

BRU



Bamboo and Rattan Update

Volume 2 | Issue 1

Sharing the latest news and activities from the bamboo and rattan sector



4

FROM THE GROUND UP

The architects rebuilding with bamboo in Lombok, Indonesia.

9

BEHIND BAHAREQUE

The surprise rebirth of a traditional Colombian architectural style.

12

RAISING THE BAR

A new bioclimatic housing design offers low-carbon housing in Ecuador.

***VERNACULAR BAMBOO ARCHITECTURE:
TRADITION OR FUTURE?***

Editorial

Bamboo and Rattan Update

Vol. 2 Issue 1

March 2021

Cover Image

The inside of the Fish-Shaped Bamboo Pavilion at the International Horticultural Exposition 2021, Yangzhou, China. Credit: INBAR.

Editorial Team

Liu Kewei (Guest editor)

Wu JunQi

Charlotte King

Contributors

SUP Atelier, Marcin Dawydzik, Pablo Jácome Estrella, Fabián Moreno, David Trujillo

To Submit

www.inbar.int/bru-magazine/
bru-magazine@inbar.int

About BRU

Bamboo and Rattan Update (BRU) is published quarterly by the International Bamboo and Rattan Organisation (INBAR). Content does not necessarily reflect the views or policies of INBAR. Articles may be reprinted without charge provided INBAR and author are credited.

About INBAR

INBAR is an intergovernmental organisation which promotes the use of bamboo and rattan for sustainable development.

www.inbar.int

INBAR Headquarters: Beijing, China

Regional Offices: Yaoundé, Cameroon; Quito, Ecuador; Addis Ababa, Ethiopia; Accra, Ghana; New Delhi, India

BRU

Welcome to the third issue of Bamboo and Rattan Update: a magazine that aims to bring together diverse voices for nature-based solutions around the world.

At the time this magazine goes to press, the world population stood at 7,855,555,000 people (according to data from the UN Population Division), and is increasing by around 222,000 people every single day.

Bamboo construction provides a thousands-year-old answer to a very current question: how can we provide housing that is resilient, affordable and sustainable for a fast-growing global population? This is a particularly pressing question for many developing countries in the tropics and subtropics, whose populations are growing quickly.

Because of its strength, load-bearing properties and flexibility, bamboo is one of the world's oldest housing materials. As well as lightweight structures like scaffolding—still in continuous use on Hong Kong skyscrapers—and bridges, bamboo poles (referred to in this issue as 'round bamboo') have been used in the main structure of buildings across South-East Asia, Africa and South America. The oldest known bamboo structure was built 9500 years ago.

Could traditional architecture have a place in the twenty-first century? The contributors to this issue of *BRU* think so.

One reason is the resilience of bamboo housing in natural disasters. Following the devastating 2018 earthquake in Lombok, Indonesia, an international team of architects and engineers has produced a design for flexible, quake-resilient bamboo housing: an affordable solution for communities looking to rebuild ('From the Ground Up', page 6). And in Latin America, bahareque bamboo architecture is staging a revival, following its performance in the devastating 1998 Colombia earthquake ('Behind Bahareque', page 9).

Climate change may also spur a change in attitude towards round bamboo construction. In Ecuador, a breathable, low-carbon bamboo house prototype has recently been approved by the Ministry of Urban Development and Housing. INBAR is now working to raise awareness among public officials about the benefits of bamboo housing, for carbon footprints and local job creation.

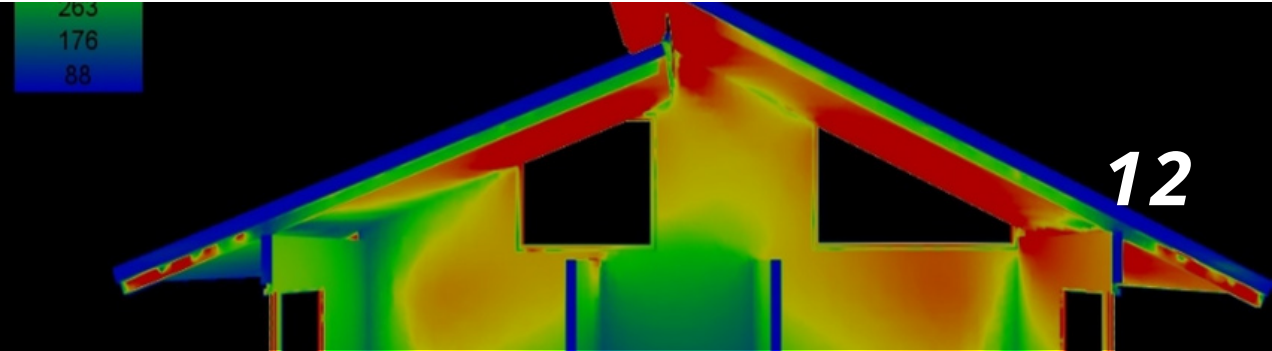
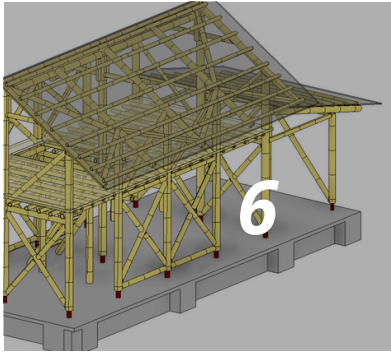
The Fish-Shaped Bamboo Pavilion, built for the International Horticultural Exposition 2021 in Yangzhou, China, showcases the potential of round bamboo construction as a strong structural material, which can be integrated into modern designs ('In Profile', page 4).

How to raise the profile of vernacular bamboo housing? In several Latin American countries, bamboo construction has been integrated into national building codes: a useful step, which provides useful directives for designers and construction workers. But more work is needed. Greater political awareness and promotion can drive investment. At the other end of the scale, local support is necessary to ensure bamboo housing is taken up by those who would benefit most. Changing the image of bamboo as a 'poor man's timber' would go a long way to making this grass plant the tradition of the future.

THE EDITORS

In this issue...

The architect firm SUP Atelier of the Architectural Design and Research Institute of Tsinghua University (THAD) on the new **Fish-Shaped Bamboo Pavilion** in Yangzhou, China (page 4); Marcin Dawydzik on building **earthquake-resilient bamboo housing in Indonesia** (page 6); David Trujillo on the **history—and future—of bahareque construction** (page 9); Pablo Jácome Estrella and Fabián Moreno on the **new bioclimatic housing design in Ecuador** (page 12). Also featured: the latest bamboo and rattan news from around the world (**Internode**, page 15); updates from INBAR (**INBAR Spotlight**, page 17); some of the recent events in the bamboo and rattan sector (**Events & Meetings**, page 19); crunching the numbers on a new report about bamboo carbon storage (**In Numbers**, page 19); and **a picture in 100 words** (back cover).



