B R U
Bamboo & Rattan Update

INBAR

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

BAMBOO FOR CLIMATE ACTION

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About INBAR
INBAR is an intergovernmental organization which promotes the use of bamboo and rattan for sustainable development.
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B R U

EDITORIAL

Welcome to the second issue of the* Bamboo and Rattan Update *for 2025, which details bamboo and rattan's role in addressing climate change and its impacts.

Once again, the record for hottest annual temperature was broken in 2024, with a global average surface temperature 1.55°C above the 1850–1900 average. This is a significant figure, as temperatures in excess of 1.5°C will usher in the worst impacts of climate change, including extreme weather incidents and sea level rise. The target is enshrined in the Paris Agreement, a legally binding international treaty on climate change, with an overarching goal to keep global average temperatures under 2°C above pre-industrial levels.

One year failing to meet the initial 1.5°C target does not necessarily mean the world's climate policies have failed. However, it is a crucial data point that highlights the real gap between policy and rhetoric. Bamboo can help bridge the divide, as a nature-based solution that directly contributes to Sustainable Development Goal 13: Take urgent action to combat climate change and its impacts.

There are several major benefits to integrating bamboo into climate policy. As one of the fastest growing plants on Earth, bamboo is capable of sequestering more carbon than most tree species, such as the Chinese fir. It can grow on rugged, poor soils without the need for extensive agricultural inputs or water, resulting in a lower environmental impact. Its multifarious applications across a diverse range of products and applications can generate new revenue streams for farmers and small enterprises, strengthening the climate resilience of local communities. Rural women, a particularly vulnerable demographic, can also participate across the bamboo value chain. This is in large part due to its lightweight and flexible nature. This increases their economic opportunities and mitigates the impacts of climate shocks.

The first article of the BRU explores the ways in which bamboo can comprehensively contribute to Brazil's fight against climate change. Authors highlight its utility as a natural carbon sink in the Amazon, along with its potential to strengthen adaptation strategies, boost livelihoods, sustainable, resilient construction, biodiversity research and more. A new national multistakeholder platform in the country, Rede Brasileira do Bambu (RBB), is bringing together academics, private sector leaders, NGOs and government officials to bridge gaps between scientific, industrial and policy spheres.

Africa is also making waves in the bamboo sector. In the second article, we learn how Cameroon is working to strengthen the resilience of local communities residing on the periphery of its national parks. Under the aegis of the Increasing the Resilience of Local Communities to Climate Change through Youth Entrepreneurship and Integrated Natural Resource Management (ACREGIR) project, staff are training locals in green project design and business creation. These efforts are creating new economic opportunities for marginalized communities where they hitherto did not exist. In addition, the project is focusing on restoring degraded land around the parks through bamboo reforestation. Nearly 15,000 bamboo seedlings have been planted to date, significantly enhancing the ecological health of the surrounding environment.

What lessons could be learned from the country with the longest history of using bamboo? The next article details the carbon storage potential of two bamboo species in southwestern China, musing about bamboo forests functioning as "long-term carbon reservoirs." The author also deftly illuminates China's long history of utilizing bamboo, highlighting archaeological and written evidence that suggests that bamboo forests have retreated southward as the climate gradually cooled. Science-based management can help enhance forest resilience while emphasizing the coordination between humans and nature as we adapt to a world increasingly shaped by erratic climate phenomena.

The final article turns its gaze back toward Latin America and the Caribbean. In response to growing climate challenges, the region is looking to bamboo as a powerful, nature-based solution for resilience and sustainable development. Through the Regional Bamboo-Based Solutions project—led by INBAR and supported by AECID—countries like Costa Rica, Panama, Cuba and the Dominican Republic are using bamboo to restore degraded land, stabilize water sources, provide clean energy and boost local economies. In Costa Rica, farmers like Carlos Castillo are growing bamboo to produce construction materials and edible shoots, while Cuba is piloting bamboo charcoal for cleaner cooking. With over 500 producers trained through Farmer Field Schools, the initiative is not only protecting the environment but also empowering communities and promoting inclusive, climate-smart livelihoods across the region.

