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sustainability initiatives

कल्पवृक्ष

GREEN GOLD

Editorial Team

Project Manager, SI: Dr. Anagha Athavale
Communications Head, VK Group: Ar. Athulya Aby

SI: Team

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Senior coordinator: Amol Umbarje
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Foreword

Dr. Anagha Athavle
Project Manager, SI

I grew up with a very limited understanding of bamboo usage, such as hoisting Gudhi during the New Year's celebration in a Marathi family, where a bamboo ladder was a staple in every household. There were a few bamboo-made articles in the kitchen and a bamboo stand, known as Tirdi, to support a corpse prior to cremation. A bamboo Basuri (flute) was a cherished childhood toy and an essential instrument for musicians. I had heard about bamboo pickle but never tasted it.

Historically perceived as the 'poor man's timber', bamboo was mistakenly classified as a tree, though it is indeed a grass, belonging to the 'Bambusoideae subfamily within the grass family Poaceae. This misidentification may have impeded its early development. Over the years, however, the versatility of bamboo has been rediscovered.

As an evergreen plant, bamboo is celebrated for its quick growth and adaptability to various climates and soil types, making it an environmentally friendly option. Its applications are vast, extending from culinary uses in communities where bamboo seeds are consumed as grain and young shoots as vegetables, to industrial uses where its strength and sustainability serve as an alternative to conventional materials like wood and steel.

Bamboo has now earned the status of 'green gold', playing a crucial role in poverty eradication and sustainable economic and environmental development. It continues to be a vital resource for rural communities, offering both livelihood and material.

This issue of IMPRINT highlights these aspects of this valuable grass and its applications. The broad and abundant usage of bamboo inspired us to explore its socio-economic, legal and, of course, the sustainability aspects. *As sustainability initiators, we hope that the theme of this issue inspires many people to embrace bamboo in their daily lives, support small start-ups and communities working with it, and advocate for its broader use across industries.*

We extend our sincere gratitude to all contributors, both known and unknown, who have enriched this edition with their insights and experiences, making it possible to share this comprehensive exploration of bamboo's bright future in sustainable development.

AR. NEELAM MANJUNATH

Principal, Manasaram Architects, Bangalore.
(Founder, Chairperson and CEO- CGBMT-School of Simple Living).

Neelam Manjunath is an architect, planner, scientist, activist & theoretician with degrees both in Science and Architecture from REI Degree College Dayalbagh, and Government College of Architecture Lucknow respectively. Neelam Manjunath established her firm in 1991 at Bangalore and had been advocating the usage of sustainable materials and technologies since. Her conviction for using Bamboo as a sustainable material is seen in all her projects. Her commendable works have earned her several national and international awards including IIA Dharamastha Manjunatheshwara Award, World Architecture community award, Aga Khan Award for architecture nominee, Arcasia gold medal for a sustainable project, amongst others. She has done Media Architecture and charrette training from Harvard design school and a PG diploma in Theology from Dayalbagh University."

Bamboo Symphony In Bangalore

The Cocoon project in Trichy

Expert Note

Nature has an innate ability to regenerate, forming the foundation of the intricate web of life and essential ecosystem services that sustain human livelihoods. As human beings rely on nature, we must prioritize nature as a fundamental stakeholder when developing solutions to address our environmental, economic, and social issues. Bamboo is a versatile plant that thrives in tropical, subtropical, and sub-temperate regions globally. Its growth patterns are closely tied to population density, and it has been a go-to natural resource in these regions for centuries. Even today, bamboo continues to serve as a practical solution for various applications.
Bamboo presents an opportunity to absorb and store carbon, mitigate greenhouse gas emissions, provide a renewable resource for housing and infrastructure, remediate degraded lands, rejuvenate lakes, and reverse air pollution. Bamboo has the ability to foster inclusive, equitable, resilient, and safe habitats while providing clean water, clean air, and local livelihood opportunities, especially for marginalized populations. Notably, bamboo stands out with remarkably low embodied energy, positioning it as an exceptionally sustainable option for building construction purposes. These characteristics underscore bamboo's viability as a building material, emphasizing its minimal environmental impact and its potential to contribute to sustainable construction practices. Bamboo as a mainstream material in construction, phytoremediation, and air pollution mitigation can serve as a nature-based solution to curb global warming and achieve net-zero carbon goals, ultimately leading to a safe, healthy and regenerative ecosystem and circular culture.

This booklet is an extremely relevant attempt to bring Bamboo back in our lives, tradition and culture of a large population from the global south and the developing world.

I congratulate the team for the excellent compilation of the booklet in a simple and attractive format to benefit the common population.

01

A BRIEF OVERVIEW OF
BAMBOO BASICS

03

BAMBOO AS
A BUILDING MATERIAL

08

Exploring a Unique
BAMBOO HOME IN PUNE

09

VARIOUS METHODS OF
TREATMENT OF BAMBOO

TABLE OF CONTENTS

A BRIEF OVERVIEW OF
BAMBOO BASICS

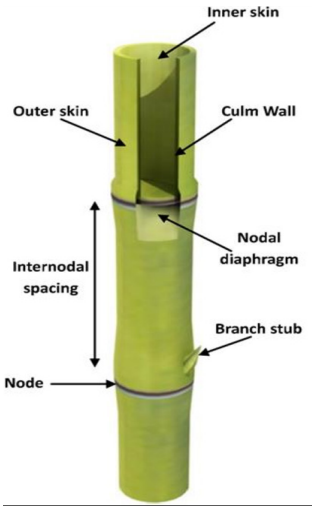
Etymology

The origin of the word “Bamboo” has two interesting stories. The first story suggests that the word was formed by combining “mamboo,” coined by the ancient Dravidians and spoken mostly by the Malayans, and “bamboes,” introduced by Dutch colonists at the end of the 16th century. Based on this, we can conclude that the word “Bamboo” was coined between 1590 and 1600.

The second story dates back to an even earlier period and suggests that the original Malay word “Mamboo” was pronounced as “Bamboo.” This emerged as an onomatopoeic term to describe the sound of burning bamboo. When bamboo is heated, the hot air inside the hollow trunks expands and eventually bursts with loud explosions, reminiscent of a “bam bam” sound. It is believed that this noise is the root of the name for the grass.

Growth

Bamboo typically takes about three years to establish itself. Once established, the new shoots, known as canes or culms, emerge from the ground each spring and grow in height and diameter for approximately 60 days. During this period, the canes also develop leaves and limbs. After this initial growth phase, the canes cease to grow in height and diameter; instead, the plant focuses its energy on producing more canes from its roots. The time it takes for bamboo to mature into a hard, wood-like material varies from 1 to 4 years, depending on factors such as the species, the diameter of the stem, soil quality, sunlight exposure, climate, and watering conditions.