IN PROFILE: **THE FISH-SHAPED BAMBOO PAVILION**

From April to October, INBAR will be hosting a Garden at the International Horticultural Exposition 2021. Here, the team behind one of the Garden's bamboo pavilions discuss their inspiration.

The Fish-Shaped Bamboo Pavilion is an open exhibition hall with a floor area covering 288 square metres.

As the major exhibition space for INBAR at the International Horticultural Exposition 2021, Yangzhou, China (Yangzhou Expo), the Pavilion will be regularly used for exhibitions and events during the six-month-long event. Once the Exposition closes in October, the Pavilion will be preserved, as a long-term testament to bamboo construction.

Building with bamboo

Bamboo was a sensible choice of building material for this Pavilion. Easily obtained, renewable and fast-growing, bamboo is used in many regions of southern China, to create structures such as pavilions, bridges and fences. In Chinese culture, bamboo is a symbol of nobleness and perseverance.

In modern times, bamboo has not played a major role in construction, due to its lack of durability. Recently, however, it has become more competitive thanks to modern processing techniques, which have significantly improved bamboo's resilience with high-temperature treatment and anti-corrosion coating. Modern processing technology also makes it possible to standardise sizes and processes in factories or on site. These technologies have all been used in the construction of the Fish-Shaped Pavilion.

Context-driven design

Yangzhou is a historical water town, and fish have been a popular element in China in both historic allusions and folk culture since ancient times.

The Pavilion's design is based on the Chinese saying, "Celebrating with gold and jade". The Pavilion plays on the golden colour of the bamboo and is constructed in the shape of a fish arching its

back (which is pronounced like 'jade' in Chinese). In Chinese culture, fish are an auspicious animal, symbolising abundance.

The building comprises a series of bamboo arcs varying in size, defining an interior space full of rhythmic curves. The head of the fish, facing west with a large opening, serves as the main entrance. Its tail points to the east with a smaller opening, where visitors can exit the Pavilion in accordance with the designated route for the Exposition Garden.

In the design process, digital models were introduced as soon as the conceptual form was confirmed. Architects and structural engineers worked together on the logic of construction. After the form was finalised, the sectional dimensions and constructional logic were defined with the help of a professional bamboo contractor.

The whole structure is divided into three systems: main pillars, subsidiary pillars and purlins. Using bamboo allows people to see this structure in full. The structure also makes use of different kinds of bamboo: raw bamboo pillars, exterior bamboo tile finish, plaited bamboo, bamboo curtain interior finish, bamboo furniture, and bamboo umbrella lights.

The Exposition will be held in spring through early autumn, when the air in Yangzhou is humid. With this in mind, the Pavilion is designed with openings on both the west and east sides to boost natural ventilation. A plexiglass belt is planned for the middle part of the building, creating diverse effects of light and shade. Rhombus-shaped woven bamboo pieces, with waterproof membranes coated on both sides, are overlapped around this belt.

Built for the future

The theme of the Yangzhou Expo is 'Green City, Healthy Life'. The INBAR Pavilion aims to promote eco-friendly bamboo construction, as a push for carbon neutrality, as well as a traditional part of Chinese culture.

With the development of modern technologies, technological problems in bamboo construction will no longer be obstacles for its promotion. As designers and builders of bamboo structures, we are fully convinced of bamboo construction's prospects across the world in the future.

About the Yangzhou Expo...

Hosted in Jiangsu province, China, the Yangzhou Expo is a six-month-long exhibition space, made up of gardens hosted by different countries and organisations. The theme of the Exposition is 'Green City, Green Life', and gardens explore the applications of horticulture and nature-based solutions to human lives.

INBAR's Garden at the Yangzhou Expo:

- Covers **over 3000 square metres**
- Includes **two bamboo pavilions** built in different styles, which integrate modern and traditional elements. One is the modern Fish-Shaped Bamboo Pavilion, which is constructed using round bamboo, and the other is the Waterside Bamboo Pavilion, a traditional garden made using modern engineered bamboo.
- Uses **a number of bamboo species for landscaping**, including *Pleiolblastus argenteastriatus*, *Phyllostachys propinqua*, *Phyllostachys bambusoides*, *Phyllostachys heterocyclus*, and *Phyllostachys aurea*.



Design: SUP Atelier of the Architectural Design and Research Institute of Tsinghua University (THAD)

Principal Architects: Song Yehao, Chen Xiaojuan

Architects: Xie Dan, Chu Yingnan, Sun Jingfen, Kuang Tianyu, Ouyang Yang, Ma Shiyu

Construction: Hangzhou Bamboo Technology Co., Ltd.

FROM THE GROUND UP

Bamboo is providing one housing solution following the recent earthquakes in Lombok, Indonesia.

In summer 2018, the island of Lombok was struck by a series of heavy earthquakes. These events gave rise to 515 casualties, damaged 129,000 houses and caused 445,000 people to be displaced.

By November, displaced residents were already rebuilding their houses. However, with few resources and little structural safety knowledge, the structures were extremely unsafe in future seismic events. The main constraint for many villagers was cost. Many buildings on the island showed significant deflections due to lack of adequate reinforcement using concrete and steel, materials which were often too expensive.

Together with a local charity, Grenzeloos Milieu, a team of engineers, led by myself, took it upon themselves to solve this complex question. With support from the engineering firm Ramboll UK and external advice by Arup bamboo specialists, we aimed to design a shelter which was affordable, comfortable and earthquake-resilient – and made from bamboo.

In Lombok, bamboo grows in abundance. Lightweight, flexible, and strong, bamboo can perform well as a construction material in

earthquake-prone conditions. It is also a vernacular method of construction in Indonesia, although it has recently declined in popularity since the arrival of concrete and western influences.

Designing with bamboo: the structural challenge

Bamboo is a natural material, and as such is highly irregular geometrically and in terms of strength: features that make it difficult to design with. In order to verify the strength of Lombok's bamboo, poles were imported to London and tested by the project partner, the University College London (UCL). Because bamboo is so irregular, it is difficult to find a one-size-fits-all strength value; as such, UCL's research enabled the team to not only determine the specimens' individual strengths, but also provide a digital blueprint of each pole with a full set of structural and geometrical properties. UCL researchers have provided a digital twin of one of the houses built in Indonesia, allowing detailed back-analysis of the structure.