It is clear that bamboo has a role to play in helping the world meet its climate goals. Ready to learn more? Grab your favorite drink or snack, sit back, and let bamboo's amazing capacity as a climate confronter astound you.

THE EDITORS

ROOTED RESILIENCE: HOW BRAZIL'S BAMBOO SECTOR ADVANCES CLIMATE ACTION

Bamboo poised to play an active role in jump-starting reforestation, green jobs and low-carbon growth.

Brazil's untapped climate ally

As the climate crisis accelerates, nations around the world are seeking scalable, nature-based solutions. In Brazil—a megadiverse country with vast forest coverage—bamboo is emerging as a strategic and underutilized resource to advance the United Nations Sustainable Development Goal 13: Climate Action.

With its fast growth, deep-rooted rhizomes and ability to restore degraded land, bamboo offers a climate-smart solution that combines ecological preservation with economic resilience. Its application in Brazil is beginning to illustrate how it can build resilience, support policy alignment and promote public awareness, comprising the three key pillars of SDG 13.

A natural carbon sink in the Amazon

Brazil is home to one of the largest native bamboo reserves on the planet. In the southwest Amazon alone, approximately 180,000 km² of bamboo-dominated forests—primarily of the *Guadua* genus—extend across Acre, Amazonas and parts of Peru and Bolivia.

These natural stands contribute significantly to carbon sequestration and biodiversity. Species like *Guadua superba* reach up to 30 meters in height, forming dense forests that act as carbon sinks while requiring no replanting due to their robust rhizomatic propagation.

Across the national territory, Brazil holds approximately 9.6 million hectares of forests with bamboo—of which 80% are in native forests. This massive natural coverage positions the country among one of the world's largest bamboo reserves, yet it remains underexploited economically. Strategic use of this resource could drastically scale up the country's contributions to climate mitigation, especially through reforestation and landscape rehabilitation.

Enhancing adaptive capacity across landscapes

In a country marked by environmental extremes such as floods, droughts and soil degradation, bamboo provides a nature-based solution for climate adaptation. In erosion-prone and flood-affected areas, its deep roots stabilize soils and absorb excess water, protecting both people and infrastructure.

Its flexibility and strength also make it ideal for building resilient structures. In rural Brazil, bamboo is increasingly used in slope stabilization, bridges and climate-resistant housing, offering a lightweight and low-carbon alternative to concrete, steel and other common building materials.

Diversified rural livelihoods and green jobs

Bamboo also strengthens social resilience by enhancing rural livelihoods. Integrated into agroforestry systems, it offers smallholder farmers a fast-growing and harvestable product that complements crops and livestock.

In Paraná and southern states, rural cooperatives engage over 100 families in bamboo cultivation, processing, and product development—from crafts to furniture and structural components. These activities regenerate landscapes while generating income and employment.

Commercial planting of Bambusa Vulgaris *in the state of Mato Grosso (Central-West Region). Credit: FS Bioernergia.*

In many regions, bamboo provides material not only for construction and artisanal use, but also for energy generation, food and soil recovery. Its low input requirements and high biomass productivity make it especially suitable for small-scale and family farming, particularly in regions facing environmental degradation or economic isolation.

Policy shifts to support low-carbon agriculture

Brazil has made significant regulatory progress by recognizing bamboo as a planted forest species under the Ministry of Agriculture. This enables bamboo to be incorporated into Brazil's ABC+ Plan (Low-Carbon Agriculture), granting access to climate finance, carbon credit schemes and technical support for reforestation and emission reduction. This policy recognition is a pivotal step for scaling up bamboo within national climate strategies and positioning it as a strategic crop for restoration and sustainable development.

In addition, the National Congress has approved a federal law establishing guidelines for the National Policy for the Sustainable Development of Bamboo (Law No. 12.484/2011). This legislation supports the expansion of research, commercialization and integration of bamboo into rural and urban development programs. Despite this legal foundation, operational implementation remains limited, highlighting the need for greater institutional coordination and funding.