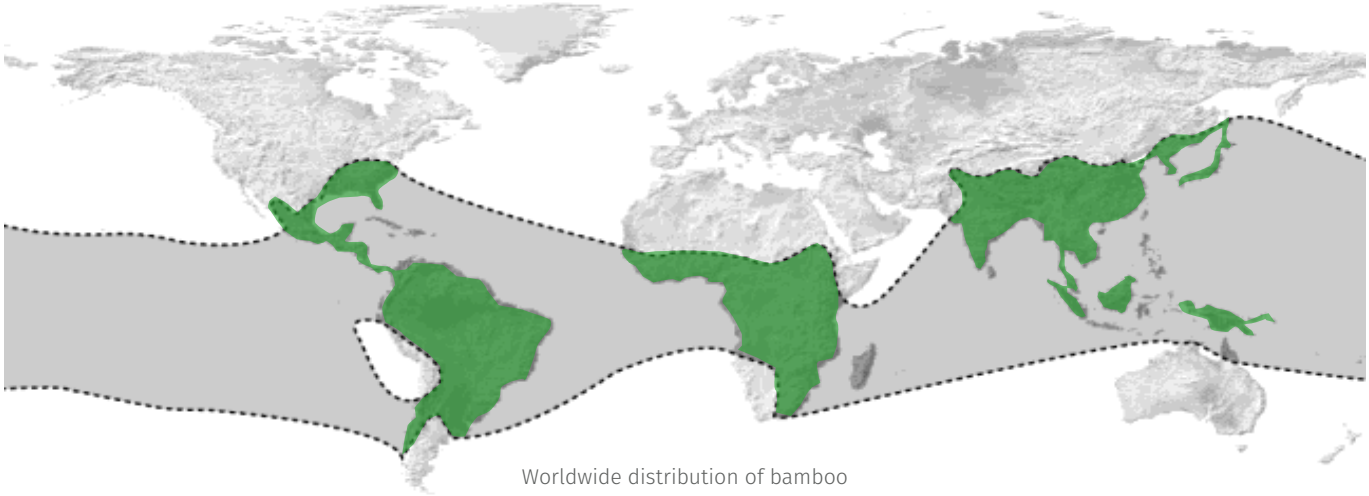
Parts of a bamboo plant

Pattern of growth of Bamboo

Distribution

Bamboo species are predominantly native to warm and moist tropical and warm temperate climates. Despite this preference, they exhibit remarkable adaptability and are found in a diverse range of environments—from hot tropical regions to cool mountainous areas and highland cloud forests. Several countries including China, Japan, Korea, India, and Australia boast numerous endemic bamboo populations.

In India, bamboo thrives from sea level up to an altitude of 3600 meters above mean sea level (msl). They grow well in regions of high rainfall, ranging from about 1200 mm to 6350 mm. The growth of various bamboo species depends on factors such as humidity, soil types, altitude, physiography, and optimum temperatures. States rich in bamboo species include Meghalaya, Arunachal Pradesh, Manipur, Assam, Mizoram, Sikkim, West Bengal, Nagaland, Kerala, Andaman, Tripura, Bihar, Odisha, Jharkhand, Karnataka, Chhattisgarh, Himachal Pradesh, Madhya Pradesh, and Maharashtra. Conversely, the states with the fewest bamboo species include Punjab, Jammu and Kashmir, Rajasthan, Gujarat, Haryana, and Goa.



Worldwide distribution of bamboo

Bamboo In MAHARASHTRA

According to the report “Bamboo Resources of the Country” prepared by the Forest Survey of India, Maharashtra has a significant bamboo-bearing area, spanning approximately 11,465 sq km across 10 districts. Notably, the Vidarbha region accounts for over 90 percent of the state’s total bamboo yield. Historically, this region has cultivated several bamboo varieties including Manvel (Dendrocalamus strictus), Katang (Bambusa bambos) also known as thorny bamboo, Manga (Dendrocalamus stocksii), and Chivari (Munrochloa ritchiei).

Among these, Manga bamboo is particularly favored by local farmers due to its versatility and utility. It is a solid, thornless variety that grows straight and can reach up to 15 meters in height. Its applications are diverse, ranging from use as stakes in horticulture to the manufacture of implements, scaffolding, furniture, and handicrafts. Manga bamboo begins to yield within five years of planting, producing about 8 to 12 sticks annually, making it an economically viable option for sustainable agriculture and various industries.

Manvel

Manga

Katang

Chivari

BAMBOO AS
A BUILDING MATERIAL

Bamboo's application in construction is revolutionizing building techniques around the world, thanks to its sustainable properties and exceptional strength, often referred to as 'green steel'.

Bamboo in construction industry

Bamboo is one of the oldest building materials. Historically, bamboo has been used for construction of houses in areas where there was abundance of plants especially in South America, Africa& south East Asia. It's role as an ecological construction material is gaining traction globally, driven by its sustainability, aesthetic qualities, and inherent strength. Its application in construction ranges from complete structural frameworks to reinforcement in concrete, reflecting its versatility and growing acceptance in modern architecture and engineering.
In the United States and France, innovative construction techniques have led to the development of houses entirely made of bamboo. These structures are not only aesthetically pleasing but also meet stringent safety standards, being certified as earthquake and cyclone-resistant. This highlights bamboo's capability to provide both safety and sustainability, making it a compelling choice for housing in disaster-prone areas.

Advantages of Bamboo in Construction

Fire Resistance:

Bamboo exhibits a high degree of fire resistance. It can withstand temperatures up to 400°C, making it a safe choice for building materials.

Elasticity:

Known for its excellent elasticity, bamboo is particularly effective in earthquake-prone areas. Its flexibility allows structures to absorb and dissipate seismic energy, significantly reducing damage during earthquakes.

Lightweight:

The low weight of bamboo makes it easy to transport to construction sites, facilitating quicker and less costly building processes.

Strength Properties:

Some bamboo species have an ultimate tensile strength comparable to mild steel, ranging from 140N/mm² to 280N/mm². This strength is largely due to the axial alignment of fibers within the bamboo, enhancing its structural integrity. In seismic zones, bamboo structures often outperform other materials due to effective energy absorption at the joints.

Environmental Benefits:

Bamboo is highly effective in carbon sequestration, absorbing more than one ton of CO_2 per ton produced.

Shortcomings of Bamboo as a Building Material

Shrinking:

Bamboo exhibits a higher degree of shrinkage compared to other woods, which can lead to structural weaknesses and limit its use in certain applications.

Bucking:

While bamboo performs well under buckling forces, its lower stress tolerance compared to materials like steel, combined with natural irregularities, can affect its reliability in load-bearing structures.

Tensile Strength Variability:

The uneven distribution of load and natural variability in bamboo's physical dimensions mean that its theoretical maximum tensile strength is seldom realized in practical applications.

Standardization Challenges:

Bamboo culms vary significantly in size and form, complicating mechanization in the manufacturing process and relegating much of bamboo fabrication to skilled handcrafting.

BAMBOO BUZZ

In India, bamboos grow naturally in almost all states except in Kashmir region of Jammu and Kashmir.

Traditional Construction Practices

Traditional bamboo houses incorporate numerous tried and tested methods to maximize durability and protect against environmental factors.

Elevation and Isolation:

Bamboo culms are typically elevated to avoid direct contact with the soil, preventing moisture absorption from the ground. This practice is crucial in humid environments where moisture can compromise the structural integrity of bamboo.

Termite Resistance:

At high altitudes, bamboo buildings benefit from natural protection against termites, eliminating the need for chemical treatments.

Airflow Design:

Structures are specifically designed to allow unrestricted airflow, a method that significantly reduces the potential for moisture buildup within bamboo culms, thereby prolonging their lifespan.

Protective Coatings:

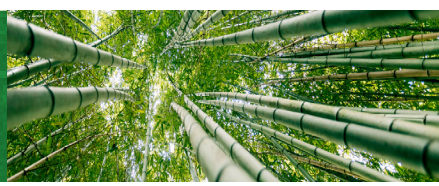
Solutions such as tar and lime wash are traditionally used as protective coatings to shield bamboo from the elements. These substances act as barriers against moisture and pests.