Rooting the design in the culture

To be successful, it was important that the housing design was adopted by the communities. To ensure this, local charity Grenzeloos Milieu conducted



The finished bamboo house design is well ventilated and quake-resilient. Credit: Ramboll UK.

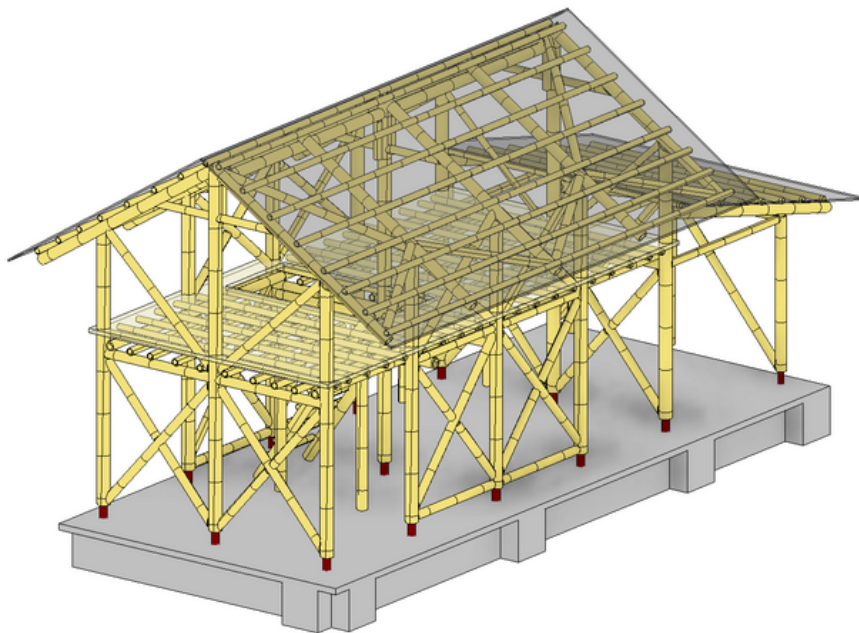
workshops with locals from different parts of Lombok to co-create a project brief: a simple list of requirements that the house design had to meet. The house design needed to include a *beruga*, or a space for spending the day and eating, and fit certain requirements for orthodox Muslim housing: no terrace above the kitchen, and a *wudu* room for washing which is accessible from the outside. A garage and ramp were provided so people could store their scooters, which were often their most valuable or important asset; the room could be converted into sleeping quarters for elderly people who could not climb stairs.

At the same time, the design also included adaptations for a healthier and safe living environment. Many people in Lombok sleep on a mattress on a floor, usually concrete, a practice which can lead to long-term health complications. By bringing the sleeping quarters upstairs, the design

allowed for better ventilation and a healthier sleeping environment. Initially, the community felt reluctant to do this because they feel safer on the ground floor in an event of an earthquake. Now, however, people seem to be convinced about the safety of the house and they do not mind sleeping upstairs.

Spreading adoption of bamboo houses

The next step was to popularise the design and promote its adoption. This was done by building three template houses, which now serve as community spaces, in the area most affected by the earthquakes. Trusted Indonesian bamboo construction groups were employed and supplemented with local apprentices. Together, they not only produced magnificent structures, but also passed on the knowledge of bamboo craftsmanship to those villages. In the future, it is hoped that these upskilled new workers will feel empowered to begin constructions on their own.



Credit: Ramboll UK.

The design philosophy of the template...

- The roof is made out of corrugated sheets of Tetra Pak: a sustainable material which is locally produced and recycled. Its reflective surface reduces the amount of trapped energy.
- Robust tension connection is difficult to achieve in bamboo. As such, the design uses a compression-only load-path in all scenarios.
- The house can be fitted and furnished in a number of different ways: the template house uses woven bamboo walls, but other materials can also be used, and additional partitions can be built to create extra rooms.
- The house is designed out of a series of frames, which can be built on the ground and then lifted into place. This ensures easier and safer construction as well as fewer mistakes due to repeatability.

FEATURED ARTICLES



"In the future, it is hoped that upskilled [bamboo construction] workers will feel empowered to begin constructions on their own." Credit: Ramboll UK.

Maintaining the safety of houses when organically adopted

As with all housing templates, organic adoption can lead to the original design being altered over time. To ensure that the most important aspects of the design remain unchanged, the project has been supplemented with a series of workshops. The workshops, which were developed by engineers but are delivered by the local charity, explain why bamboo is the material of choice and honestly address both the advantages and disadvantages of the material. There is an entire workshop dedicated to basic engineering principles, to discourage design alterations and explain why that bamboo 'X' in a wall (bracing element) is critical to the stability of the building. The workshop also explains how and why insects attack the natural materials and how this can be prevented. According to a team member, "Education is key to a successful adoption, as people fear most the unknown and fail mostly when an unknown unknown hits them."

Looking ahead

The project is nowhere near finished; it will take a long time until it reaches critical mass and people grow and build their own safe bamboo homes.

However, the charity has already sponsored five houses and planted three bamboo forests that are run by village communities on their own land; one of the apprentices is now selling bamboo crafts.

Work is underway to make the design as useable as possible. A student from the university ETH Zurich is helping the project parametrise the design so that

it can be adopted to any size of existing foundations. The engineering team is continuing to work with UCL to adopt their innovative way of designing with bamboo through scanning and testing each element.

One long-term aim of the project is to enable local communities to benefit from bamboo in a multitude of ways. The idea is to create a 'bamboo circular economy', where bamboo creates additional value at each stage of the process. One year after bamboo is planted, its shoots can be harvested for food; two years later, families can start selling bamboo arts and crafts, for which many people in Lombok are well known. After five years, bamboo culms reach their full strength and can be treated and used for construction purposes or any required maintenance. As one bamboo root can live for up to 100 years, a bamboo plantation can provide a long-term source of benefits to the community.

Bamboo is an incredibly sustainable and affordable material and could become a viable commercial housing material. For now, Lombok's bamboo houses aim to bring a vision of beautiful, nature-integrated, affordable and safe housing closer to reality.

MARCIN DAWYDZIK

Marcin is a chartered engineer at Ramboll with a huge passion for humanitarian engineering. Prior to his involvement in Indonesia, he provided intermediate engineering education in Africa and collaborated on shelter assessment during the Syrian refugee crisis in Greece. In his day job he delivers complex projects in central London.

BEHIND BAHAREQUE

An introduction to one of the oldest bamboo construction traditions.

