

CHAPTER

8

ENGINEERING APPLICATIONS: BAMBOO-BASED COMPOSITES

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8.1 BAMBOO: GLOBAL DISTRIBUTION, GROWTH, AND APPLICATIONS

Bamboo belongs to the grass family *Poaceae* and subfamily *Bambusoideae*. The distribution of bamboos on Earth ranges from 51°N latitude in Japan (Sakhalin Island) to 47°S latitude in southern Argentina (Yeasmin et al., 2015). The distribution of bamboo globally is shown in Figure 8.1. Bamboo possesses a distinctive rhizome-dependent system, distinguishing it from trees and contributing to its status as one of the fastest-growing plants globally (Farrelly, 1984). Certain bamboo species can achieve growth rates of 90–120 cm per day, approximately one mm every 90 seconds (s) (Austin et al., 1970). The maturation cycle of bamboo typically lasts between three and five years (Khajouei-Nezhad et al., 2023). The quick growth of bamboo renders it an optimal substitute for lumber sourced from diminishing natural forests. Furthermore, bamboo possesses significant strength, flexibility, and an excellent strength-to-weight ratio, rendering it appropriate for both structural and non-structural uses (Agrawal & Das, 2023).

Bamboo is gaining significant favour globally owing to its sustainability and eco-friendliness. Apart from that, its increasing popularity can also be attributed to its versatility, which allows it to be

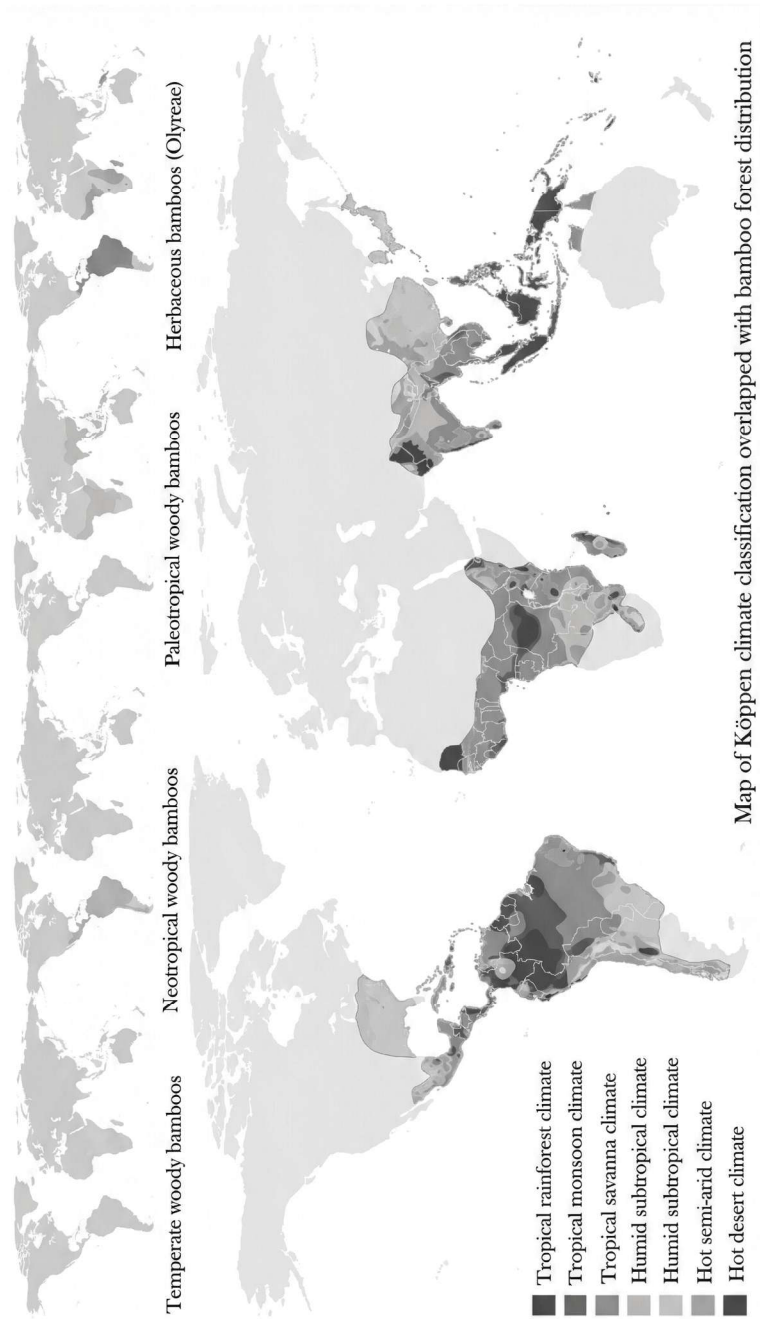


Figure 8.1 Bamboo types and their distribution around the world with different climate zones (Huang et al., 2017)

converted into a wide range of products. According to a market report by Credence Research (2023), the global bamboo market is bound to see a significant expansion over the next decade. The global bamboo market was valued at approximately USD 75 billion in the year 2023. It is projected to reach USD123 billion by 2032, with a Compound Annual Growth Rate (CAGR) of 5.65% (Credence Research, 2023). The growth of technology in bamboo processing techniques, coupled with supportive local government initiatives, has undoubtedly contributed to the development of bamboo and its products.

As mentioned above, bamboo is a versatile material that can be used in a wide range of sectors. For instance, bamboo is often used in civil engineering construction such as bridges and housing projects (Sil, 2024). Also, bamboo can be used as a substitute for timber to produce various wood-based engineered products and composites such as bamboo composite laminates, plywood and mat boards that are intended for flooring, decking and furniture applications (Dauletbek et al., 2022). Moreover, bamboo exhibits major contributions to the food industry, as bamboo shoots are considered a nutritious food that is rich in protein, fibre, and vitamins (Wang et al., 2020). Apart from that, bamboo can be used in many other sectors, such as pulp and paper (Shamsuri and Main, 2021), biofuel (Song et al. 2022), textiles (Rocky and Thompson 2020) and many others. This chapter delineates the varieties of bamboo-based composites categorised by the conversion method of bamboo culm, their applications across many sectors, and the constraints and challenges encountered by these products.

8.2 TYPES OF BAMBOO-BASED COMPOSITES

There are several types of bamboo-based composites based on the conversion method or mode of bamboo culm. In a review by Kumar and Mandal (2022), the modes of using bamboo for composites or laminates can be divided into three, which are (1) Roller-pressed bamboo culm, (2) Bamboo strips, and (3) Bamboo fibre. The types of usage mode of bamboo for their respective composites or laminate preparations are summarised in Table 8.1.