Mud Coating and Plastering:

In regions like Bangladesh, mud-coating is commonly applied to bamboo huts as an additional layer of protection. Plastering bamboo with cement is another effective method to shield it from microbial attacks and further ensure its durability.

BAMBOO BUZZ

World bamboo Day is celebrated on September 18th every year to raise awareness about the importance of bamboo and its many uses.



Bamboo in Contemporary Construction

Bamboo is emerging as a futuristic construction material due to its rapid renewability, exceptional strength, and environmental benefits. Its innovations in durability and processing are setting the stage for widespread adoption in sustainable architecture. **The Green School in Bali,** Indonesia, built in 2007, stands as a testament to its viability as a primary building resource. This international K-12 school is constructed entirely out of bamboo, chosen for its environmental benefits and natural beauty. The school serves as a model for sustainable education facilities worldwide, promoting an ethos of environmental stewardship and innovative architectural design.

The **Bamboo Wing,** located at the Flamingo Dai Lai Resort in Vinh Phuc Province, Vietnam, is an architectural marvel designed by Vo Trong Nghia Co., Ltd. Completed in 2010, this 1,600 m² structure is remarkable for its open space design, spanning 12 meters without any vertical columns. Inspired by the form of bird wings, the Bamboo Wing floats elegantly over the natural landscape, providing a venue for various events such as weddings, live music concerts, and ceremonies. The design captures wind inside the building, minimizing the need for air conditioning, and features deep eaves and water in the open spaces, allowing guests to feel seamlessly connected with nature.

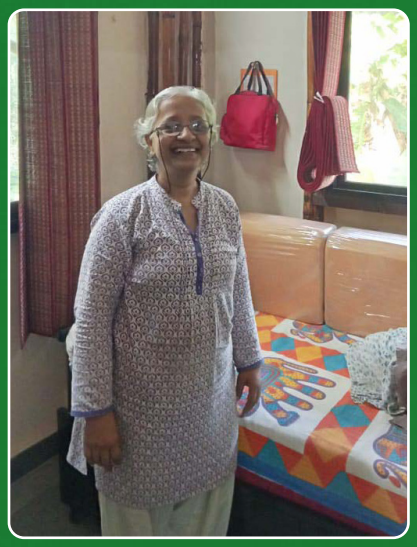
Located in the Palampur region of Kangra district, Himachal Pradesh, the **Bamboo Grass Museum** is a unique attraction that draws knowledge seekers and tourists alike. Situated at the CSIR-IHBT in Holta-Bansuri, this museum is a creative hub showcasing the versatility of bamboo. Palampur, known for its offbeat tourism, benefits significantly from this museum, which stands just 3 kilometers from the main city. The museum serves as an educational resource, highlighting bamboo's ecological and practical applications while promoting conservation and sustainable use of bamboo resources.

Bamboo's modern architectural applications were recently highlighted at new terminal at **Bengaluru (Kempegowda) International Airport.** Completed in 2022, the airport is one-of-a-kind, using laminated bamboo tubes instead of traditional bamboo stems. These tubes are made from bamboo strips laminated into solid and hollow forms in specially developed presses, allowing for custom-made tubes with minimal tolerances. The production process includes innovative treatments to ensure the bamboo meets strict sustainability and safety standards. This innovative use of laminated bamboo not only enhances the terminal's aesthetic appeal but also underscores bamboo's role in sustainable and durable architectural design, affirming its status as "green steel."

BAMBOO BUZZ

15%

of the people in the world live in houses made of bamboo



A LIFETIME HOME

Exploring a Unique Bamboo Residence in Pune

Suvarna and Yogesh, formerly active community workers in Madhya Pradesh, had always prioritized environmental and social contributions. Their transition to Pune marked a new chapter. Driven by Suvarna's desire for a budget-friendly yet long-lasting home, they turned to their friend, the late Mr. Sunil Deshpande, an ardent advocate for bamboo usage and tribal empowerment. Together with his wife, Mrs. Nirupama Deshpande, Sunil worked with tribes in the Melghat region under the Sampoorna Bamboo Kendra initiative, promoting sustainable bamboo practices.

The execution of their dream home was led by Mr. Raghvendra Deshpande, a civil engineer, with a dedicated team from the Melghat region, known for their expertise in bamboo construction. Bamboo was sourced locally from the nearby Panshet area and treated on-site to ensure its longevity and resilience. The construction utilised minimal bricks, with a composite structure that was mud-plastered for better thermal comfort, leaving the main bamboo pillars exposed for aesthetic appeal.

The result was a beautiful home, offering peace and spiritual vibrancy. The construction process was not just about building a house but creating a sanctuary that resonates deeply with everyone who visits.

The house stands as a testament to the couple's commitment to sustainability and their belief that eco-friendly living can be achieved within a modest budget.

VARIOUS METHODS OF
TREATMENT OF BAMBOO

Untreated bamboo typically has a durability of about 2 to 5 years. Due to the presence of large amount of cellulose, starch and water content, it is vulnerable to attacks by fungi and termites, which can be effectively mitigated through both traditional and modern treatment methods.

Traditional Practices

Water soaking/leaching

Water soaking, or leaching, is a process lasting 4 to 8 months where bamboo is soaked in running or still water. This method washes away water-soluble substances such as starch and sugars from the bamboo. As nutrients are depleted, the bamboo becomes less susceptible to attacks by insects and fungi. While these methods enhance bamboo's resistance to biodegrading agents, their effectiveness can vary based on factors such as the species of bamboo, its age, moisture content, nutrient levels, and time of harvest.

Fermentation

Fermentation involves composting bamboo with mud and tree leaves for a period of 3-4 months. During this time, the microorganisms and bacteria in the compost convert the starches and sugars in the bamboo into acids, effectively reducing the likelihood of insect predation.

BAMBOO BUZZ

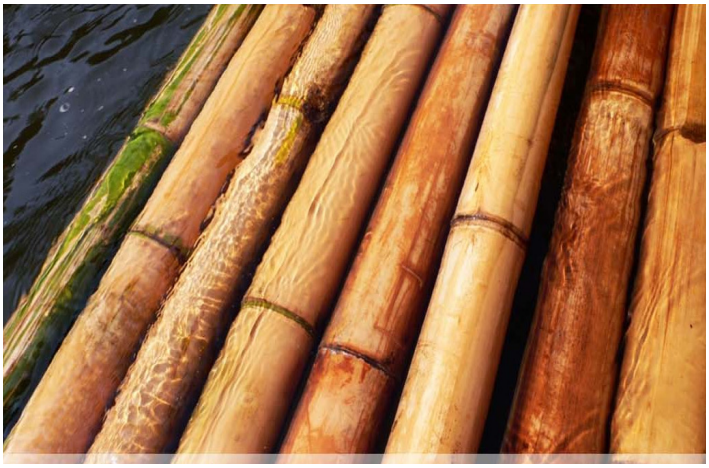
Bamboo plants absorb 12 tonnes of carbon dioxide per hectare in a year and produces 35% more oxygen than trees on a pound-for-pound basis.

Smoking And Heating

Smoking bamboo poles reduces the moisture content in freshly harvested bamboo and extrudes out the sugars that are in the pole. Furthermore, the chemical compounds found in smoke are absorbed by the bamboo tissues and help to protect them from insects.