The concept of using a wooden or bamboo frame that is then clad or infilled with a composite made from mineral materials (such as soil, clay or plaster), attached to a lath or lattice of wood or bamboo, is not new. Wattle and daub has been used for millennia throughout the world, including by the Romans for their apartment blocks or *insulae*. Lath and plaster, its more modern descendent, was in use until the mid-twentieth century in the United Kingdom and North America. A similar construction system is *stucco*, as used in the United States of America as an external cement-mortar render applied onto a metal lath. This system is very similar to engineered bahareque.

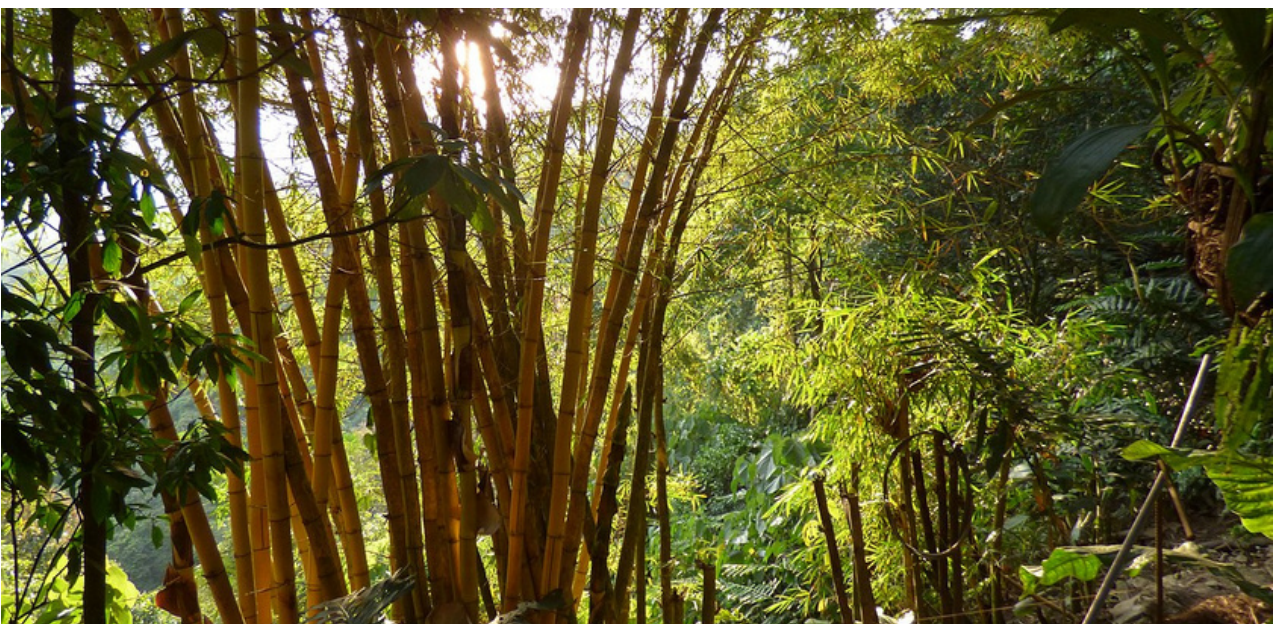
What is the origin of the term bahareque? The word bahareque or *bajareque* is a Spanish word of Taíno origin. Its broadest definition denotes a system that combines wood and/or bamboo with soil or clay infill. Bahareque distinguishes itself from the aforementioned European and North American construction systems, in that it may include bamboo or cane within the system. A similar system used in

Peru is *quincha*. Interestingly, the Spaniards used a system similar to quincha in the Philippines for religious buildings: this system is called *tabique pampango*.

This diversity of origins, names and histories suggests that there is no single history of bahareque construction. However, what can be tracked is the history of *bahareque encementado*, or engineered bahareque, as an earthquake-resistant structural system that may incorporate bamboo within its shear walls, and whose design is 'codified', or contained within a national building code.

The roots of engineered bahareque

Engineered bahareque originates in the coffee-growing region of Colombia. This remote mountainous area was sparsely populated until the late eighteenth century, when it started being colonised by people from the north-east. It is claimed that these settlers initially built one- and two-storey houses using rammed earth. This system proved to be inadequate, as the houses had poor seismic performance and the coffee region is very seismically active. As such, a new system evolved that used a timber frame on the top floor. This system was called *estilo temblorero* or 'tremor-proof' style.



Bamboo is a common sight across many parts of Colombia, including the remote, mountainous coffee-growing region. Credit: INBAR.

FEATURED ARTICLES

Gradually, timber-framed structures became the norm. Bamboo was also incorporated into the frames as an inexpensive and abundant timber substitute. In general, the wealthier the owner, the less bamboo would be used. A great diversity of cladding systems emerged for these timber/bamboo frames, including: wattle and daub, wooden planks, metal sheets and eventually cement-mortar render, which was sometimes retrofitted onto wattle-and-daub frames. The cement-mortar render cladding permitted the development of a more complex and unique architecture that evoked European masonry-based architecture. Colombian architectural historians have named all these systems simply as bahareque, and the system that used cement-mortar render cladding, as engineered bahareque.

Eventually, with the advent of large roads into the region, as well as two large fires which destroyed parts of the city of Manizales in 1925 and 1926, all the bahareque systems were displaced by the more 'desirable' and fire-resistant masonry or concrete-based systems. Throughout the latter part of the twentieth century, a few architects and engineers continued to promote the bahareque systems with limited success.

However, on 25 January 1999, residents of the

coffee-growing region were reminded, once again, about the qualities of bahareque.

The rebirth of bahareque

At 1:19PM, an earthquake measuring 6.2 on the local magnitude scale struck Colombia's coffee-growing region, causing extensive damage to numerous poorly built masonry and/or concrete buildings, resulting in 1230 deaths and USD 1.8 billion in losses. Traditional bahareque buildings performed fairly well, though poorly maintained houses less so; modern engineered bahareque structures performed very well.

Bahareque buildings' performance prompted the Colombian Earthquake Engineering Association to consider promoting these structures once more. The Association then persuaded the managers of the government's fund for the reconstruction of the coffee region of the need to research and then codify the system.

Researchers from the National University of Colombia spearheaded the project. They identified that cement-mortar render, reinforced by chicken-wire applied onto a flattened bamboo lath, and nailed onto bamboo-timber frames, reflected current best practice. They also researched the seismic



Left: Split bamboo mats nailed onto bamboo frames at 'Bambusa' in Colombia: the first housing project to be designed in accordance with Chapter E.7. Architect: Jaime Mogollón; Engineer: Samuel D. Prieto. Right: Engineered bahareque house on a shake table at Universidad de Los Andes. Its seismic performance was excellent. Credit: David Trujillo.



