

Bamboo Social Impact Study

Potential economic, social, and climate-positive impacts of developing an end-to-end value chain for locally sourced bamboo

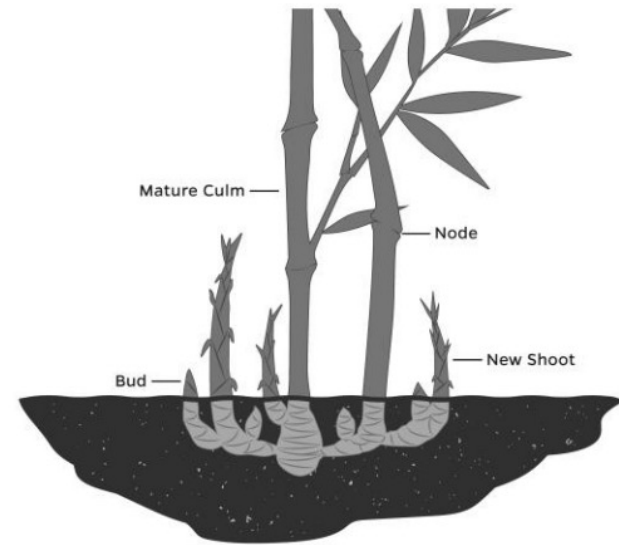


Source: ADB



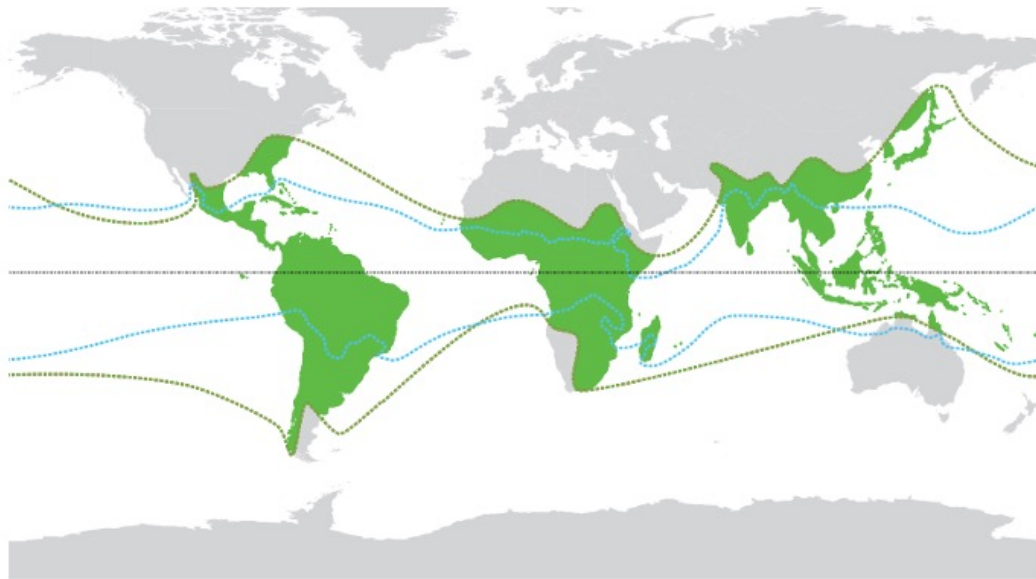
About Bamboo

- A type of woody grass
- Underground rhizome system and above ground stems (culms)
- Range in height according to species, from 50cm to 35m tall, and up to 30cm in diameter
- Approximately 1,400 known species of bamboo worldwide
- Grows rapidly: sustainable alternative to traditional timber, maturing in 3-7 years compared to 20+ for timber



Source: D Lieurance, A Cooper, AL Young et al. Running bamboo species pose a greater invasion risk than clumping bamboo species in the continental United States. *Journal for Nature Conservation*; 2018;43:39-45.

The world's natural bamboo habitat



Est. 35mn ha of
bamboo resources
worldwide

24.9mn ha in Asia

Source: DE Hebel, F Heisel, A Javadian et al. Constructing Bamboo: Introducing an alternative for the construction industry. FCL Magazine Special Issue, 2015.

<https://www.research-collection.ethz.ch/handle/20.500.11850/155584>

Framing the impact of bamboo: Strengths and weaknesses of bamboo agroforestry

Strengths

Versatile, natural product with low environmental impact

Eco-friendly wood substitute

Stable local market where bamboo is indigenous

Growing international market for wide range of bamboo products

Weaknesses

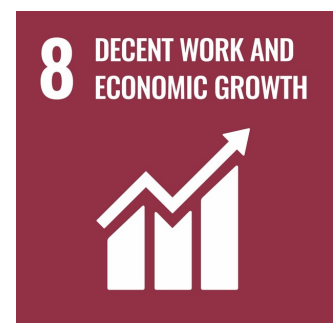
Farmers lack knowledge in bamboo plantation management

Advances in bamboo technology far from the materials sources

Often lacks a single government entity responsible for development



Framing the impact of bamboo:



Bamboo as a building material

- Can have the same tensile strength as steel
- Has better thermal properties than reinforced concrete
- Has a shorter growth cycle and better carbon sequestration properties than timber
- Is more amenable than other low-cost bio-based materials for transformation into high-quality building materials through advanced production technologies

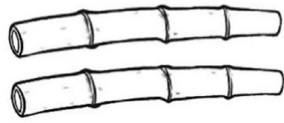


Source: construction workers: Base Bahay Foundation
material: Better Bamboo Buildings

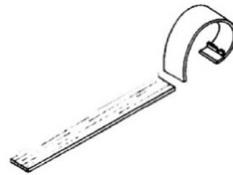


Bamboo as a building material

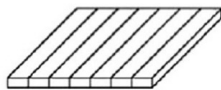
Types of bamboo building materials:



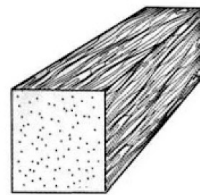
Bamboo poles



Flattened bamboo



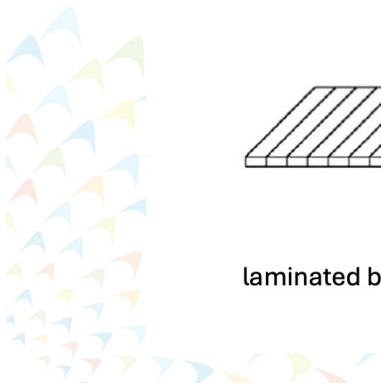
laminated bamboo



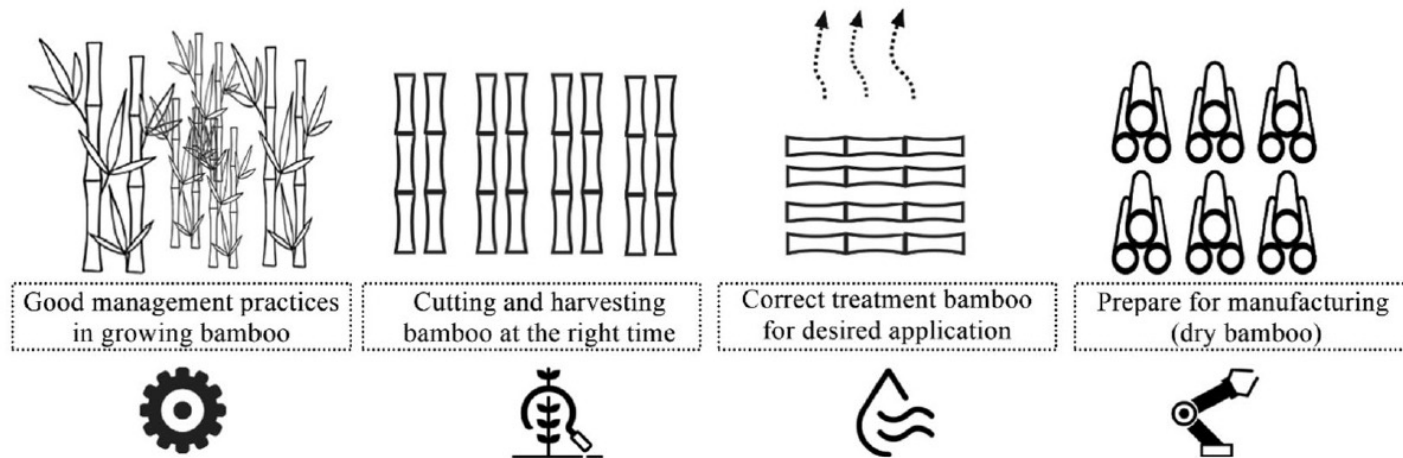
Strand-woven bamboo



Source: Base Bahay Foundation Inc.



Bamboo as a building material barriers and facilitators: technical expertise



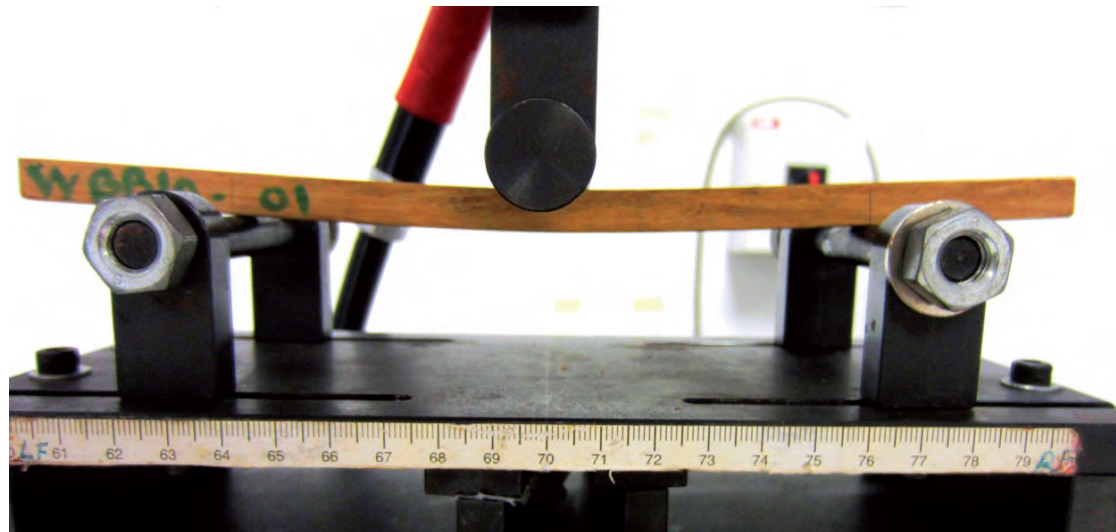
Source: Burger, M., Oosthuizen, G., Oberholzer, J., Wet, P. D., & Ras, C. (2017). Strategies to standardize bamboo for manufacturing process chains. *Procedia Manufacturing*, 8, 330–337.

Bamboo as a building material barriers and facilitators: supportive policy environment

- In 2010, the Government of the Philippines created the Philippine Bamboo Industry Development Council
- In 2018, the Government of India launched the National Bamboo Mission
- In 2023, the People's Republic of China initiated a 3-year action plan to promote the use of bamboo as a substitute for plastic
- In 2024, Indonesia's Ministry of Industry announced it was preparing a roadmap for the development of the bamboo industry



Bamboo as a building material barriers and facilitators: research and innovation



Photos credits: Alireza Javadian and Dirk E. Hebel, School of Engineering, NUS Singapore.