Technical standards enabling sustainable construction

To facilitate bamboo's broader application in infrastructure, the Brazilian Technical Standards Association (ABNT) has developed technical norms for structural use of bamboo. These standards cover harvesting, preservation, design and performance criteria for construction applications.

These standards are essential for unlocking the potential of bamboo in low-carbon buildings and disaster-resilient public works. While still in the early stages of adoption, they lay a foundation for mainstreaming bamboo into sustainable urban and rural infrastructure.

Brazil currently has at least three technical norms published for bamboo, including guidelines

on structural use, preservation methods and quality assurance. This growing base offers crucial support for expanding bamboo in civil construction, especially in low-income housing and public projects.

Strengthening national associations and value chains

Despite promising advances, Brazil's bamboo ecosystem requires stronger institutional coordination. National associations, including researchers, producers and entrepreneurs, are key to connecting stakeholders, influencing policy and advancing technical innovation.

However, these networks often lack sufficient visibility, funding and organizational support. Strengthening them will be critical to expanding bamboo's contribution to climate action across Brazil's diverse regions.

The recently formed Rede Brasileira do Bambu (RBB) is an example of this effort. As a national multi-stakeholder platform, RBB brings together academics, business leaders, NGOs and government representatives to promote policy advocacy, research dissemination and sustainable commercialization of bamboo. Its work is essential for bridging gaps between the scientific, productive and policy spheres.

Commercial plantations and industrial expansion

In the industrial sector, bamboo is making headway as a renewable resource. In Bahia and other regions, commercial plantations of *Bambusa vulgaris* produce over 150,000 tonnes annually for pulp and bioenergy—displacing fossil fuels and cutting emissions.

Currently, Brazil has an estimated 18,000 hectares of planted bamboo forests, concentrated mainly in the Northeast (Bahia) and Southeast (São Paulo, Minas Gerais). These areas are expanding, particularly through private investment. One large agroindustrial group alone maintains over 30,000 hectares of bamboo to supply its industrial production of pulp and energy.

The economic potential is considerable: market studies estimate that the bamboo sector in Brazil could generate over 50,000 direct jobs and R$1.5 billion (approx. USD 300 million) in annual revenue if fully developed. Value chains include not only biomass and pulp, but also panels, biochar, bamboo shoots, composites and engineered structural components.

Bamboo's circularity, from its rapid growth and clean burning to its biodegradability, makes it a valuable raw material in the green transition.

Climate education and public awareness

Bamboo is also playing a growing role in climate education and public engagement. Civil society groups, schools and municipalities are using bamboo to link environmental learning with hands-on sustainability projects like eco-construction, reforestation and green entrepreneurship. This grassroots work builds public understanding of climate challenges and positions bamboo as a tangible, inclusive tool for local climate action. Notably, public schools in states like Acre and Paraná have incorporated bamboo-based environmental education projects in their curricula, teaching students about biodiversity, carbon cycles and sustainable construction using local resources.

Research and global knowledge sharing

Scientific institutions like Embrapa and universities are mapping native species, conducting field trials and assessing carbon sequestration metrics. With more than 250 native bamboo species—including many that remain underexplored—Brazil has the potential to become a global leader in bamboo biodiversity research and sustainable use.

Current studies are identifying high-potential native species such as *G. weberbaueri*, *G. tagoara*, and *Apoclada simplex* for structural applications and reforestation programs. Several pilot projects are also testing their adaptability in degraded soils and their carbon capture rates under different climatic conditions.

Brazil's experience in integrating bamboo into forest conservation and industrial production

Commercial plantation 12 years old since planting, Dendrocalamus asper *in the State of Minas Gerais (Southeast Region), developed by the company BAMBUGX. Credit: Vitor Marçal.*

provides useful models for other countries. Through platforms like INBAR, Brazil contributes knowledge and lessons to a growing global movement toward nature-based climate solutions.