*Low-cost engineered bahareque houses at 'Villa Diana Carolina' in Ricaurte, Colombia.
Architect: Simón Vélez. Credit: David Trujillo.*

performance of these walls as well as mortar-filled bamboo joints.

Codifying bahareque in Latin America

Among the researchers' main outputs were a handbook titled *Manual de Construcción Sismo Resistente de Viviendas en Bahareque Encementado* (Construction Handbook for Earthquake-Resistant Engineered Bahareque Housing) and a new chapter for the Colombian design and construction code, NSR-98. Chapter E.7, which prescribed procedures for building one- and two-storey engineered bahareque houses, was incorporated into NSR-98 by decree on 18 January 2002. It was possibly the world's first national building code to include bamboo as a structural product.

Chapter E.7 only allows designers to use bamboo within the bahareque system, although it does make an allowance for bamboo elements to be used as complimentary columns. Its contents underpins later codes that emerged in Peru (E.100 in 2012) and Ecuador (NEC-SE-Guadua in 2016); it is also the basis for *Norma Andina para Diseño y Construcción de Casas de Uno y Dos Pisos en Bahareque Encementado* (Andean Standard for Design and Construction of One- and Two-Storey Engineered Bahareque Houses) published by INBAR. The design methods contained in chapter E.7 are also the basis for later designs in Mexico, Nepal and the Philippines. Interestingly, engineered bahareque has proven to be also very resilient to typhoons, as has been demonstrated in the Philippines.

The future of engineered bahareque

The widespread adoption of bamboo-framed engineered bahareque housing would seem like an obvious way to achieve numerous United Nations Sustainable Development Goals. Engineered bahareque is resilient to natural disasters; it has a significantly smaller embodied carbon and yet is more economical than confined masonry alternatives; and if properly designed, it can be very durable and fire-resistant.

Yet despite recent gains, the uptake of bahareque has been slow. To date, the world's largest engineered bahareque housing project, *el Proyecto Nacional del Bambú*, in Costa Rica, precedes the publication of Chapter E.7. This would suggest that institutional and financial commitments are more important to its adoption than legislation.

There is reason for optimism, however. Engineered bahareque offers a tried and tested low-cost housing solution for many countries across the developing world, especially in disaster-prone countries with an abundance of bamboo. With greater understanding, we may yet see an uptake in its use.

DAVID TRUJILLO

David is a civil engineer who has been working with bamboo structures since his undergraduate years in Colombia. He recently completed his PhD by Portfolio in this field. He is an Assistant Professor at Coventry University, and Chairs the INBAR Construction Task Force.

RAISING THE BAR

A demonstration project in Ecuador could pave the way for climate-smart bamboo construction across Latin America.

Construction is a climate change issue. According to the Global Alliance for Buildings and Construction, the building and maintenance of new housing accounts for 38% of worldwide carbon emissions. Emissions from buildings start with their construction, which typically uses materials such as steel, cement and glass, and continue throughout the building's operation. A structure which is not energy-efficient, or poorly adapted to the local climate, will use more energy over its lifespan.

Low-carbon construction materials and smart building design are both imperative to reduce carbon emissions, and so combat climate change. This is particularly critical in fast-developing areas of the

world, such as Latin America and the Caribbean. In 2018, the building sector in Central and South America accounted for 24% final energy consumption and 21% carbon dioxide emissions. Given the region's expected growth rate—by 2040, Latin America's population is expected to expand by a further 20%—the construction sector will continue to play an important role in climate change discussion.

Bamboo: a low-carbon housing solution

The region may find a solution in a common grass plant: bamboo. The fast-growing plant is widely distributed across some 11 million hectares in the region, among crops, on riverbanks, and on the sides of mountains. The *Guadua* genus has been used for construction in Latin America for millennia: the oldest known bamboo house, from the Ecuadorian Las Vegas culture, is thousands of years old, and in many parts of the region, it is possible to see bamboo houses which have been standing for more than 100 years.



Promoting the uptake of bamboo housing requires more than just design: education and national standards are also important. Credit: INBAR.

Bamboo and carbon storage

As with all grass plants, bamboo can store carbon in the plant, soil and products.

- According to research published by INBAR in 2021, over 30 years, a plantation of *Guadua* bamboo can store and reduce 401 tC/ha – compared to just 236.7 tC/ha for Chinese fir trees.
- This is because bamboo is a grass, not a tree, which means it grows fast (most species can be harvested within three to seven years) and regrows quickly without the need to replant. Over a period of time, bamboo can be used to create a large number of products, all of which store carbon, in addition to the carbon stored in the plant itself.
- In addition to housing, bamboo can be used to make a wide range of products, including flooring, furniture, decking, drainage pipes and even wind turbine blades.

Like other countries in Latin America, Ecuador has been building with bamboo for many years. However, the plant is still widely considered a low-quality construction material, and used mainly for informal structures. Few architects or construction workers are familiar with how to use bamboo. This perception has begun to shift since the devastating earthquake in Manabí province in 2016, and the subsequent studies about bamboo housing's resilience in natural disasters.

In 2017, Ecuador's Ministry of Urban Development and Housing published a standard for building with *Guadua* bamboo. The next year, the government developed a national Bamboo Strategy, which highlighted construction as one of the most important sectors for development.

In 2018, a project in Ecuador aimed to build more awareness and support for bamboo construction. The project was funded by the Spanish Agency for International Development Cooperation, AECID, and implemented by INBAR, with participation from central and local governments, as well as academic institutions and producer organisations from Manabí province.

Smart design

The project team designed a prototype for a



A detail from inside the house. Credit: INBAR.

two-bedroom house using bamboo. The model, which includes a living room, dining room, kitchen and bathroom, and covers an area of 57 square metres, can be made using the bahareque method, a kind of wattle-and-daub construction technique, with bamboo walls. The design was nicknamed the 'Bioclimatic Bamboo House'.

The prototype creators created an innovative structure which adapted to the climate. High ceilings and wide eaves prevent the entry of rain carried by the wind, while allowing ventilation and natural light, and maintaining a consistent temperature. The design aimed to reduce energy costs and produce a carbon footprint smaller than similar-sized buildings constructed using iron and concrete.

The Bioclimatic Bamboo House was subjected to a thermal comfort study, which determined that the house meets international standards for light and ventilation, directly contributing to a reduction in energy use of fans or air conditioning inside the home.