The Role of Bamboo in Economic Development: value chain analysis

- Growing demand for bamboo
- Sector not well-positioned to take advantage of demand
- Not enough government support and strategy
- Severe information asymmetries along the value chain
- Human resources constraints

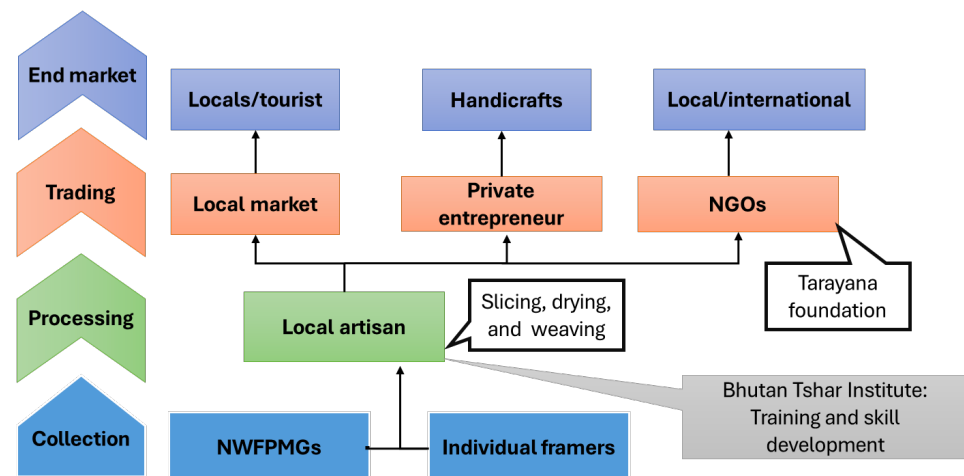


Source: ADB



The Role of Bamboo in Economic Development: Bhutan

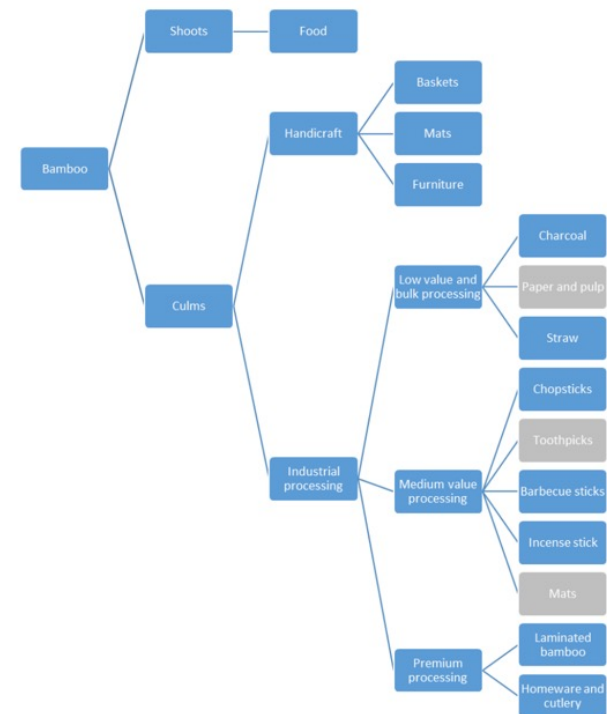
- 33 species of bamboo.
- Used to produce a diverse range of bamboo products, including baskets, drumsticks, and furniture
- Aging local artisan community
- Informal sales arrangements often result in inconsistent sale prices
- Government promoting the use of bamboo and cane through various supportive incentives and policies



Source: Tshering, Chungdu & Orong, Karma & Wangmo, Kezang & Tenzin, Tshewang & Tshering, Namgay & Tshering, Lagay. (2024). Bamboos and Canes Value Chain Analysis for AFoCO Project Sites in Bhutan.. 10.13140/RG.2.2.31927.12966.

The Role of Bamboo in Economic Development: Cambodia

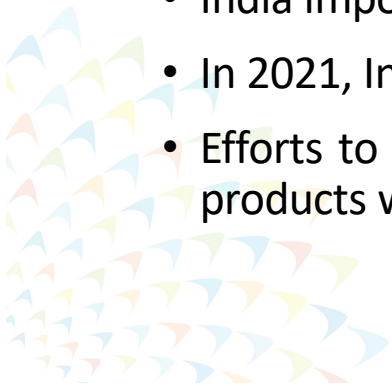
- 4 bamboo species are known to be grown and used in Cambodia
- Mostly used for hand-crafted furniture and small homewares such as chopsticks, barbecue skewers, and incense sticks, limited amount of industrial processing of bamboo sticks and bamboo charcoal
- Emerging trend of higher-end bamboo products, such as water bottles, cutlery, and premium bags
- 3 main value chains: bamboo shoots, handicrafts, and industrial processing.
- Current processing chain in Cambodia primarily focuses on low and medium-value bamboo products



Source: Nuppun Institute for Economic Research Report For "NTFP Value Chain Analysis" Phase II - Value Chain Studies. 2019.

The Role of Bamboo in Economic Development: India

- Second-largest producer of bamboo after the PRC
- Seventh-largest exporter
- Bamboo cultivation significant source of livelihood for half of the country's tribal population of 68 million people
- Major export destinations of bamboo products: Bhutan, Bangladesh and Nepal.
- High domestic demand for bamboo
- India imports most of the required raw materials, in particular from the PRC
- In 2021, India imported 88% of its bamboo raw materials
- Efforts to promote the bamboo value chain have primarily focused on low-value-added products with labour-intensive work, resulting in limited profitability



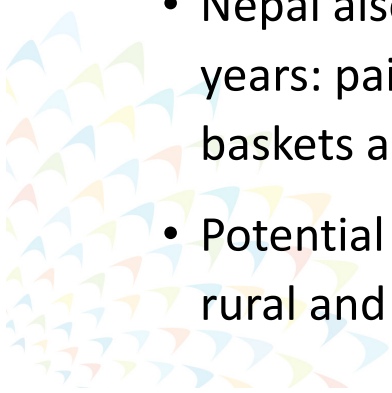
The Role of Bamboo in Economic Development: Indonesia

- >140 bamboo species 2.1 million hectares of bamboo forest
- Used for construction, housing, household items, and handicrafts
- 2018 study of bamboo value chain: significant contributor to rural economy
- Performance of the three bamboo value chains was good, but room for improvement
- Low prices and irregular demand, profits unevenly distributed. Growers and artisans



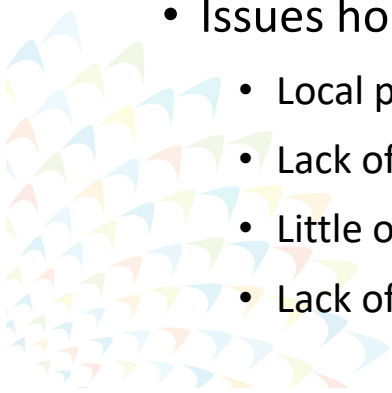
The Role of Bamboo in Economic Development: Nepal