Bamboo for climate action on all fronts

Brazil's bamboo sector is advancing Sustainable Development Goal 13 across its three key dimensions:

- Resilience and adaptive capacity: Bamboo protects vulnerable landscapes and communities, reinforces ecosystems and supports diversified rural livelihoods.
- Policy coherence and low-carbon transition: Legal recognition, technical norms and integration into national agriculture and climate strategies demonstrate bamboo's alignment with Brazil's climate goals.
- Public awareness and participation: From schools to cooperatives, bamboo fosters environmental education, green jobs and sustainable lifestyles rooted in local action.

Realizing this potential will require an integrated strategy involving institutional strengthening of national associations, broader dissemination of technical norms as well as investment in research and processing infrastructure. Ultimately, a massive effort is needed to incorporate bamboo in climate policies at all levels of government.

Bamboo can help Brazil meet its climate targets, restore degraded lands, promote equity in rural areas and lead innovation in sustainable materials. As a renewable, resilient and locally abundant resource, bamboo offers Brazil, and the world, a deeply rooted response to the climate emergency.

ANELIZABETE ALVES TEIXEIRA & VITOR HUGO SILVA MARÇAL
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STRENGTHENING WOMEN AND YOUNG PEOPLE'S RESILIENCE TO CLIMATE CHANGE

The ACREGIR project promotes the improvement of living conditions for communities in Cameroon.

Considered to be one of the greatest challenges of our generation, climate change and its ramifications, including resulting environmental disasters, manifest themselves in different ways depending on region, generation, age, social class and gender.

In Cameroon, as in many other countries, the most vulnerable and marginalized populations are the hardest hit. Among these populations, women and young people are the first to suffer from climate change, due to socio-economic and cultural factors. Women and young people do not enjoy equal access to assets, resources and property, making them even more vulnerable. As a result, many women and young people in Cameroon live in poverty. Tackling the disproportionate impact of climate change on different vulnerable groups in Cameroon is now a major concern for the government. Communities that depend on natural resources for their livelihoods are particularly vulnerable to ever-increasing climatic hazards and subtle changes in temperature and rainfall conditions. These changes, and the uncertainties associated with them, make resilience a priority for communities.

To improve their living conditions, the project entitled Increasing the Resilience of Local Communities to Climate Change through Youth Entrepreneurship and Integrated Natural Resource Management (ACREGIR) launched in 2023 after being initiated by the Government of Cameroon, with financial support from the Adaptation Fund and administration by the International Fund for Agricultural Development. ACREGIR is being executed by several partners including INBAR, with activities being undertaken in three national parks: Waza, Bénoué and Kimbi-Fungom. The aim is to strengthen the resilience of local communities, particularly young people and women, in adapting to climate change by promoting resilient livelihoods and integrated natural resource management on the periphery of these national parks. To achieve this objective, the project relies on two key elements: Eco-entrepreneurship and degraded landscape restoration.

Eco-entrepreneurship: Empowering women and youth to build climate change resilience

Involving women and young people, and ensuring that their knowledge is integrated into climate change resilience strategies, is an effective response to the challenges of poverty and marginalization facing them. The ACREGIR project aims to train eco-entrepreneurs in green project design and business creation in response to the challenges posed by climate change. For INBAR, as an important implementer of the project, it is crucial to create economic opportunities by offering them training, facilitating access to markets and integrating their traditional knowledge into solutions to combat climate change. Between 2023 and 2025, the ACREGIR project trained 1266 eco-entrepreneurs, including 550 women, 716 men and 762 young people. According to Farkang Ngangue, a beneficiary of the eco-business creation training based in the Bawan locality in the Bénoué region, she had never dreamed of obtaining such training, having married at an early age. "This training is an opportunity for me to improve my financial situation by setting up my own nursery to produce bamboo and other non-timber forest products (NTFP) seedlings. I'd also like to give other women hope for their future."

