a particular classification for bamboo furniture, trade

statistics currently do not capture the value. Wooden furniture is the most common classification.

- **BAMBOO HOUSING:**

Bamboo housing can be divided into three categories: Traditional bamboo houses are made of bamboo culms; traditional bahareque bamboo buildings are composed of bamboo frames coated with cement or clay; and modern prefabricated bamboo houses are made of bamboo laminated boards, veneers, and panels. Traditional bamboo dwellings are home to nearly one billion people, according to experts. Unlike brick or cement constructions, these structures are usually less expensive than timber dwellings, are light, sturdy, and earthquake resistant. Engineered bamboo-based prefabricated buildings have a number of advantages. They can be packed flat and transported for a low cost over large distance. They are more aesthetically pleasing and environmentally friendly. Bamboo materials are commonly available and can be grown for a reasonable price.

- **BAMBOO RAW MATERIALS:**

Bamboo is a non-permanent material. Its use in exposed settings necessitates prior treatment [20], and it can be improved further with the use of current engineering techniques. Bamboo may be turned into modern items (engineered bamboo) that can compete in price and performance with wood products.The use of bamboo in composite panels and boards overcomes culm-related quality discrepancies and allows for the development of uniform products. Engineered bamboo has the potential to replace wood, steel, and concrete in a variety of applications.

B. INDUSTRIAL USE AND PRODUCTS

- **BAMBOO PULP, PAPER AND CLOTH:**

Bamboo is used as pulp, paper, and more recently fabric in several bamboo-producing countries, including China and India. Bamboo paper is nearly identical to wood-based paper in terms of quality. Its brightness and optical qualities stay steady over time, whereas those of wood-based paper may deteriorate. Bamboo fibers have morphological properties that produce paper with a high tear index, similar to hardwood paper. When compared to softwood paper, the tensile stiffness is slightly lower. Hardwood and softwood papers have similar strain strengths.

Bamboo paper's quality can be increased by refining the pulp.

C.FOOD PRODUCTS

- **BAMBOO SHOOTS:**

Bamboo shoots are edible and appetizing in about 200 species of bamboo, including: *Acidosasa edulis, Chimonobambusaquadrangularis, Phyllostachys heterocycla var. pubescens*, *Phyllostachys praecox, Phyllostachys dulcis, Phyllostachys iridescens.* Bamboo shoots are tasty and nutritious, with a high fibre content. Bamboo vegetables are available at Chinese grocery stores and restaurants all over the world. Because cooking does not alter the texture of the shoots, they remain crisp after cooking. Bamboo shoots that have been cooked can be preserved in containers and exported all over the world.

D. CONSTRUCTIONAND STRUCTURAL APPLICATIONS

- **BAMBOO CHARCOAL:**

Bamboo charcoal has long been used as a replacement for wood charcoal and mineral coal. It has the ability to act as a fuel, absorbent, and conductor. Bamboo charcoal has about half the calorific value of oil of the same weight. Bamboo charcoal that has been activated can be used to clean the environment, absorb excess moisture, and make medications. Bamboo charcoal has a six-fold higher absorption capacity than wood charcoal of the same weight. China is a world leader in manufacturing. The largest customers are currently Japan, the Republic of Korea, and the Chinese province of Taiwan, but imports are fast rising in Europe and North America. The success of bamboo charcoal in international trade can be attributed to three factors: When compared to tree species, bamboo grows quicker and has a shorter rotation; bamboo charcoal has a calorific value and absorption properties that are comparable to or better than wood charcoal; and it is cheaper and easier to make.

- **BAMBOO PANELS:**

Bamboo panels were first produced in China in the early 1800s. In Asia, more than 20 different types of panels are currently produced. Bamboo has a longer fibre than wood, which gives it technological advantages. The panels are commonly utilised as structural elements or as shapes for concrete mouldings in modern building. Flooring, roofing, partitions, doors, and window frames are just a few of the applications. Due to their rigidity and endurance, bamboo panels have several

advantages over wooden boards. Veneers, stripboards, matboards, fibreboards, particle boards, medium density boards, mixtures of these, and combinations of these with wood and other ligno-cellulose materials and inorganic substances are all examples of bamboo veneers, panels, and boards.

- **BAMBOO FLOORING:**

Bamboo flooring is a high-quality product with a wide range of applications and a significant worldwide consumer market. Because of its smoothness, brightness, stability, high resistance, insulating capabilities, and flexibility, it offers some advantages over timber flooring. Bamboo flooring has a smooth natural shine that preserves the natural gloss and elegance of bamboo fiber. This flooring appeals to the most discerning customers in Europe, Japan, and North America. In 2004, China's yearly bamboo flooring manufacturing was projected to be 17.5 million. Exports account for almost 65% of overall output (Customs General Administration of China, 2004). Products and crafts made from bamboo in China, India, Malaysia, the Philippines, and Thailand, bamboo crafts and woven mats are traditional items. The method has been used for thousands of years. These various goods have become an integral part of everyday life, literature, and art. Fruit baskets, trays, bottles, jars, boxes, cases, bowls, fans, screens, curtains, pillows, lampshades, and lanterns are among the roughly 20 types of woven bamboo products available in Asia.

- **BAMBOO FUEL:**

Bamboo may be pyrolyzed to produce three useful products: bamboo charcoal, oil, and gas. Depending on the aim and market conditions, changing the pyrolysis parameters can vary the product shares. Bamboo extracts are rich in nutrients and can be used in medications, cosmetics, and beverages. Bamboo gas can be utilised as a petroleum alternative. Bamboo charcoal is a fantastic cooking and barbecuing fuel. Activated charcoal is used as a deodorant, a purifier, a disinfectant, a pharmaceutical, an agricultural chemical, and a pollutant and moisture absorbent.

DISCUSSION AND CONCLUSION:

Bamboo has a wide range of applications, which is why it is known as "green gold," and it has enormous potential to offer rural populations with a source of income and economic security. As a result, a concerted effort should be

Comment [D3]: It is important to state the theoretical and practical contribution of this study, as well as the limitation and study forwards

undertaken to realize Bamboo's full potential, as it is past time. There are numerous obstacles, such as a lack of planting material, overexploitation of resources, a lack of awareness about conservation practices, a lack of storage and warehousing, and so on, and a significant amount of work must be done to address these flaws in bamboo farming. Bamboo farming should be enhanced by expanding bamboo research and development operations in order to improve its genetics and produce high-quality planting material. Also, at the farm level, commercialization of bamboo as an enterprise should be pursued, as should raising awareness among farmers by informing them of the vast applications of bamboo cultivation and providing them with quality planting material.

SUMMARY:

Bamboo is a versatile plant that has a wide range of uses and provides services to millions of people all over the world, including in India. This study discusses its enormous potential of bamboo for earning a living or for sustaining better livelihood.

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Comment [D4]: Use the newest literature, it is the newest publication better in 5 years

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