- >50 species of bamboo found in Nepal
- Estimated 63,000 hectares of private land, public land, riverbanks, and national forests
- Most bamboo products, from small producers and traders, consumed domestically
- Nepal also been marketing bamboo products internationally for more than 20 years: painting materials, wood charcoal, plywood and laminated products, baskets and furniture
- Potential to provide employment and economic growth prospects for Nepal's rural and urban populations



The Role of Bamboo in Economic Development: Pakistan

- In the 1980s, various bamboo species from Bangladesh, the PRC, Sri Lanka, and Thailand were introduced into Pakistan, 3 native species
 - Almost all grown on private farms in the Punjab region
 - Mostly consumed domestically
 - Relatively poor quality of the bamboo grown makes it difficult for it to compete in the international market.
- Issues holding back the bamboo industry in Pakistan:
 - Local product manufacturing sector almost non-existent
 - Lack of research and data on bamboo resources
 - Little or no policy supporting the bamboo sector
 - Lack of interest from research institutions and academia

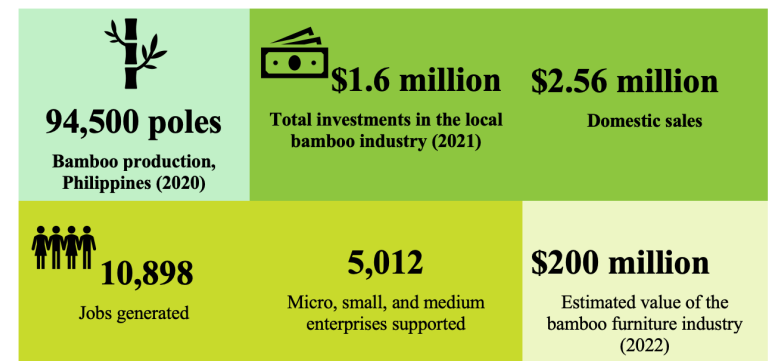


The Role of Bamboo in Economic Development: People's Republic of China

- >590 bamboo species more than any other country
- Largest bamboo industry in the world: >10,000 bamboo processing enterprises
- PRC's bamboo exports account for 75% of the global total
- Government has invested heavily in research and development on bamboo-related technologies such as high-yield plantations, and new processing and product development
 - Industry benefits from favourable policies and regulations at central and local government level
 - The country's bamboo value chain is well developed
 - Lack of data on all aspects of the industry
 - Increasing competition in the global market from neighbouring countries

The Role of Bamboo in Economic Development: Philippines

- 62 species, including 21 species that are native to the country
- Estimated total area of bamboo stands in the country: 39,000-53,000 hectares, mainly growing sporadically or in patches in backyards and riverbanks
- Used housing construction for centuries
- World's 6th largest exporter: France, Germany, Japan, UK, USA
- 2021 total investments: \$1.6 million, domestic sales of \$2.56 million
- Industry generated 10,898 jobs and supported 5,012 micro, small, and medium enterprises
- In 2022, the value of the bamboo furniture industry was estimated to be \$200 million and is expected to grow at a compound annual growth rate of 6.1%
- Bamboo industry part of the informal sector, not reached its full potential as a driver of economic growth



Source: Source: ADB. From Roots to Revenue: Securing Finance and Climate Solutions Through Bamboo Agroforestry.

The Role of Bamboo in Economic Development: Thailand

- 69 species
- Long used for a range of products
- Exported as bamboo poles and processed bamboo products including plywood, furniture, tissue, wicker, charcoal, and as a foodstuff
- Exports of bamboo products are increasing over time

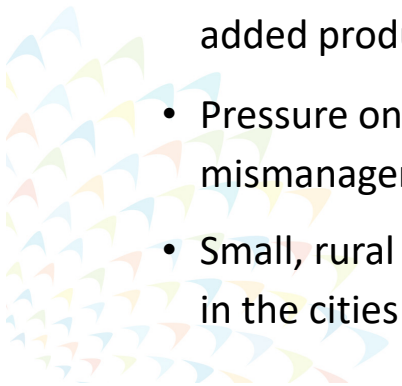


The Role of Bamboo in Economic Development: Viet Nam

- 210 bamboo species
- Bamboo and rattan industries provides 3.4 million jobs
- \$348 million in exports (2018).
- Industry focused on low value-added products
- Weak coordination among chain actors and resources
- Significant information asymmetries a barrier to upgrading to more value-added products
- Pressure on bamboo resources, due to overexploitation and mismanagement
- Small, rural bamboo enterprises compete with more lucrative employment in the cities



Source: ADB



Social Impact of Bamboo for Housing

- Most of the low-income housing needs are not met by government-led housing programs
- Families self-build working with locally hired masons, incrementally
- Often leads to the selection of suboptimal housing materials choices, and a rejection of traditional materials like bamboo
- BUT: traditional and vernacular architecture using locally available materials has the advantage of being well adapted to the social conditions and environment of its specific location
- Bamboo is a material used in traditional architecture, and preservation of its use helps enable culturally significant practices to continue and thrive



Credit: Kawayan Collective

Social Impact of Bamboo for Housing: qualities of bamboo

Disaster recovery: Because bamboo frequently grows in regions that are susceptible to hurricanes and typhoons, stands that have been flattened during storms can be repurposed immediately to construct temporary shelters

Seismic performance: traditional bamboo structures have excellent seismic performance during earthquakes

Thermal comfort and energy efficiency : research shows that bamboo structures score well compared to conventional structures in both regards

Bamboo housing can also be designed to be extremely energy efficient, both in construction and in cooling and heating



Credit: Kawayan Collective

Social Impact of Bamboo for Housing: Cement bamboo frame technology

- One of the most developed examples of enhanced traditional bamboo construction practices
- Innovative construction technology that uses treated, load-bearing bamboo as its sole structural element
- Inspired by ancient Latin American building techniques, blended with Asian bamboo construction traditions and European standards
- Prefabricated and sustainable frame system comprising treated load-bearing bamboo, metal connections and mortar-cement plaster.
- Enables the rapid construction of strong homes
- Tested for resistance to earthquakes of magnitude 7-8 and typhoons with winds of up to 300 km/h, resistance to fire and insect infestation



