

Major Contributions of Bamboo Grass in Maintaining Ecosystem, Sustainability, And Climate Change Mitigation: An Indian Perspective

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ABSTRACT- India is blessed with rich biodiversity, including bamboo, often called India's "Green Gold" due to its numerous ecological applications. The National Bamboo Mission identifies 136 bamboo species in India, with commercially important species including *Bambusa*, *Bambusa tulda*, *Bambusa balcooa*, and *Bambusa Dendrocalamus*. Bamboo, known for its rapid growth, belongs to the grass family *Poaceae* and can withstand freezing temperatures, with some species surviving temperatures as low as -29°C . India boasts one of the largest bamboo cultivation areas globally, covering approximately 13% of the country's forested hectares. Bamboo is a versatile plant with applications in construction, handicrafts, textiles, and as a food source for various wildlife species. Bamboo plays a significant role in maintaining the balance of oxygen and carbon dioxide in the atmosphere, releasing 35% more oxygen than equivalent tree species. Planting bamboo can thus significantly reduce carbon footprints and contribute to combating global warming and climate change. Furthermore, bamboo is a sustainable alternative to wood, highlighting its potential to reduce pollution and mitigate environmental degradation.

Keywords: Global warming, Ecosystem, Sustainability, Carbon footprint, Climate Change, Environment, Biomass, Soil erosion

1. INTRODUCTION

Bamboo is among the fastest-growing plants globally, categorized as evergreen perennial flowering plants belonging to the subfamily *Bambusae* of the Grass family *Poaceae*. According to Chunvy P. (2013), bamboo, a rapidly growing woody grass, plays a significant role in nature-based solutions, acting as a carbon sink and producing various types of products. Its major contribution lies in credit for carbon

projects, as bamboo exhibits fast growth and has a remarkable carbon sequestration capacity. This plant species is widely distributed globally, thriving in temperate, subtropical, and tropical regions. Climate change significantly impacts worldwide, adversely affecting our environment leading to unfavourable conditions for all living organisms, including droughts, ecosystem deterioration, earthquakes, landslides, and floods. There is an urgent need for proper action to

mitigate the effects of climate change and achieve the Sustainable Development Goals (SDGs) for 2020 set by the United Nations. According to Chunvy P. (2023), studies have concluded that bamboo is crucial in mitigating climate change as a carbon sink in biomass form and as carbon storage in bamboo products.

1.1 REVIEW

According to Yanxia et al. (2010), a technical report highlighted bamboo's rapid growth as a grass species beneficial to humanity. A review of studies conducted in China concluded that bamboo is a relatively important carbon store in ecosystems, suggesting that bamboo forest ecosystems can help mitigate climate change. Global deforestation is identified as one of the most significant sources of carbon emissions, emphasizing the importance of forests as crucial carbon sinks. Studies at the national level have indicated that bamboo is classified as grass rather than a tree. However, bamboo forests play a vital role in the carbon cycle, sequestering carbon through bamboo fibre via photosynthesis.

2. MATERIAL AND METHOD

A systematic review was conducted based on the study of various research papers, articles, and magazines, and a comprehensive interpretation of findings from various research projects to comprehensively understand the various uses of bamboo forests and their major contributions to mitigating climate change, soil erosion, and wasteland restoration in the environment.

2.1 OVERVIEW OF BAMBOO SPECIES

Bamboos constitute a diverse group of mostly evergreen perennial flowering plants belonging to the subfamily Bambusoideae of the grass family Poaceae. Giant bamboos represent the grass family's largest members, with individual

Dendrocalamus sinicus culms reaching lengths of up to 46 meters and thicknesses of up to 36 centimetres. Internodal regions of the stem in bamboo are typically hollow, and vascular bundles in the cross-section are dispersed throughout the culm's walls.

2.2 TAXONOMY

Bamboos are a group of woody perennial evergreen plants classified within the true grass family Poaceae. They have long been regarded as the basal grass genera, primarily due to bracteates, indeterminate inflorescences, "pseudo spikelets," and flowers with three lodicules, six stamens, and three stigmata.



Figure 1. Bambusa bamboo plant species

2.3 CULTIVATION CONDITIONS OF BAMBOO

Bamboos (Bambusoideae) are distributed worldwide, with most species native to warm and moist tropical and warm temperate climates.

They also thrive in cool mountainous regions and highland cloud forests.