Salt Water / Sea Water Immersion

The bamboo is submerged in salt water for 30 days to 3 months to allow the fibers to absorb the salt solution and release the sugary content from the parenchyma within the bamboo. Holes are punched through the core of the pole, to break free the internodes of the bamboo to allow for maximum penetration of salts into the bamboo. On some occasions, minuscule holes are also drilled from the outside skin at each internode for very thick-walled bamboo.



Modern Practices

Traditional methods for preserving bamboo, while simple, safe, and inexpensive, have shown limitations, especially when bamboo culms are exposed to outdoor conditions. Factors such as sunlight, rain, weathering, and attacks by microbes and insects significantly reduce the durability of traditionally treated bamboo. Consequently, these methods often prove to be impractical or unreliable in the modern construction industry, necessitating the use of chemicals to prolong their durability . Some of these methods are:

Boucherie Process

The Boucherie process involves replacing the sap in freshly cut bamboo with a preservative solution. By applying pressure to one end of the culm, the preservative is forced through the vascular system, effectively protecting it against decay and insect attacks. This method is efficient for treating bamboo shortly after harvesting, ensuring deep penetration of the preservative.

Vacuum Pressure Treatment

This method uses a vacuum to extract air and moisture from the bamboo's vascular structure, followed by the introduction of a preservative under high pressure. The vacuum-pressure cycle ensures thorough impregnation of the preservative into the bamboo, providing long-term protection against fungi, insects, and weathering.

Boil Treatment

Green bamboo is first steamed at approximately 100 degrees Celsius for two hours. This helps to open up the bamboo's vascular system, making it more receptive to preservative treatments. After steaming, the bamboo is quickly quenched in a preservative solution where it remains for about two days. Finally, the treated bamboo is stored for a month to allow the preservative to fully integrate and stabilize within the bamboo structure.

Dip Diffusion

In this process, the culms are submerged in a solution of boric acid and borax for 10 to 20 days. To enhance the preservative's penetration, holes are sometimes bored near the nodes. The extended soaking period allows for thorough saturation, which is critical for ensuring the longevity and durability of the bamboo in various applications.

Further Reading: Let's Build With Bamboo – A complete Construction Manual" by Ar. Neelam Manjunath

BAMBOO BUZZ

After the blast of 1945 in Hiroshima, bamboo was the first plant to re-sprout. It has also survived through natural disasters such as Hurricane Ivan and Katrina.

GOVERNMENT POLICIES DRIVING

INDIA'S BAMBOO REVOLUTION

Over the past few decades, legislative changes have been a pivotal force in driving India's Bamboo Revolution.

A Legislative Leap Forward

In a groundbreaking move in November 2017, bamboo shed its old cloak as a "tree" under the Indian Forest Act of 1927, and stepped into its true identity as a grass. This wasn't just a botanical correction; it represented a seismic shift in economic opportunity for India's bamboo growers. For decades, despite being the world's second-largest bamboo cultivator, India found itself entangled in red tape that hindered bamboo's domestic potential and forced import from Taiwan even for basic uses like incense sticks. Farmers in the bamboo-growing states, particularly the North East, had to face harassment quite often because they could neither cut it nor transport it. This reclassification finally set bamboo free, promising a new era of growth and sustainability.

Used in the first light bulbs

Thomas Edison's light bulb used a carbonized bamboo filament, which allowed his light bulb to last 1200 hours.

The Economic Promise of Bamboo

With bamboo now recognized as a Minor Forest Produce (MFP), it stands as a beacon of economic hope for rural India. The NITI Aayog paints a promising picture, estimating that bamboo can spur activities worth Rs 50,000 crore, marking a significant jump from its current economic contribution. This is not just about boosting GDP; it's about transforming lives, with the potential to lift over 5 million families out of poverty.
Farmers receive a 50% direct subsidy at Rs 1.00 lakh per hectare, government agencies receive a 100% subsidy, and entrepreneurs receive a 100% subsidy for establishing various product development units, etc.
The bamboo mission programme will enable about 5.01 million families of artisans and farmers to cross the poverty line. According to estimates, investment in bamboo production enhancement would yield a five-fold return within 5-8 years. While the central government has streamlined much of the regulatory framework, challenges persist, particularly at the state level where policy discrepancies can complicate bamboo trading and cultivation.

National Bamboo Mission (NBM)

Originally launched in 2006, the National Bamboo Mission (NBM) received a major facelift in 2018, being restructured as a Centrally Sponsored Scheme (CSS). Once operating under the environment ministry, is now under cover of agriculture ministry, shifting its focus from restoring bamboo forests to promoting farm bamboo and developing its market linkage. NBM focuses on various activities such as promoting bamboo plantation, providing technical support, market expansion, and developing bamboo-based industries. The mission also aims to enhance the income of bamboo farmers and improve the overall quality of bamboo products, thereby contributing to rural development and environmental sustainability.

National Bamboo Mission

सत्यमेव जयते

MAHARASHTRA'S MODEL FOR BAMBOO DEVELOPMENT

Maharashtra's comprehensive approach to bamboo development offers a replicable model for other states and regions. By addressing each link in the value chain—from cultivation and processing to market integration and entrepreneurship—the state is positioning itself as a leader in the sustainable and economically vital bamboo industry.

In 2016, the Maharashtra government took a significant step by establishing the Maharashtra Bamboo Development Board, charged with transforming the state's bamboo sector. The board's primary mission is to enhance bamboo plantations on farmlands, thereby boosting farm incomes, contributing to climate resilience, and ensuring a steady supply of quality bamboo for industrial needs.

Skill Development and Capacity Building

In addition to infrastructure, there is a strong emphasis on product development tailored to market demands. This involves supporting research and development, entrepreneurship, and creating business models at the micro, small, and medium enterprise levels to feed into larger industries.

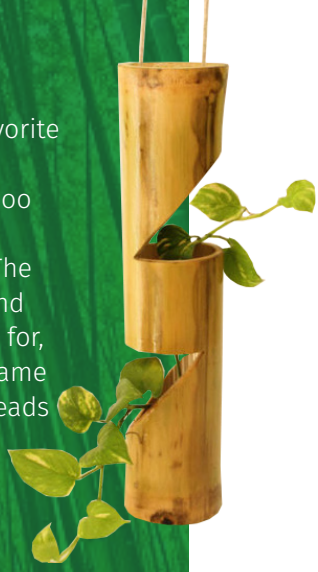
The **Bamboo Research and Training Centre (BRTC)** established in Chichpalli, District Chandrapur, serves as a focal point for education and skill enhancement in the region. The BRTC offers various programs including Bamboo Value Addition Training for unemployed men and women, support for Self Help Groups in bamboo article manufacturing, and a diploma course in Bamboo Technology affiliated with the Maharashtra State Board of Technical Education. It also focuses on training artisans in creating bamboo handicrafts using the latest technologies and artistic designs. The **Bamboo Society of India, Maharashtra chapter,** chaired by Dr. Hemant Bedekar, plays a crucial role in advancing the bamboo sector through scientific research, education, and the promotion of sustainable bamboo products. The society's goals include sponsoring research, organizing training programs, and serving as consultants on bamboo development projects. Formed in April 2019, **the Maharashtra Bamboo Promotion Foundation** emerged in response to the identified need for a cohesive ecosystem in the bamboo sector. By identifying gaps and implementing innovative interventions, the Foundation aims to streamline the linkage between bamboo producers and the market. By emphasizing the development of organized marketplaces for farm-grown bamboo and integrating appropriate tools and technologies, the foundation is working to improve the entire supply chain. While the raw materials and skilled labor are available, and there is a demand for bamboo products, the connective infrastructure remains underdeveloped. The foundation's strategy involves piloting innovative projects that, if successful, can serve as scalable models for broader adoption.