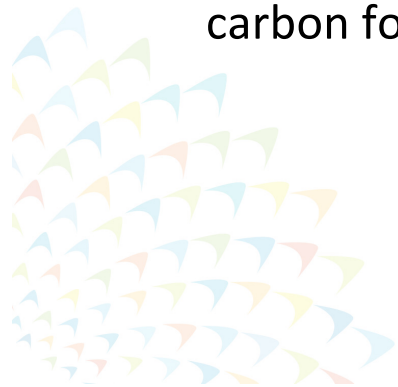
Source: Hilti Foundation. Tackling the Global Housing Crisis with Bamboo. 2019.
<https://www.hiltifoundation.org/stories/tackling-the-global-housing-crisis-with-bamboo>

Environmental Impact and Contribution to Climate Action

- “A powerful ally in the fight against climate change, land degradation, and environmental sustainability.” (World Bamboo organization)
- Due to its propensity for rapid growth, hardiness
- Remarkable carbon sequestration capacity, far beyond that of trees
- Replacement for other materials with a larger carbon footprint



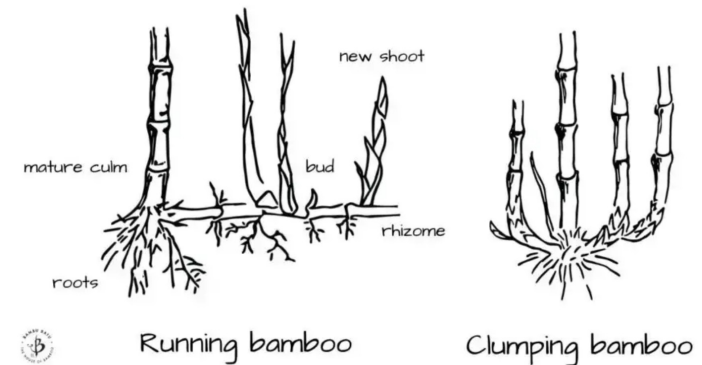
Credit: Base Bahay Foundation



World Bamboo Organization. Why bamboo? <https://www.worldbamboo.net/bamboo>

Environmental Impact and Contribution to Climate Action

- A valuable asset to control soil erosion: grows well on steep hillsides, road embankments, gullies, or on the banks of ponds and streams
- A positive impact on biodiversity and offer excellent habitats for a variety of flora and fauna
- Two growth strategies, one invasive, one beneficial
- Beneficial: clumping type bamboo develops new culms at the margin of an existing clump
- Invasive: running type bamboo spreads via long, running shoots



Source: Bambu Batu **Bamboo Basics: Running vs Clumping** 2021. <https://bambubatu.com/bamboo-basics-running-vs-clumping/>

Environmental Impact and Contribution to Climate Action: Agroforestry or monoculture?

	Bamboo agroforests	Bamboo plantations as monoculture or mixture of bamboo species
Advantages	<ul style="list-style-type: none"> Multiple crops more options Better risk management Early returns because of Different crops higher total productivity More tolerance of pests and diseases Crop maintenance rather than weed control Environmental benefits (improved soil, erosion control, carbon sequestration) 	<ul style="list-style-type: none"> Simpler to plan and manage Laborers require less skill Easier to mechanize Maximizes production of one crop
Disadvantages	<ul style="list-style-type: none"> No recipe for implementation Knowledge intensive depending on a number of different crops More complex management including attention to timing of management More difficult to mechanize certain operations 	<ul style="list-style-type: none"> Reliance on the market for a single crop More susceptible to pests and diseases Not using all ecological niches so lower total productivity Surges and lulls in labor demand No early yields, all early cash flow is negative

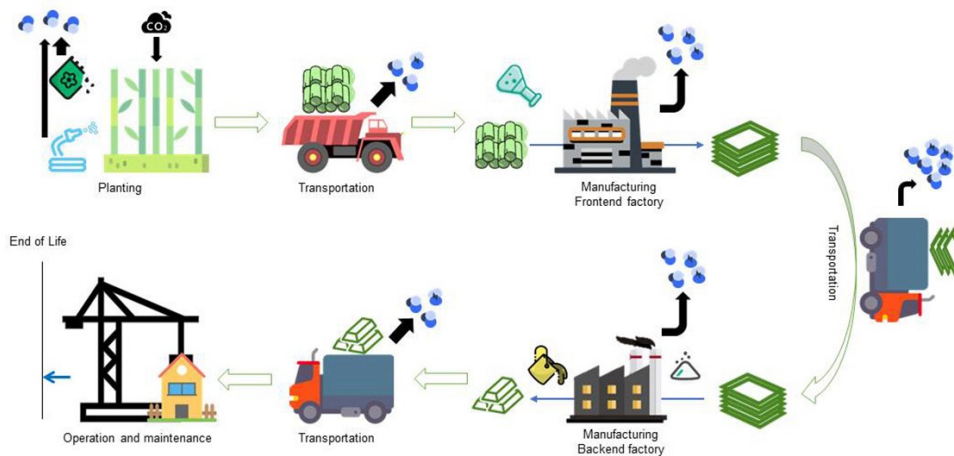
Source: Pacific Agribusiness Research for Development Initiative Bamboo Agribusiness Compendium October 2021.

Environmental Impact and Contribution to Climate Action: bamboo materials



Source: United Nations Environment Programme, & Yale Center for Ecosystems + Architecture (2023). Building Materials and the Climate: Constructing a New Future. <https://wedocs.unep.org/20.500.11822/43293>.