A carbon footprint study shows that the Bioclimatic Bamboo House is carbon-negative throughout its lifespan. Although the house construction generates 75.6 kilograms of carbon dioxide per square metre (kgCO₂eq/m²), the carbon stored in the bamboo mean that the house captures

FEATURED ARTICLES

82 kgCO₂eq/m², resulting in a negative balance of -6.8 kgCO₂eq/m². By comparison, constructing a brick house in the region generated 150 kgCO₂eq/m², and a cement one, almost 200 kgCO₂eq/m².

National uptake

In a major step forward for bamboo construction uptake, Ecuador's Ministry of Urban Development and Housing validated and approved the Bioclimatic Bamboo House prototype in November 2018. The approval means that the prototype can be used in Ecuador's 'Casa para Todos' ('A House for All') plan—the national social housing programme that provides houses to low-income people—and signals support for bamboo construction more generally.

As part of the initiative, public officials and construction workers were trained in the use of bamboo in construction, under the Ecuadorian Construction Standard for 'Guadua Structures'. The aim of the training was not only to transfer knowledge, but also to generate awareness and interest among public officials about the potential of bamboo construction.

Likewise, several municipalities are incorporating

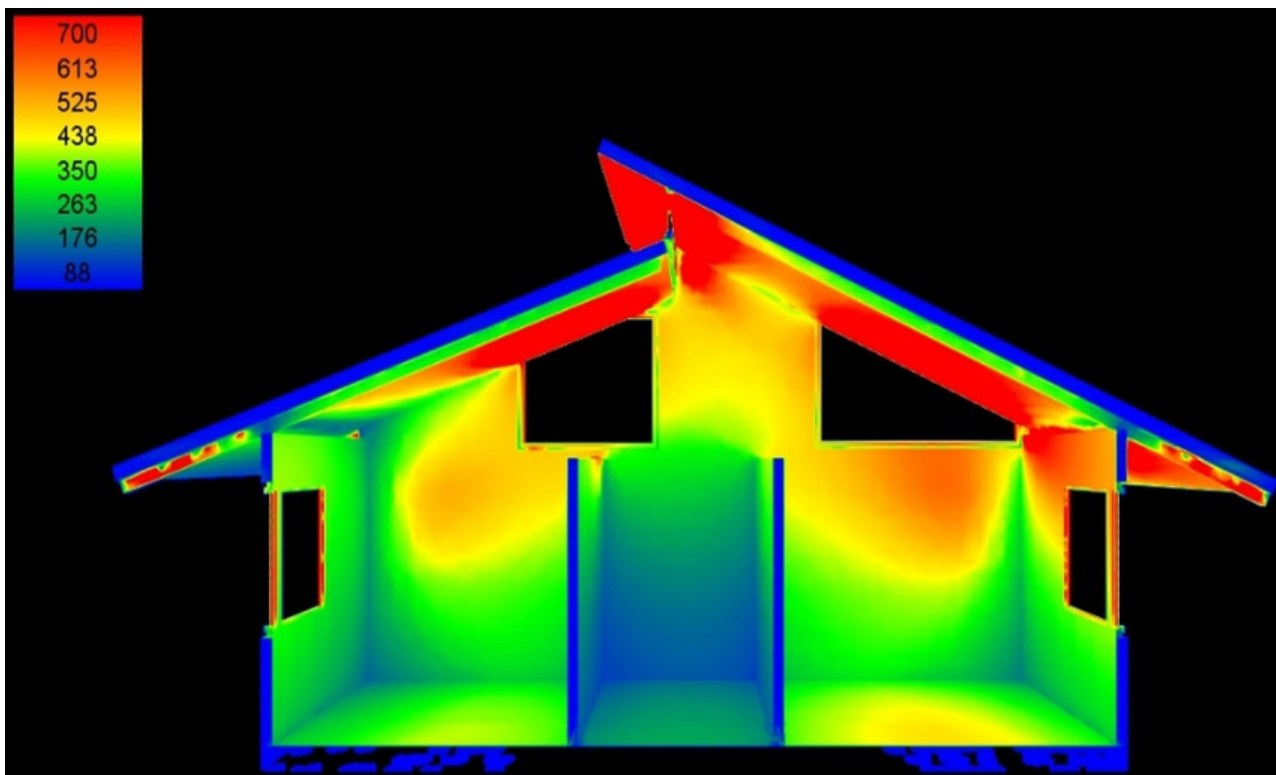
regulations that encourage the use of sustainable materials in construction, especially bamboo, and that include bamboo rooms in plans for public and community infrastructure. A number of municipal governments now provide incentives for using bamboo in the construction of houses, resulting in a price reduction of 75% for obtaining a construction permit.

A sustainable supply of well-managed bamboo is critical for these construction programmes. The project team supported municipal governments to develop and approve regulations for the sustainable management of bamboo production.

Slowly, bamboo in Ecuador is shedding its image as the material of the poor and is becoming the material of prosperity and aspirational lifestyles. It can be an important part of Latin America's push to more circular development, and low-carbon construction.

PABLO JÁCOME ESTRELLA AND FABIÁN MORENO

Pablo is INBAR's Regional Coordinator for Latin America and the Caribbean. Fabián is Manager of the INBAR-AECID Sustainable Construction with Bamboo Project.



The house's thermal comfort study "determined that the house meets international standards for light and ventilation, directly contributing to a reduction in energy use of fans or air conditioning inside the home." Credit: INBAR.

INTERNODE

Collating the latest international news and activities about bamboo and rattan sector development.



Ms. Julia Wangari, one of the women in the project, displays some of the products at the cooperative in Small Athi in Murang'a County. Credit: Joseph Kanyi | Nation Media Group.

Wangari Maathai's bamboo legacy

A women-led cooperative in Murang'a county, Kenya, is raising money to revitalise a bamboo farming industry initiated by the late Nobel laureate environmentalist, Professor Wangari Maathai.

The cooperative, which is made up of 720 women, aims to raise KES 1.5 billion [USD 13 million] by 2022 to establish a fully-fledged bamboo processing industry.

The company is one of several community-based women's organisations for bamboo and tree cultivation first established by Professor Maathai in the early 1990s. Maathai described bamboo products as "long-lasting, inexpensive, easy to recycle or compost at the end of useful life, and made from eco-friendly resources."