In addition, the project has taken great care to develop a manual on the creation of

Bamboo charcoal is an eco-friendly, economically viable alternative to wood charcoal.

eco-businesses targeting women and young people, entitled *Learner's Manual for the Creation and Management of Eco-Businesses* (*Manuel de l'apprenant base de création et de gestion des éco-entreprises*). This manual is a practical, accessible and inspiring tool for those who have chosen to commit themselves to a more sustainable economy. Representing the fruit of the expert wisdom of players involved in support, incubation and local development, this manual provides concrete methods, tools and advice, adapted to the realities on the ground. It was designed to stimulate the autonomy, rigor and innovation of project leaders, while giving them the keys to translating their ideas into impactful initiatives.

This new dynamic supported by the project enables beneficiaries to build an eco-business based on economic aspects, business plans, leadership, entrepreneurship and citizenship, as well as on training in the legal status of land occupation and the use of natural resources in the intervention zones. And the ACREGIR project doesn't stop there; it supports beneficiaries all the way through to professional integration. Elvis Meh, the project's community relay in the Kimbi-Fungom area, commented, "I really appreciate the initiative of the project. The advantage of being in entrepreneurship is that I can open and control a business through my business plan and also intervene in climate change through agriculture (agroforestry), including tree planting."

By involving women and young people as priority actors in the face of the adverse effects of climate change, the ACREGIR project places particular emphasis on promoting community-based resilience, which aims for community responses to climate change.

Restoring degraded land inside and around national parks

The Far North, North and North-West Regions are experiencing severe degradation of their ecosystems because of climate change and the

intensification of human pressures. Insecurity, flooding, drought and soil infertility are forcing communities to make greater use of the parks, increasing human pressure in and around the regions' national parks

In this context, the ACREGIR project provides a nature-based solution that addresses all the issues present in its intervention zones. The project aims to support the restoration of degraded areas in and around the Waza, Bénoué and Kimbi-Fungom National Parks, and to increase the resilience of ecosystems and riparian communities through reforestation using bamboo, a multi-purpose plant resource. To achieve this, the project is focusing on three key areas: Restoring degraded areas through reforestation in and around the parks; developing income-generating activities (development of the bamboo eco-businesses); and raising awareness among local stakeholders of more sustainable natural resource management practices.

Currently in the third year of the project's implementation, the restoration actions are conclusive. The forest has been restored on degraded land inside and around the parks, thanks to the planting of around 14,500 bamboo seedlings; two natural physical fences with bamboo have been established: A 2-km physical fence in Waza and a 12-km physical fence in Bénoué; three farmer field schools have been created; three nurseries have produced 28,439 plants; and 1136 people including 529 women, 607 men and 394 young people have been mobilized and taught agro-silvo-pastoral practices.

To achieve these results, the project relies on the conservation actors in these parks. Tchakalina Gassissou, Conservator of the Waza National Park, expressed his satisfaction in these words: "The conservation service of the Waza National Park is delighted with the presence of the ACREGIR project, which today is breathing new life into restoration activities by involving women and young people." These groups of people, especially women, often marginally participate in project activities because of their culture and customs. "In this respect, integrating a gender perspective into the project's restoration approach helps to mitigate the effects of climate change, because when land is degraded, women and young people are particularly affected, given their major roles in food production," adds Gassissou.

Local stakeholders have received training on the creation of pro-poor eco-enterprises.

Diverse communities around the three parks were targeted for focused trainings.

Promotion of income-generating activities through capacity building

The strong dependence of communities living near the parks on natural resources, the pressure of all the illegal activities they engage in, such as poaching and deforestation, and the demographic growth linked to internally displaced persons from the Northwest and Southwest crisis and Boko-Haram make it difficult to use resources sustainably. It is important for the project to find alternative solutions to slow down or halt this trend, hence the awareness-raising campaigns linked to the sustainable use of these resources and the introduction of income-generating activities. Within this framework, the project foresees financing sustainable harvesting and local processing of commercially viable NTFPs as well as local nature-based enterprises by 2025, to help bolster community resilience to the impacts of climate change through alternative income generation. To this end, thirty eco-entrepreneurs or eco-businesses will be financed or created.