What is the ground reality of Bamboo trading? Are people happy doing the business?

Prashant Date from Nasik, initially a grape cultivator, pivoted to bamboo farming due to the scarcity of bamboo needed to support his vines. Starting in 2017 and inspired by agricultural departments in Dapoli and Kolhapur, he embarked on a journey across India, collecting different bamboo species. His efforts led to the creation of the 'DATE BAMBUSETUM,' which now hosts 94 out of 148 bamboo species. This achievement was recognized by the 'India Book of Record 2022' and even attracted the attention of the Governor of Maharashtra, who inaugurated the bambusetum in September 2022.

Prashant's bamboo venture has transformed into a robust business, where he owns four companies involved in various aspects of the bamboo industry, including treatment and preservation. His success story not only highlights the economic viability of bamboo farming but also its potential in promoting sustainability and biodiversity. Looking forward, Prashant plans to expand bamboo farms across Maharashtra and develop an oxygen park to support ecotourism, continuing to inspire other farmers with the potential of bamboo as a sustainable and profitable crop.

The ‘Basuri,’ made from bamboo, is not only Lord Krishna’s favorite instrument but also one of the earliest instruments in Indian classical music. As explained by Mr. Chaitanya Dixit, this bamboo flute, crafted from the slender Dolu or Dolu Bash bamboo of Northeast India, requires careful balance in its construction. The thickness and diameter of the bamboo determine the pitch and playability of the Bansuri. These flutes are meticulously cared for, oiled biannually with strong-smelling oils like mustard or sesame to prevent damage, and adorned with strategically placed threads to prevent cracks, ensuring their integrity across changing temperatures.



Burud Ali, Pune

Near Pune’s central vegetable market, Mahatma Phule Mandai, lies Burud Ali, a historical enclave where the Burud community has crafted bamboo products for generations. These artisans, integral to local economies before the widespread use of metals, produced everything from kitchen wares to decorative items using bamboo, a resource once abundantly available near their homes.

The Burud community traditionally supplied bamboo items essential for daily life, standing out as craftsmen in a society that valued their skills. However, rapid urbanization posed significant challenges, chief among them the loss of nearby forests, their primary source of bamboo. This depletion forced many artisans to relocate their operations or source bamboo from far—from Bhore and Velha to the Konkan region and even Assam—escalating their costs and complicating their craft.

Today, over 100 households of the Burud community still reside in areas like Ravivar Peth and Ganesh Peth, but only a few continue their ancestral trade. Faced with stiff competition from cheaper, mass-produced plastic products, these artisans persist in using traditional tools such as the sickle (Koyta), carving tool (Karvat), and hammer (Hatoda) to create bamboo products that are a testament to their enduring craft and creativity.

Despite these challenges, the recent reclassification of bamboo from a tree to a grass by the government has sparked a glimmer of hope, simplifying some of the regulatory burdens associated with bamboo cultivation and potentially easing the way for more sustainable practices. Moreover, research institutes in the Vidarbha region are now rolling out training programs and scholarships aimed at modernizing bamboo crafts and expanding market reach.

However, these benefits have yet to fully reach the artisans of Pune, leaving many struggling to keep pace with modernization and new entrepreneurs who bring in advanced machinery and new business strategies.

The Burud community in Pune stands at a cultural and economic crossroads, striving to preserve their heritage while adapting to a rapidly changing world. They hope for increased support to revive their traditional businesses and keep their unique craft alive in the face of modern challenges. Visit Burud Ali, explore their work, and choose bamboo for your home—it’s a choice for sustainability and a nod to tradition.

BAMBOO START UPS IN MAHARASHTRA

Bamboo Based start-ups are flourishing in the state, driven by innovation entrepreneurs dedicated to exploring the potential of this versatile material.

Konkan Bamboo and Cane Development Centre (KONBAC)

Established in 2004 with support from The International Bamboo and Rattan Organization (INBAR) and the Center For Indian Bamboo Resource & Technology (CIBART), the Konkan Bamboo and Cane Development Centre (KONBAC) has grown into a pioneering not-for-profit entity dedicated to bamboo innovation. Over the past two decades, KONBAC has transformed into a self-sufficient ecosystem for designing, prototyping, and producing bamboo products tailored for the Indian market, while linking rural bamboo producers with lucrative markets.

Sanjeev Karpe, the Director of KONBAC, has been instrumental in redefining bamboo from a “poor man’s timber” to a “rich man’s choice,” advocating for its adoption as a sustainable alternative to wood. This shift not only aims to improve livelihoods among the rural poor but also leverages bamboo’s environmental benefits. KONBAC’s strategies focus on providing economic stability, promoting sustainable agriculture, and creating jobs in rural communities. Looking forward, KONBAC plans to expand its successful model across India, introducing a range of bamboo-based products like pre-fabricated houses, furniture, and crafts. This expansion is set to foster new business opportunities, encourage investments, and bolster the bamboo sector, establishing bamboo as a mainstream material with significant environmental and socio-economic benefits.

Abhisar Innovatives by Minakshi Walke

Based in Chandrapur, Minakshi Walke embarked on her bamboo journey by participating in a 70 day training program conducted by the Forestry Department in 2018. With minimal assets but abundant creativity, she first made headlines in 2019 by crafting bamboo crowns for the Miss Climate beauty pageant. Her craftsmanship blossomed with the creation of friendship bracelets

and an innovative QR code reader from bamboo. Her venture into bamboo rakhis proved highly lucrative, with sales extending to London and earning her a profit of 3 lakh rupees. Today, she oversees the production of 10,000 rakhis annually, has trained 300 women, and received the Nari Shakti and Woman Hero awards for her contributions.

Bamboo Tantra by Daya Patki

An Environmental Science master's graduate, Daya grew up around her father's bamboo nursery and recognized the market's lack of access to bamboo products. This early exposure, coupled with her informal apprenticeships with skilled artisans, sparked her passion for bamboo and its potential, leading her to found Bamboo Tantra. She focused on process innovations to meet market demands for uniform jewelry sizes and shapes. Bamboo Tantra now offers a diverse range of modern and traditional bamboo jewelry, including 65 earring designs and 25 necklace types, alongside other bamboo products like brushes, pens, and straws.
Daya also hints at an upcoming line of bamboo shoot cuisines, promising further innovations in the bamboo sector. Her commitment extends beyond entrepreneurship; she is dedicated to empowering women by providing training and career opportunities in bamboo craft. Her efforts were nationally recognized when she was honored by the Ministry of Skill Development and Entrepreneurship on International Women's Day for her role in uplifting women through skill development.

Bamboo Socks by Navin Kumar Mali

Tackling a common discomfort – smelly socks—Navin Kumar launched Bamboo Socks, leveraging bamboo's natural benefits for an eco-friendly solution. These socks offer multiple advantages:

- Moisture-Wicking: Keeps feet dry and comfortable, regardless of activity.
- Softness and Durability: Bamboo fibers provide silk-like softness yet are durable enough for daily wear and frequent washing.
- Antimicrobial and Hypoallergenic: Ideal for sensitive skin, the socks resist bacteria and fungi.
- Thermal Regulating: Ensures feet stay warm in winter and cool in summer.
- Chemical-Free Assurance: OEKO-TEX 100

Certification guarantees the socks are free from harmful chemicals and safe for the environment. Mali's innovation not only addresses foot odor but also combines style, comfort, and sustainability. Bamboo Socks exemplify how eco-friendly products can meet consumer needs while upholding ethical standards and promoting environmental health.