Environmental Impact and Contribution to Climate Action: bamboo life cycle assessment

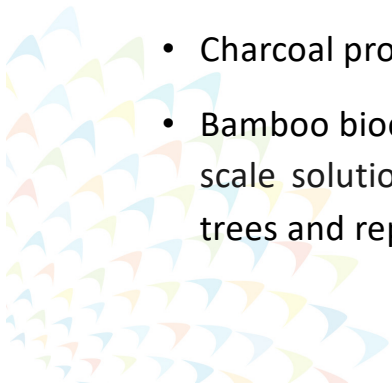


Source: Source: P Xu, J Zhu, H Li, et al. Are bamboo construction materials environmentally friendly? A life cycle environmental impact analysis. Environmental Impact Assessment Review, Volume 96, 2022.

- Studies show environmental impact values of bamboo construction materials significantly lower than that of other building materials and can be easily controlled
- Degree of carbon emissions associated with bamboo products heavily depends on how they are manufactured and transported
- LCA methodology relies on access to extensive data, which may not be available for low-cost housing projects such as social housing in developing country settings

Environmental Impact and Contribution to Climate Action: bamboo as an energy source

- Currently underutilized as a fuel source
- Considered as a renewable source because new culms grow from existing clumps after harvesting, no replanting required
- Bamboo rich in lignocelluloses, considered a promising alternative to petroleum-based fuel
- Can be transformed into four different energy forms: bioethanol, bio-oil, biogas, and biochar
- Bamboo charcoal a viable alternative to wood for biomass energy, used for cooking by over a third of the world's population
- Charcoal production can also be a source of rural household income generation
- Bamboo biochar, created by pyrolyzing organic waste, and used for soil remediation. Has potential as a large-scale solution to offset global greenhouse gas emissions: produces approximately 1/3 more oxygen than trees and replenishes fresh air by capturing up to 12 tonnes of carbon dioxide per hectare



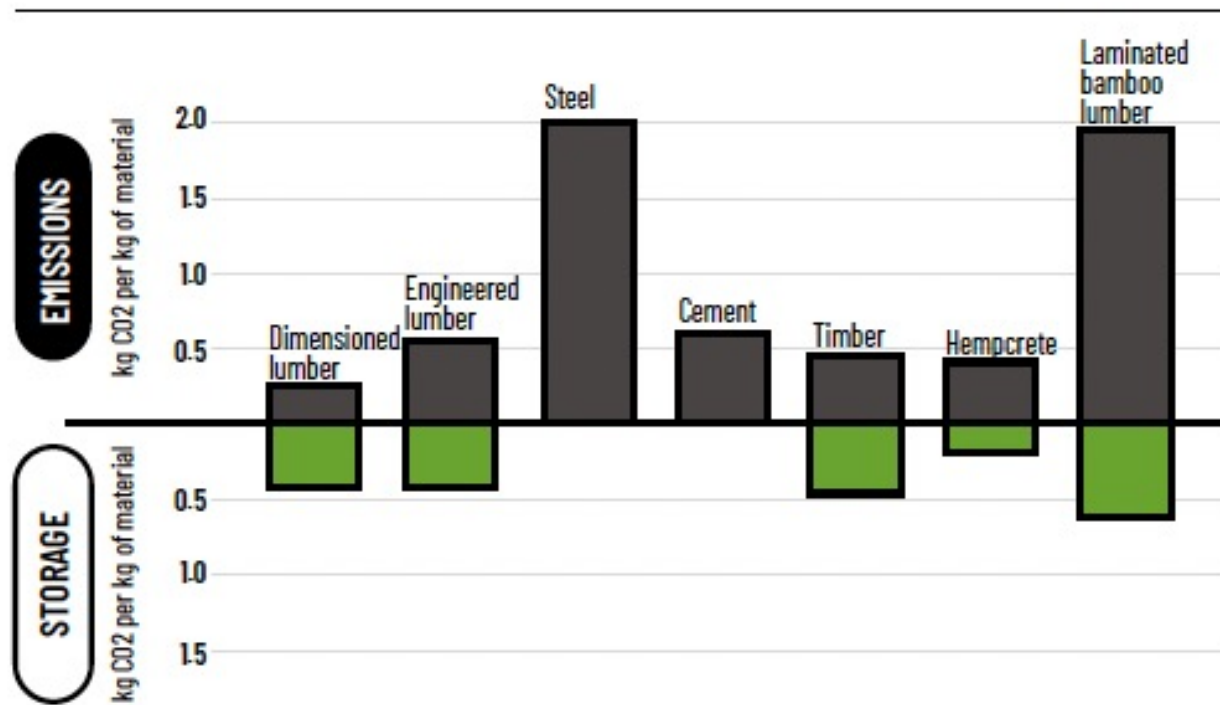
Environmental Impact and Contribution to Climate Action: carbon capture

Building material	Density (kg/m ³)	Energy for production (MJ/kg)
Concrete	2400	0.8
Steel	7800	30
Wood	600	1
Bamboo	600	0.5

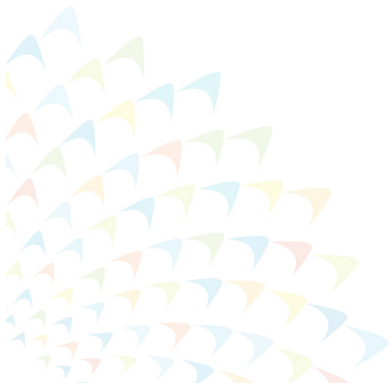
Kg=kilogram, m=meter, MJ= megajoule

Source: R Manandhar, JH Kim and JT Kim. Environmental, social and economic sustainability of bamboo and bamboo-based construction materials in buildings. *Journal of Asian Architecture and Building Engineering*, 2019, 18:2, 49-59.

Environmental Impact and Contribution to Climate Action: treatment issues

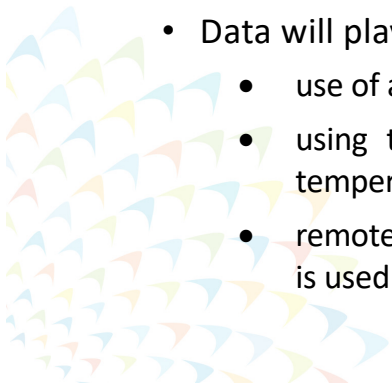


Source: Xu et al cited in United Nations Environment Programme, & Yale Center for Ecosystems + Architecture (2023). Building Materials and the Climate: Constructing a New Future.