Going forward

In the future, INBAR, in partnership with key entities such as the Ministry of the Environment, Protection of Nature and Sustainable Development of Cameroon are laying a strong foundation for strengthening the resilience of women and youth to climate change. This includes supporting the development of sustainable bamboo and other NTFP value chains. These value chains stem from the creation of community nurseries, plantations, the processing and commercialization of bamboo, and other NTFPs.

INBAR plans to establish three common production and training centers to provide state-of-the-art machinery and tools to produce high-grade bamboo products for workshops. Another goal is to facilitate the creation of a virtual market through a virtual marketplace, website and mobile application to bring together buyers and eco-entrepreneurs. Integrating these activities will provide a solid path for livelihood enhancement while protecting nature and mitigating the effects of climate change.

RENÉ KAAM

René Kaam is the INBAR Regional Director for Central Africa.

BAMBOO AND CLIMATE CHANGE: FROM CARBON SINK POTENTIAL TO ECOLOGICAL ADAPTATION

Bamboo forest in Wangjianglou Park, Chengdu, Sichuan. Credit: Feng Pengfei.

Bamboo is reshaping climate solutions through its ancient resilience and modern ecological power.

As one of the fastest-growing plants on Earth, bamboo, with its distinctive physiological traits and ecological functions, plays a significant role in addressing climate change. From the potential of bamboo as a carbon sink to the historical shifts in its geographical distribution, the relationship between bamboo and climate is not only a product of natural evolution but also a key factor shaping the sustainable development of human societies.

Carbon sink function: Bamboo forest ecosystems regulating the climate

Bamboo forests exhibit a carbon sequestration capacity that surpasses most conventional forest types. Recent studies have highlighted the unique role of phytolith-occluded carbon (PhytOC) sequestration in bamboo species. Phytoliths are silica structures formed within plant cells. They are capable of encapsulating organic carbon that remains stable in soil for millennia. For example, in the karst regions of southwestern China, research by a team from Guizhou Normal University (Song Lukang, Sheng Maoyin, et al., 2025) demonstrates that the PhytOC stored in soils under *Phyllostachys edulis* (Moso bamboo) and

Bambusa emeiensis forests ranges from 0.30–1.43 t/hm² and 0.81–1.78 t/hm², respectively. When accounting for regional variation, the storage potential reaches 0.30-1.78 t/hm², with mature forests exhibiting the highest carbon accumulation. The elevated available silicon content in karst soils contributes to significantly higher PhytOC stocks in bamboo forests compared to non-karst areas, which underscores the regulating influence of geological conditions on carbon sink capacity. This characteristic of bamboo forests as a "long-term carbon reservoir" positions them as a vital nature-based solution for carbon neutrality strategies.

Furthermore, the rapid growth cycle of bamboo further enhances its carbon sequestration efficiency. Studies indicate that the carbon sequestration capacity of *P. edulis* is about 5.09 t/hm², which is 1.46 times that of Chinese fir forests and 1.33 times that of tropical rainforests. Its extensive rhizome system also promotes soil organic carbon accumulation, forming an integrated carbon sink network from the surface to the underground. However, current research on bamboo carbon sink mechanisms is largely focused on phytolith-associated pathways. How to optimize stand structure through mixed-species plantations, for instance, in order to enhance the performance of overall carbon sequestration remains an area for future investigation.