Since its inception, as a community of 24 women, the industry has grown; project chairperson Ms. Wangui Kamau reports there are 100,000 bamboo poles in storage, and products, mostly made from *Oxytennera Abyssinica*, include everything from furniture to kitchen utensils and jewellery. *Source: Nation, 12 February.*

Bamboo in North America

A growing number of conservationists are planting bamboo in the United States of America, according to a report released in *Inside Climate News*.

Bamboo is becoming a more popular plant to help

counter dust storms and desertification in drier parts of the United States of America. Companies include Resource Fiber, a 100-acre bamboo nursery and the largest bamboo growing operation in North America. The company is planning to establish a USD 3.6 million bamboo manufacturing facility in Alabama.

Source: Inside Climate News, 11 January; Bham Now, 19 January.

New research on pandas and biodiversity

The preservation of giant panda habitats does not always safeguard nearby species, according to research published in the academic journal *Biological Conservation*.

Whereas the conservation of certain 'umbrella species' can often protect surrounding flora and fauna, this is not necessarily the case with the giant panda.

The study analysed eight mammal species in giant panda nature reserves across China. Of these species, three—the Asiatic black bear, the forest musk deer, and a species of Chinese deer—continued to suffer significant habitat loss even under panda conservation efforts.

In an interview with *Treehugger*, one of the study authors suggested that "the effectiveness of nature reserves should be evaluated from a multi-species perspective, because what we need is a balanced

ecosystem instead of a single species.”

Source: *Treehugger*, 7 January.

Bamboo push in the Philippines

In the first few months of 2021, the Philippines has continued to promote bamboo as a source of income and tool for land rehabilitation.

The Department of Environment and Natural Resources is continuing to restore degraded riverbanks with bamboo, as part of the ‘Build Back Better’ Task Force established in November last year. Between 9 and 21 February alone, more than 49,000 bamboos were planted, covering approximately 173 hectares of river banks. Some 151,000 seedlings are now being prepared for planting in May.

In March, it was announced that the government of the Philippines has allocated at least PHP 22 billion [USD 450 million] for the development of the country’s bamboo sector between 2021 and 2022. The Trade and Industry Secretary Ramon M. Lopez announced the investment at the North Luzon and Central Luzon Virtual Bamboo Summit. Mr. Lopez said that money would be spent on planting at least 60,000 hectares of bamboo, as well as providing support for bamboo agribusiness and smaller enterprises to grow.

Source: *Manila Bulletin*, 18 February and 23 March.

Jamaica invests in bamboo development

Jamaican company Bamboo Bioproducts Ltd. (BPP) plans to spend USD 300 million to establish a new facility in Frome, Westmoreland. The facility will focus on creating bamboo pulp for paper production. According to paper sector publication *Nip Impressions*, BPP estimates that the facility will create 500 jobs directly, and up to 5000 jobs indirectly.

In addition to BPP, *Jamaica Observer* reported that the government of Jamaica is looking to create new partnerships to develop the country’s bamboo sector. According to State Minister in the Ministry of Industry, Investment and Commerce, Dr. Norman Dunn, discussions are underway with several overseas investors with a view to securing their support to expand the sector.

“We import too much, and we can manufacture [many of the imported products] right here [in Jamaica]”, Mr. Dunn said. “We are encouraging... manufacturers and innovators in Jamaica to come forward and produce world-class, quality products that we believe can stand the test of time and

scrutiny anywhere in the world. This is the right time to invest.”

Source: *Jamaica Observer*, 11 January; *Nip Impressions*, 18 March.

Bamboo is part of reforestation efforts in Timor Leste

A European Union-financed forestry project in Timor Leste is scaling up efforts to include bamboo.

Since 2018, *Ai ba Futuru* (“Trees for the Future”), a programme financed by the European Union with EUR 14 million and co-funded by the German Federal Ministry for Economic Cooperation and Development, has been working with the Timorese authorities and smallholder farmers to help preserve forests and improve the livelihoods of rural communities.

As part of this work, *Ai ba Futuru* is assisting in the establishment of four new bamboo pre-processing centres in Viqueque, Lautem, Baucau and Manatuto. In 2021, the initiative announced it will be hiring young carpenters and providing training to operate the machines to cut and split bamboo; these splits will then be transported to the Bamboo Institute in Dili, where they are transformed into furniture and handicrafts. The carpenters have already established nurseries to grow bamboo saplings, to ensure supply.

The pre-processing centres are built locally, and it is hoped they will provide employment and a regular source of income to the workers and their families.

Source: *European Union External Action*, 29 January.

Want more nature-based solutions in your inbox?

For regular updates in your inbox on bamboo- and rattan-related news, and the quarterly *Bamboo and Rattan Update*, sign up to the INBAR newsletter.

WWW.INBAR.INT/NEWSLETTER/

INBAR SPOTLIGHT

INBAR commissions research, conducts project work and raises awareness about bamboo and rattan across its 47 Member States.



The Latin America and Caribbean Ambassadors' Dialogue included a panel discussion about bamboo's importance for regional development. Credit: INBAR.

Promoting sector development in Latin America and the Caribbean

On 18 March, diplomatic representatives from 15 countries attended the Latin America and Caribbean Ambassadors' Dialogue at INBAR Headquarters (pictured), to discuss how bamboo can support post-COVID economic recovery and more sustainable development in the region.

INBAR's diplomatic dialogue, themed around 'Triangular cooperation, knowledge transfer and best practices', included a visit to the bamboo and rattan product showroom, speeches, videos, and a panel discussion about bamboo's potential in the region.

The Minister of Agriculture and Livestock of Ecuador, His Excellency Mr. Xavier Lazo Guerrero, gave a video speech at the event, saying that his country's promotion of the bamboo sector has "allowed for the development of more than 500,000 people" who are indirectly and directly involved in the value chain.

Representatives from the bamboo companies Ningbo Shilin, based in China, and Bambusa, in Spain, also talked about market development.

Following the presentations and videos, a number of representatives from governments and international organisations took part in a spirited panel discussion about the future of bamboo in the region.

Joining the Decade on Ecosystems Restoration

INBAR has become a supporting partner of the United Nations Decade on Ecosystem Restoration 2021-2030.

The Partnership Committee approved INBAR's application to become a supporting partner in early March. In their acceptance letter, the Committee hoped that INBAR "will be able to help promote and amplify the Decade and its activities, help strengthen restoration capacity and monitoring efforts, and support the coordination of UN Decade initiatives within your field of expertise."

The Decade on Ecosystems Restoration strategy is led by the United Nations Environment Programme and the Food and Agriculture Organization of the United Nations. It will launch on World Environment Day on 5 June 2021, and aims to push attention towards the importance of ecosystems for sustaining life on earth, and the urgent need to protect them.