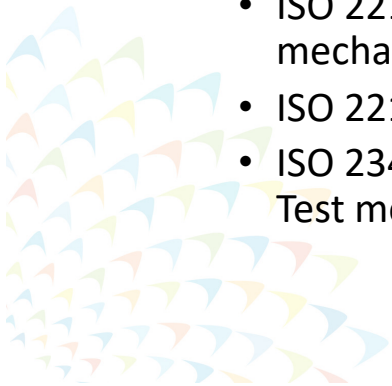
Environmental Impact and Contribution to Climate Action: the need for data

- Bamboo cultivation can be used to generate carbon credits in three key ways:
 - Planting bamboo in degraded or deforested areas can create new carbon sinks
 - Integrating bamboo into agricultural systems can enhance carbon sequestration
 - Sustainable bamboo harvesting and processing techniques that reduce emissions compared to conventional practices
- Bamboo agroforestry could be used towards a country's National Determined Contributions for reduction in carbon emissions but not for 10 years and not without good data
- Risk of greenwashing in countries lacking robust regulatory systems,
- Data will play a key role in addressing these challenges:
 - use of artificial intelligence or smart technologies for smart monitoring;
 - using the Internet of Things, building a sensing network, using chips to track and measure, for example, temperature;
 - remote sensing, which could also be used to track, for instance, that the bamboo grows to a certain height before it is used



Aligning Bamboo to Global Standards and Frameworks: ISO and bamboo

- International Standards Organization has a technical committee devoted to bamboo and rattan standards relevant to bamboo.
- Already 6 ISO standards directly related to bamboo with more in the pipeline
 - ISO 21625:2020 Vocabulary related to bamboo and bamboo products.
 - ISO 21629-1:2021 Bamboo floorings Part 1: Indoor use
 - ISO 19624:2018 Bamboo structures — Grading of bamboo culms — Basic principles and procedures
 - ISO 22157:2019 Bamboo structures — Determination of physical and mechanical properties of bamboo culms — Test methods
 - ISO 22156:2021 Bamboo structures — Bamboo culms — Structural design
 - ISO 23478:2022 Bamboo structures — Engineered bamboo products — Test methods for determination of physical and mechanical properties



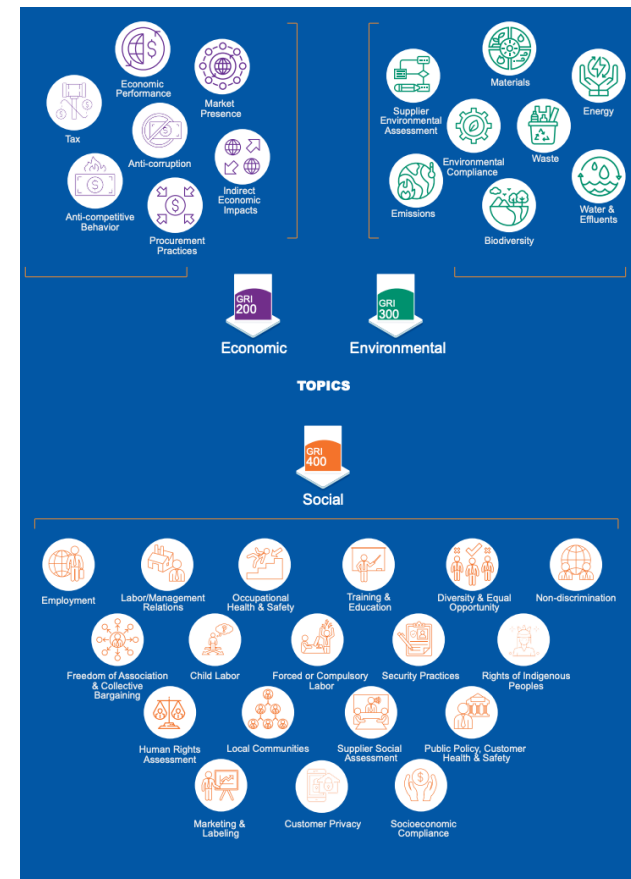
Aligning Bamboo to Global Standards and Frameworks: FSC and bamboo

- The Forest Stewardship Council is an international voluntary accreditation and independent third-party certification organization
- Certification enables holders to market their products and services as “the result of environmentally appropriate, socially beneficial and economically viable forest management”
- Also sets standards for the accreditation of certification bodies that certify compliance with FSC's standards
- Issues forest management certification for forest managers
- Issues chain of custody certification for material suppliers and finished goods manufacturers that verify forest-based materials are produced according to FSC standards along the whole value chain
- FSC also investigates false claims in FSC-certified supply chains through so-called transaction verification loops, has taken punitive action against violators in bamboo supply chain

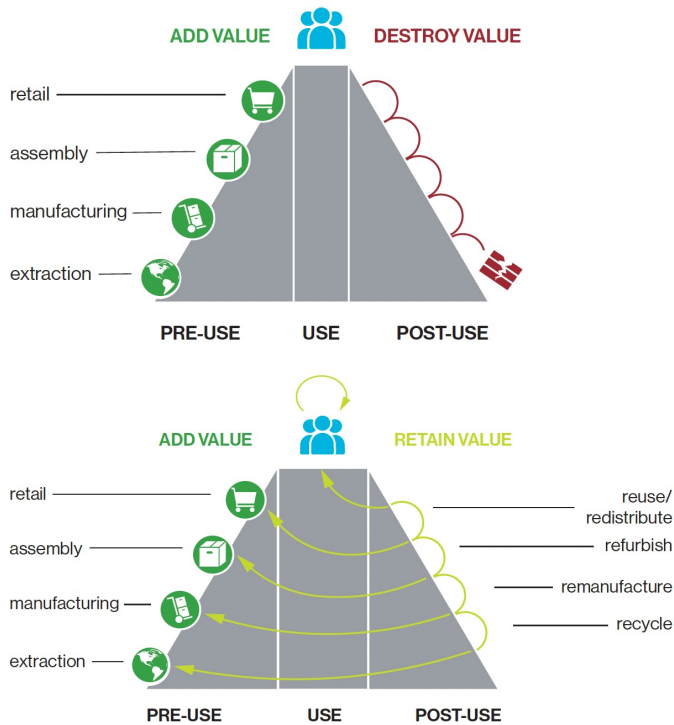


Aligning Bamboo to Global Standards and Frameworks: ESG

- Global Reporting Initiative (GRI) Standards widely used by organizations to report their impacts environmental, social, and governance (ESG) impacts
- Apart from the three GRI Universal Standards, which apply to all GRI RSG reporting, there are 40 sector standards with direct relevance to bamboo currently at various stages of development