Bamboo India by Yogesh and Ashwini Shinde

Founded in 2016 by Yogesh Shinde and Ashwini Shinde, Bamboo India has established itself as a pioneering enterprise in Pune, India, dedicated to combating plastic pollution through the development of eco-friendly, functionally efficient and visually appealing bamboo products. Their diverse range includes bamboo toothbrushes, speakers, bottles, and more.

The company has garnered significant attention and accolades for its commitment to sustainability and entrepreneurship, featuring prominently in media outlets like Economic Times, TEDx, Times of India, and The Better India. Recognized internationally, Bamboo India was lauded at the United Nations' Startup Innovation Exhibition, received commendation from Prime Minister Narendra Modi, and represented India at the World Bamboo Congress in Beijing. The startup's impressive trajectory continued as it achieved remarkable success on Shark Tank India Season 1, further cementing its status as a leader in sustainable business practices.

Bamboo Garden, Amaravati

India's first Bamboo Garden, located in the heart of Amaravati and previously known as Wadali Garden, is a testament to dedication, teamwork, and innovative environmental stewardship. The garden was transformed from a simple city park into a thriving bamboo sanctuary and a popular tourist destination, thanks in large part to the efforts of Mr. Salim Sayyad, a caretaker initially engaged in routine planting activities.

Salim's growing interest in bamboo led to the development of this specialized garden after he received support from the Tata Trust and attended a workshop in China. Committed to creating a unique space, he began intensive planting in 1993, sourcing various bamboo species predominantly from Northeast and South India. Today, the garden boasts 73 bamboo species, making it the most diverse collection in India.

The renaming of the park to simply 'Bamboo Garden' was an initiative pushed by Salim to reflect the park's new identity, sparking curiosity and drawing more visitors. This influx has benefited not just the garden but also the local community, including security staff, gardeners, snack vendors, and transportation providers, enhancing local employment and generating significant revenue for the government.

Salim's dedication to maintaining a natural aesthetic led him to reject professionally designed architectural plans in favor of more organic, bamboo-based structures like see-saws and adventure games. His hands-on approach and deep knowledge of bamboo cultivation have earned him recognition as an informal scientist and accolades for his contributions to botany and environmental conservation. His work not only supports biodiversity but also provides educational opportunities for botany students from across India, cementing his legacy and the garden's status as a pioneering environmental project.

These entrepreneurs are not only capitalizing on bamboo's ecological and sustainable properties but are also driving significant social change by creating employment opportunities and fostering community development. Each initiative exemplifies how traditional materials can be transformed into modern enterprises, contributing to both economic growth and environmental sustainability in Maharashtra.

BAMBOO CRAFTSMANSHIP OF THE MUTHUVANS OF KERALA

An Ingenious Response To Location And Materiality

> ...Making is a correspondence between maker and material, and this is the case as much in anthropology and archaeology as it is in art and architecture.
>
> - Tim Ingold

The Muthuvans: Living In Harmony With Nature

It took modern architects decades to figure out that bamboo might just be the perfect natural building material, gifting it the nickname 'green steel'. The Muthuvans of South India figured it out centuries back.

The Muthuvan tribal communities are found mainly in the hill forests of Western Ghats, bordering Kerala and Tamil Nadu. It is believed that they are the descendants of a group of people who followed Kannaki, a legendary character from a Tamil epic, worshiped as a goddess in certain regions. The origin of the name muthuvans comes from the word 'muthuku', meaning 'back' in Malayalami, as they are said to have carried the Goddess Kannaki on their backs. Living in harmony with nature and co-existing effortlessly with animals, the Muthuvans have a deep connection to the forests they inhabit. They firmly believe that the forest provides them with everything they need, and the reverently protect it. Weary of outsiders, their way of life has evolved around the materials available in their natural surroundings.

The Muthuvans' understanding of their surroundings and their resourcefulness is evident in their use of bamboo as a building material. Eetta, also called Indian reed bamboo or elephant bamboo, is a species of bamboo endemic to the Western Ghats.

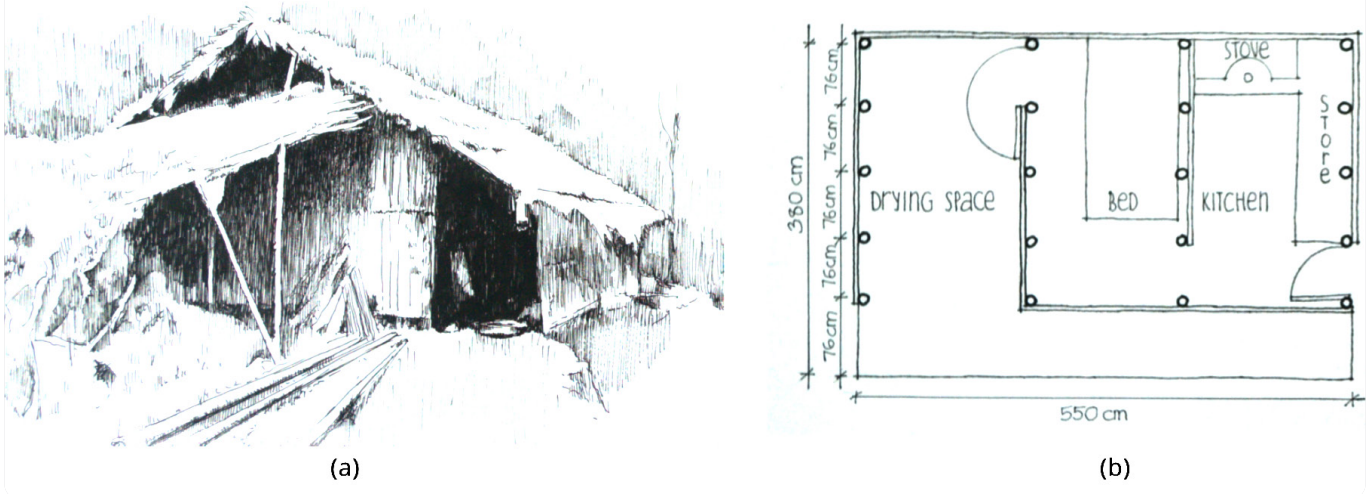
Of the 36 tribes of Kerala, the Muthuvans are some of the craftsmen who excel in the use of the indigenous bamboo. Drawing from Tim Ingold's concept of craftsmen as those who "think through making", they practice the "art of inquiry". Their architecture evolved by understanding the fluxes and flows of the material available, in contrast to modern architects who "does his thinking in his head, and only then applies the forms of thought to the substance of the material world."