A new Training Centre in Ghana

INBAR's West Africa Regional Office has opened a Bamboo Common Production Training Centre (CPTC) at Obogu, Ghana, to provide training in skills for bamboo product development.

CPTCs aim to combine access to bamboo processing machinery with a skill-learning centre for bamboo product design. The Centre in Obogu, which opened in February, is equipped with machines to process bamboo culms, produce laminated boards and toothpicks, and create bamboo furniture, including the production of desks for schools in Ghana. More than 2500 artisans and smallholder farmers are expected to benefit from the facilities and training courses offered by the centre.

The Obogu CPTC (pictured) was created as part of the ongoing Inter-Africa Bamboo Smallholder Farmers Livelihood Development Programme, funded by the International Fund for Agricultural Development. The Programme aims to scale up bamboo cultivation and use among smallholder farmers in Cameroon, Ethiopia, Ghana and Madagascar.

A visit from the Pakistan Embassy

In January, a delegation of spouses and staff from the Embassy of the Islamic Republic of Pakistan in Beijing visited INBAR Headquarters.

The delegation was headed by Mrs. Farah Moin, wife of the Ambassador of Pakistan to China, and included around 20 people, including Mrs. Leena Ahmed Farooq, spouse of the Deputy Head of Mission, Mrs. Saleha Awais Khan, spouse of the Counsellor, and Dr. Aqsa Shaukat, Third Secretary.

During the visit, Professor Jiang Zehui, Co-Chair of INBAR's Board of Trustees, introduced INBAR's work

promoting bamboo and rattan for sustainable development. The delegation was also shown around the bamboo and rattan showroom.

Bamboo is already cultivated in several parts of Pakistan, and the country boasts somewhere in the region of 15 bamboo species. Bamboo housing has also been used throughout the country to build a variety of emergency, transitional and permanent shelters, in response to a number of debilitating earthquakes and floods.

Celebrating International Day of Forests

On 19 March, INBAR Deputy Director General Professor Lu spoke at an event to mark International Day of Forests. The event was hosted by the United Nations (UN) Forum on Forests, and featured speakers from a number of United Nations organisations, including Mr. Volkan Bozkir, President of the UN General Assembly, and Dr. Qu Dongyu, the Director General of the Food and Agriculture Organization of the UN.

Speaking in the Observers section of the event, Professor Lu summarised how bamboo and rattan "have enormous potential to contribute to forest restoration, improving the health and wellbeing of people and planet." He discussed the plants' importance as a source of income for rural communities and habitat for different species, as well as a means to restore degraded land and prevent deforestation.

The event was broadcast on UN Web TV.



The new CPTC in Ghana includes machines to process bamboo culms and produce a variety of products, from toothpicks to furniture. Credit: INBAR.

EVENTS AND MEETINGS



INBAR EVENTS

25 January

Pakistan Embassy delegation visit to INBAR
Beijing, China (pictured)

18 February

Opening of the Ghana Common Production and Training Centre
Obogu, Ghana

23 February

Webinar: Innovative rattan applications and the economic potential of the rattan sector
Virtual INBAR event

2 March

Webinar: manufacturing bamboo products
Virtual INBAR event

9 March

Webinar: Bamboo policy: a roadmap for bamboo development
Virtual INBAR event

18 March

Latin America and Caribbean Ambassadors' Dialogue
Beijing, China

21 March

International Day of Forests
International day

6-7 April

Second International Forest City Conference
Nanjing, China

8 April-8 October

The International Horticultural Exposition 2021, Yangzhou
Jiangsu, China

13 April

Webinar: Bamboo textiles
Virtual INBAR event

18 May

Webinar: Management of spreading bamboo
Virtual event

Find out about relevant upcoming events at www.inbar.int/event/

IN NUMBERS

1.7x more carbon

... The amount of carbon stored in *Guadua* bamboo plants and products, according to new research published by INBAR.

According to the new Working Paper, which looks at how to integrate bamboo forestry projects into carbon markets, a well-managed plantation of *Guadua* bamboo can store, or avoid, 401 tonnes of carbon per hectare over a 30-year period. This is more than the 236.7 tonnes of carbon stored or avoided by Chinese fir trees. *Moso* bamboo can also store more carbon than Chinese fir: over the same time period, it can store or avoid 295.7 tonnes carbon per hectare.

The amount includes the carbon stored in bamboo plants and soil, as well as in the products made from harvested bamboo. Finally, the calculation estimates the amount of carbon which these harvested products can avoid: for example, by avoiding deforestation, or by replacing industrial materials made from emissions-intensive steel, or PVC, with materials made from bamboo. *Guadua* is a genus of woody giant bamboo, which is very common across Central and South America, making it a potentially important source of carbon storage and durable products.

The Working Paper, King, C., van der Lugt, P., Thang Long, T., Li, Y. (2021) 'Integrating Bamboo into Carbon Markets', can be downloaded from INBAR's Resource Centre.

A PICTURE IN 100 WORDS



Bamboo weaving artist Mou Xiaoyan waves thin bamboo strands, or 'bamboo silk', through the air. In recent years, Xiaoyan's city of Chishui, in Guizhou province, China, has become a hub for traditional bamboo artisanship. Now part of a UNESCO-protected World Heritage Site, Chishui residents are unable to rely on traditional livelihoods such as mining, hunting and logging. Instead, locals are relearning old crafts, such as bamboo weaving, where hair-thin strands of bamboo are woven tightly around ceramics. It is one example of how governments are using traditional crafts to help revitalise China's rural areas.

Credit: Wang Changyu, submitted for the INBAR China Photo Competition 2020

UPCOMING:

INBAR WEBINARS ON TEXTILES, 'FOREST CITIES' AND MORE

Virtual events

www.inbar.int/inbar-webinars/

Since 2020, INBAR has been providing online events for a wide range of audiences, including policymakers, foresters, sustainable development practitioners, bamboo and rattan artisans and entrepreneurs. The 2020 sessions, which covered everything from environmental management and poverty reduction to health and construction, have been viewed more than 100,000 times online so far.

In 2021, INBAR has planned more webinars, including a live recording of the Second Forest Cities conference, which will be taking place in Nanjing, China, as well as a webinar on bamboo textiles production, management of spreading bamboos and using bamboo for landscape restoration. You can register to attend the webinars for free at the above URL.



CHINA | CAMEROON | ECUADOR | ETHIOPIA | GHANA | INDIA

www.inbar.int | [@INBAROfficial](https://www.instagram.com/INBAROfficial)