Bamboo and Circular Economy Principles



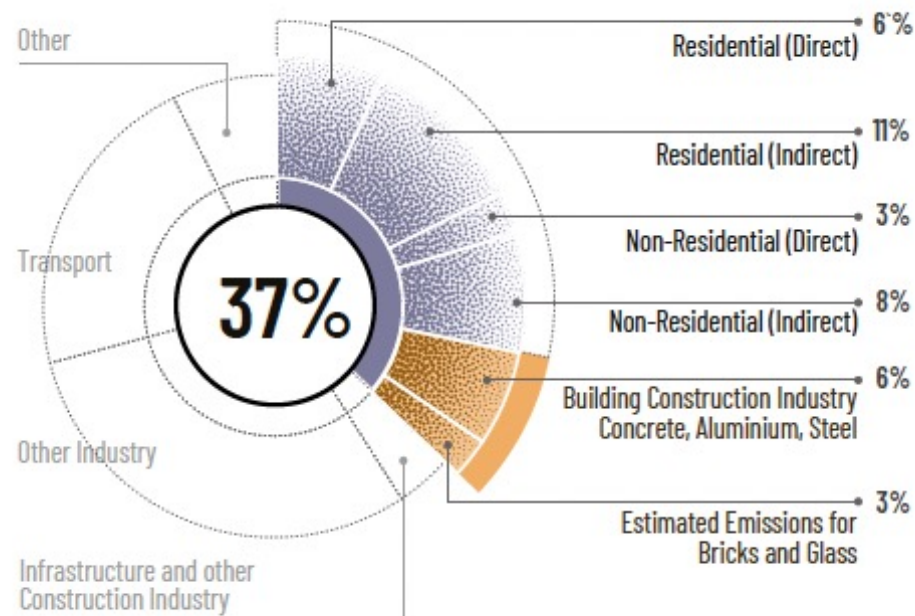
Source: J Oomen. Net-Zero Homes: How circular economy solutions to the housing crisis in low-income countries are key to achieving global climate targets. Habitat for Humanity Terwilliger center for Innovation in Shelter. 2022.



Credit: Kawayan Collective

Bamboo and Circular Economy Principles

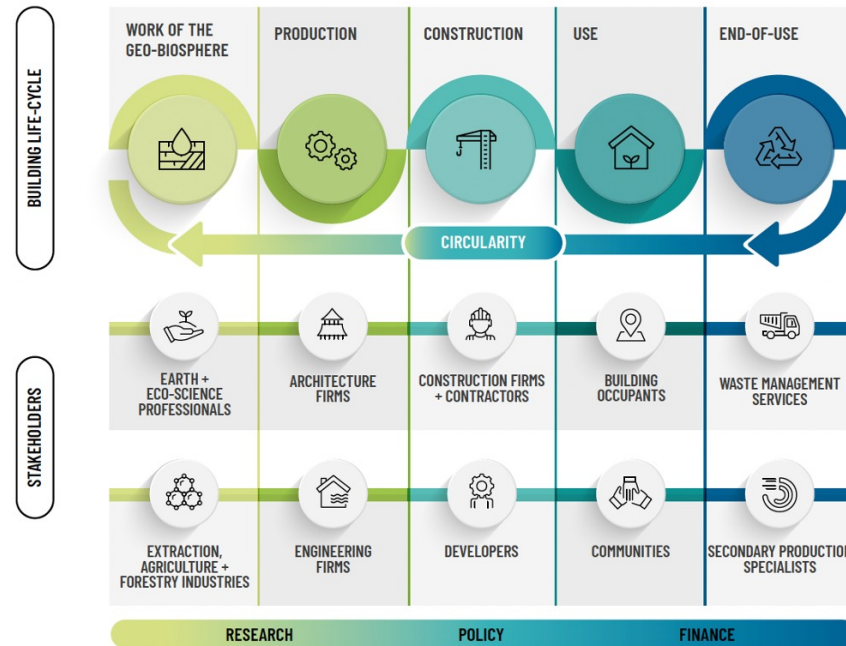
- Bamboo, circularity and the construction industry
- Global share of buildings and construction operational and process carbon emissions, 2021



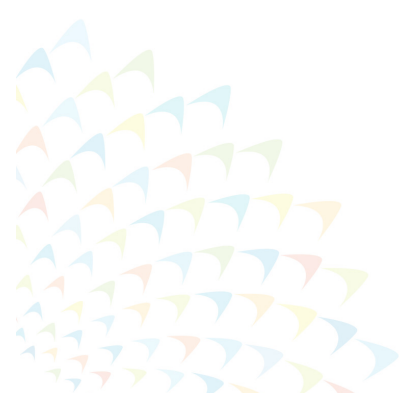
Source: United Nations Environment Programme, & Yale Center for Ecosystems + Architecture (2023). Building Materials and the Climate: Constructing a New Future.

Bamboo and Circular Economy Principles

Key stakeholders whose participation is critical to the decarbonization of buildings at different life phases



Source: United Nations Environment Programme, & Yale Center for Ecosystems + Architecture (2023). Building Materials and the Climate: Constructing a New Future.



Maximizing the social impact of bamboo

Recommendations

1. Convene national stakeholders within and beyond the government
2. Work on both supply and demand
3. Identify and tackle the pain points along the bamboo value chain
4. Support the development of a local or domestic manufacturing
5. Address the polarizing status of bamboo as a construction material
6. Incentivize the use of bamboo in affordable housing
7. Work with other alternative materials sectors
8. Foster international knowledge sharing
9. Work with communities that already want to go green