Eetta: The Versatile Building Material

The thin, tall, shrubby reeds grows in bunches and possess large mass of foliage. With comparatively thinner walls (than other bamboos), and thickly clumped culms, eeta is commonly used for various traditional crafts like basket weaving and paper making. The Muthuvans are one of the few who use it extensively for construction, possibly due to easy availability and light-weight. Almost everything they need – ranging from houses (maadam) to hoses, bridges to bird catchers, windshields to workshops (aala) and special residences for women (eetillam), and even the ladders for making them – are constructed using eetta. Structural members, walls, door, partitions, roof coverings, and even connecting members are made using this versatile material. Building materials used in construction are not only influenced by location, but also by specific needs and challenges faced by these communities. Eetta is not the only thing found in abundance in the Western Ghats; it is also home to a large number of wild elephants. Recognising elephants' behavior of walking slower downhill and faster uphill, the Muthuvans carefully select the location for constructing their houses (maadam). These housing units are typically built at mid-altitudes on high platforms, on inaccessible terrains with climbing aids, or on higher altitudes with windshields. The Muthuvan huts are made of reeds and thatched with its leaves. Some house walls are paneled with wooden branches and mud applied on it. A typical maadam comprises three or four separations; one for cooking, one for sleeping and the other for common uses. Some maadams are accompanied by

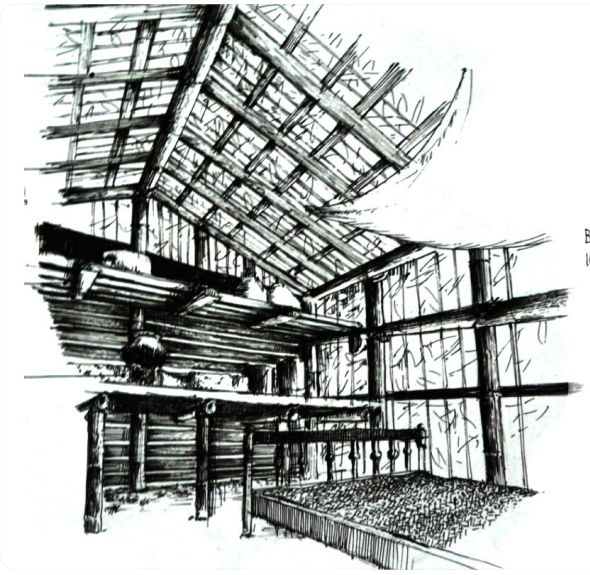
eettillams and aalas. Water carriage systems, made using split sections of bamboo, direct water from higher streams to areas of inhabitation for personal use. Sometimes, simple or hanging bridges are also constructed for connectivity over short spans, using horizontally arranged bamboo shoots with smaller cross pieces anchored to rocks and supported by inclined bamboo members.

As agriculture is the primary occupation of the Muthuvans, safeguarding their crops from elephants and other wild animals becomes a major concern. The treehouse (aerumadam) is a particularly interesting construction, built specifically for this purpose. The Muthuvans employ pattakottu – producing low frequency sound by hitting on tins – and lighting fires inside the aerumadam to scare off elephants. Factors such as location, tree structure, and topography are carefully considered during the installation of these treehouses, ensuring their effectiveness in protecting the crops.

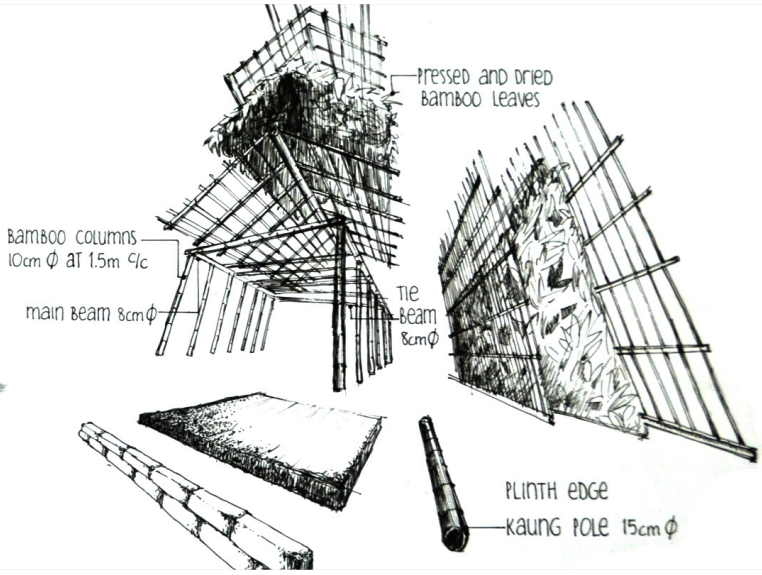


1.a. View of a typical maadam (house).

1.b. Plan of a typical maadam showing three internal separations: one for cooking, one for sleeping and the other for common uses.low for those interested.



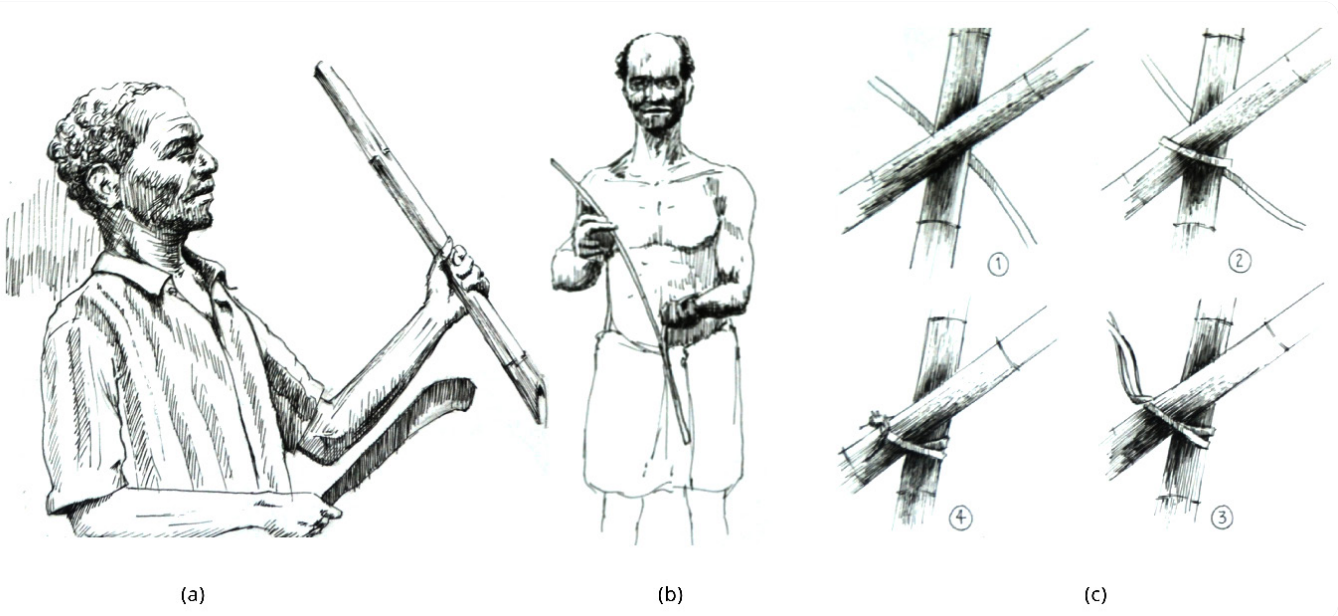
2.a. Interior of a typical maadam, showing an internal loft added for storage.



2.b. Exploded perspective of a typical maadam with details of building materials used.

Building With Bamboo: An Art of Inquiry

One of the key challenges of building with bamboo is connecting the poles. With no specific joineries and systems to use, many modern builders find it difficult to work with bamboo. Thus among the Muthuvans' construction techniques, the maadamkettu forms the crux of the traditional bamboo craft. Maadamkettu is the unique technique of tying the joints – a simple method employing the strands of a fresh bamboo shoot itself for binding. The shoot is cut to required length for tying of the joint and then split through the center using a vakkatti, an indigenous knife. The split pieces are further divided into thin sticks lengthwise, and the inner core is peeled off in strands. These strands are then formed into loops around the desired joint, with the ends twisted together and folded back to strengthen the joint. Due to strain energy, the loops remain intact and grow stronger over time as they dry. The maadamkettu adds to the ingenuity of the eetta construction.