2.4 VARIOUS BAMBOO SPECIES

Studies have revealed that bamboo is abundant in India, with the country estimated to have more than 13.96 million hectares under bamboo cultivation, encompassing over 136 distinct species. Bamboo covers nearly 13% of India's forest area, making it the world's second-largest bamboo-growing country after China. Among the numerous bamboo varieties, some notable ones include Bambusa bamboo, commonly known as Indian thorny bamboo, which is prevalent in India and primarily used for construction, furniture making, and handicrafts. Bambusa tulda, native to the Indian subcontinent, Indochina, Tibet, and Yunnan, is called India timber bamboo. This species serves as a major food source for elephants and is utilized for making paper, furniture, and handicrafts.



Figure 2. Bamboo is used in Drip irrigating system preparation in Meghalaya states

2.5 MAIN ADVANTAGES OF BAMBOO

According to the International Network for Bamboo Report (INBR) (2013), bamboo offers several advantages in mitigating and adapting to climate change. Often mistaken for wood, bamboo is a prominent type of grass known for

its versatility as a construction building material. Some key advantages of bamboo include the following: Bamboo contains fibres in its poles that exhibit high tensile strength. Bamboo is lightweight, making it easy to transport. Due to its high water and silicic acid composition, bamboo has natural fire resistance, making it a safe building material. Bamboo is resistant to insects and fungal attacks, although special treatment may be required for preservation. *Bendrocalmus strictus*, known as male bamboo or Calcutta bamboo, is native to the Indian subcontinent and serves as raw material for paper mills while offering edible shoots. A published paper in China Dialogue (Climate News) dated October 29, 2020, concluded that bamboo could contribute to greenhouse gas emission reduction in two ways: as forests that absorb significant carbon sink sources and as producers of durable products that store carbon, serving as replacements for timber, concrete, and steel. Additionally, bamboo is essential for maintaining ecosystems as it grows rapidly and efficiently collects carbon. Its shallow root system allows annual harvesting, making it a fast-regenerating natural resource.

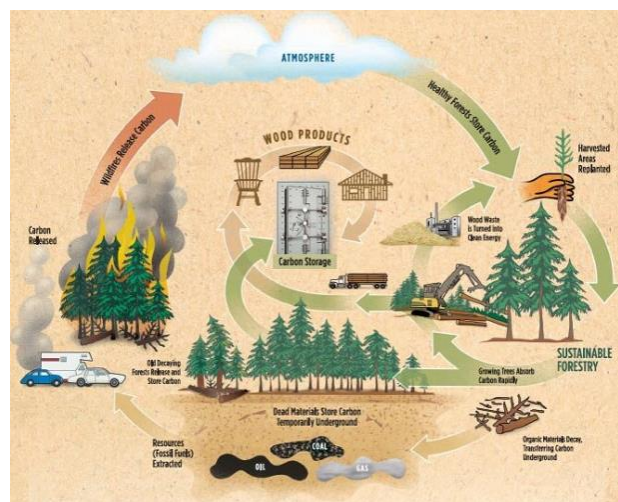


Figure 3. Picture of the Bamboo carbon cycle (Source: Google)

IMPORTANCE OF BAMBOO IN CARBON SEQUESTRATION

Bamboos, classified as C3 plants, possess normal photosynthetic capacities, with their main advantage in mitigating climate change lying in their rapid biomass generation and renewability. Newly planted bamboo forests exhibit rapid biomass growth for ten or more years before reaching a plateau, significantly increasing productivity per unit area and doubling productivity compared to other types of forests. Bamboos can be utilized for various forest-based climate change activities, including afforestation, reforestation, forest management, and avoided deforestation.

3. CONCLUSION

Fast-growing bamboo grasses have proven their ability to thrive on sloping and degraded soils, earning them the moniker "Poor man's timber" and generating income from bamboo products. Bamboo has gained attention for removing substantial amounts of carbon dioxide from the atmosphere, contributing to keeping global warming below 1.5°C. Research indicates that one hectare of bamboo plantation and its products could absorb 306 tonnes of carbon over 60 years, compared to 178 tonnes for Chinese trees. Bamboo's rapid growth and high annual regrowth rate after harvesting make it an excellent biomass accumulator, effectively transforming carbon dioxide into biomass through photosynthesis and increasing the carbon sink capacity of bamboo ecosystems. Bamboo plays a crucial role in maintaining the balance of oxygen and carbon dioxide in the atmosphere, releasing 35% more oxygen than an equivalent area of trees. Planting bamboo offers significant benefits in reducing carbon footprints and combating global warming. It is an

alternative replacement for wood and supports sustainability in economic growth across various climatic conditions and altitudes. In conclusion, bamboo is a fast-growing, renewable, and easy-to-grow resource with diverse applications, including construction, food, paper, and other sustainable materials.

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