3. The steps illustrating maadamkettu, a unique technique of employing the strands of fresh bamboo for binding.

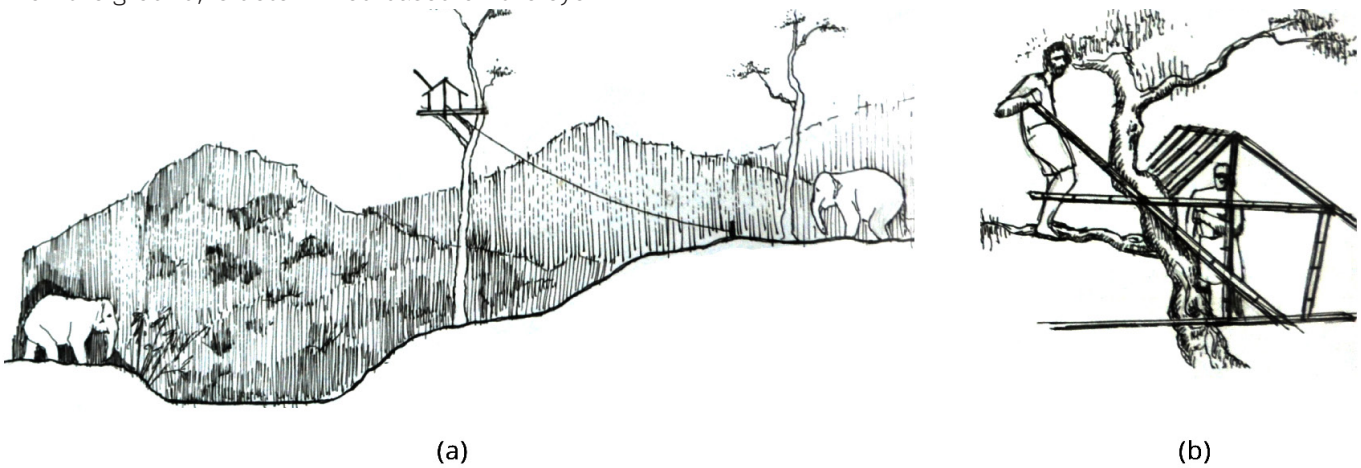
3.a. The shoot is cut to required length for typing of the joint.

3.b. The split pieces are further divided into thin sticks lengthwise, and the inner core is peeled off in strands.

The first step in any sort of construction is the selection and processing of eetta. Bamboo presents certain limitations due to its natural tendency to bend and its tapering sections. Especially for making maadams, selecting eetta with relatively straight sections throughout its length is paramount for its stability. The outer-most layer, comprising largely of foliage, is peeled off from the carefully selectected eetta. The bamboo is usually used with minimum processing after sun-drying. They are cut into desired length, tied in a bunch, and carried onto the site.
To construct a maadam, columns of bamboo are first inserted in the soil to a depth of 30cm. The floor is prepared within this bounds using mud and plinth is secured using the trunk of a Kaung tree (a type of palm). The framework for the roof is then built, and the rafters are laid out. All the joints are made using maadamketutu. Water-tight roof coverings made of half cut poles. Pressed and dried bamboo leaves are used as roof and wall coverings, providing natural protection and insulation. An internal loft is added for storage. It typically takes 2-3 days to complete the construction of a maadam.

4. Eeta with relatively straight sections throughout its length are selected and the outer-most layer, comprising largely of foliage, is peeled off. They are cut into desired length, tied in a bunch, and carried onto the site.

When making an aerumaadam, a tree with inverted tripod branching is selected on a suitable site so that the columns can be raised on it. Laying of the bamboo ladder using maadamkettu is the next process, to facilitate access to the treehouse. The height of the aerumaadam, usually around 5 meters off the ground, is determined based on the eye-level of elephants. After laying the columns (central higher), main beams are laid out with additional rafters at 50cm intervals. Dried bamboo leaves are laid onto the roof, walls and floor. Approximately 30 bamboos are required for making a typical aerumaadam of 2.5x2.5m.



(a) (b)

4. Eeta with relatively straight sections throughout its length are selected and the outer-most layer, comprising largely of foliage, is peeled off. They are cut into desired length, tied in a bunch, and carried onto the site.

The Muthuvans' mastery of selecting and processing eetta, along with their ingenious construction techniques, exemplifies the successful utilisation of bamboo as a building material. While other forms of timber are available in the forest, circular hollow sections makes eetta light-weight and easy to handle, transport and store. The presence of transverse walls at the nodes gives bamboo high strength, enabling it to traverse longer spans. This combined with flexibility gives it earthquake resistance. Joints can be made easily (with transverse and longitudinal cuts) making it easy to build with, using basic hand tools like knives and grub hoe. Its versatility adds to the advantage that the single material can be used to construct structural members, partitions and coverings, and is adaptable to the varied landscape of the forest. Community participation in construction also improves civic bonds, reduce cost and result in a sustainable design. These highlight how building materials play a crucial role in the construction of human settlements.

However, despite its advantages, the Muthuvans' construction practices are undergoing a significant transformation due to the durability concerns of eetta, the influence of external factors, and the need for alternative materials. The absence of treatment processes leaves the eetta susceptible to degradation over time. As a result, the maadams and aerumaadams require reconstruction every 3 to 4 years to maintain their stability and functionality. With increasing outside influence and encroachments on their traditional lands, the availability of eetta is dwindling, leading the Muthuvans to explore alternative construction materials like Kaung and concrete. These materials offer enhanced durability, but come with their own implications, such as potential environmental concerns and a departure from traditional construction methods.

The evolving construction practices have not only affected the physical structures but have also had a socio-economic impact on the Muthuvan community. Men, in search of better livelihood opportunities, have started migrating to nearby towns and tea-estates for work. This trend represents a shift away from their traditional occupation of agriculture, as external influences shape their lifestyle and economic choices.

Striking A Balance: Modernisation And Cultural Heritage

The Muthuvans' innovative use of eetta, skillful construction techniques, and their slow retreat from it, demonstrate how building materials are chosen based on their suitability for specific locations, their durability in the face of environmental challenges, and their adaptability to fulfill particular needs. As the Muthuvans adapt to changing circumstances, it becomes important to support and safeguard this cultural knowledge. Despite its natural limitations, bamboo proves to be a sustainable and reliable resource when harnessed appropriately. Initiatives that promote sustainable bamboo cultivation and implementing treatment processes can help extend the lifespan of bamboo structures, discouraging the shift to concrete in sensitive areas.

The unique understanding of eetta by the Muthuvans holds potential for uses in contemporary design as well. Eetta, with its inherent advantages such as light-weight, earthquake resistance, and simple joinery, may be used to make easily assemblable and collapsible structures, especially valuable in emergency situations like disaster rehabilitation. The technique of maadamkettu can be utilised for temporary structures, fostering reusability and resourcefulness. By integrating modern architectural knowledge with such indigenous wisdom, communities can pave the way towards resilient, culturally rich, and sustainable architectural practices.

Written By

Ar. Athulya Aby

Architectural Writer and Communications Manager at VK Group

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Thank you.

Transforming Traditions into **Sustainable Innovations** *Harness the Eco-power of Bamboo for a* **Greener** ***Future***

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