Historical records: Climate-driven shifts in bamboo distribution

The geographical distribution of bamboo is highly sensitive to variations in temperature and precipitation. Archaeological evidence indicates that during the Yangshao Warm Period, which occurred approximately 3000 to 8000 years ago, bamboo forests were widely distributed across the Yellow River Basin. Findings such as skeletal remains of the bamboo rat (*Rhizomys*) unearthed at the Banpo site in Xi'an and bamboo relics discovered at the Shizhao Village site in Gansu suggest that the mean annual temperature in the northwestern region during that period was 2–3°C higher than present-day temperatures. The northern limit of bamboo distribution extended beyond 35°N latitude. In the verse, "What grows on Mount Zhongnan? There are catalpas and plums" from the "Odes of Qin" section in the *Book of Odes*, an ancient collection of Chinese poetry, "catalpas" refers to *Catalpa bungei*, as interpreted in *Correct Meaning of Mao's Annotations* (*Mao Shi Zheng Yi*). However, in light of archaeological evidence from the Yangshao Warm Period, such as the bamboo rat remains found at the Banpo site, there is reason to hypothesize that bamboo forests may have once extended along the northern slopes of the Qinling Mountains. Until the Qin and Han dynasties, the Guanzhong region was renowned for its extensive bamboo groves, famously referred to as the "thousand mu of bamboo in Weichuan." According to the "Treatise on Geography" in the *Book of Han*, an official position titled Administrator of Bamboo Affairs (*Si Zhu Zhang Cheng*) was established specifically to oversee state-run bamboo plantations, which reflects the significant economic and ecological importance of bamboo forests during that period.

However, as the climate gradually cooled, the distribution of bamboo forests retreated southward. From the Eastern Han Dynasty onward, cold events became increasingly frequent, as indicated by records such as the heavy snowfall in the third year of the Tianfeng Era of the Xin Dynasty. As a result, the northern limit of bamboo shifted southward to the Huai River Basin. The Little Ice Age in the Ming and Qing dynasties further constrained the habitat range of bamboo in northwestern China. Species dependent on bamboo ecosystems, such as the bamboo rat, subsequently disappeared from the Yellow River region. These shifts in distribution not only reflect the selective pressures imposed by climatic fluctuations on native species but also highlight the ecological role of bamboo forests as climate indicators. It is also worth noting that compounded effects of human activity, such as intensive bamboo harvesting and other natural environmental changes may have accelerated the degradation of bamboo ecosystems in certain areas. There are historical records and contemporary ecological studies supporting this.

Future challenges: Adaptation strategies and risk management in a changing climate

In the context of ongoing climate change, bamboo forests are now facing risks and opportunities. On one hand, rising temperatures may enable

Bamboo broken by ice and snow disasters. Credit: Feng Pengfei.

suitable habitats for bamboo to expand into higher latitudes. Model projections suggest that a 2°C increase in temperature could lead to a 15–20% expansion in bamboo forest coverage across China. This expansion is expected to be particularly pronounced in the southwestern karst regions, where silicon-rich soils are likely to support enhanced carbon sink potential. On the other hand, the increasing frequency of extreme weather events, such as droughts and intense rainfall, poses significant threats to the ecological stability of bamboo forests. For example, after unprecedented torrential rain in Henan Province on 20 July 2021, high levels of precipitation led to root rot in some bamboo forests. This incident underscores the vulnerability of bamboo ecosystems to extreme climate-related events.

In response, science-based management has emerged as a critical approach in balancing carbon sequestration gains with ecological resilience. One effective strategy is the development of mixed-species bamboo plantations, which can enhance their ecological resilience. For example, incorporating nitrogen-fixing tree species into Moso bamboo plantations can improve soil fertility while mitigating the impact of extreme rainfall on monoculture systems. In addition, genomics-based adaptive breeding is emerging as a promising direction for future development. For instance, a 2024 study conducted by Zhao Hansheng's team at the Beijing Bamboo and Rattan Science and Technology Key Laboratory of the National Forestry and Grassland Administration analyzed the haplotype-based pangenome of *P. edulis*. Their findings revealed that allelic variations in core genes associated with resilience play a pivotal role in high-temperature adaptation, offering valuable molecular targets for the breeding of heat-tolerant bamboo varieties.

At the policy level, it is essential to establish standards for quantifying carbon sinks and integrate them into carbon trading systems. Pilot projects in China have already demonstrated the feasibility of generating carbon credits through bamboo forest management. However, existing monitoring approaches, including integrated remote sensing and field survey techniques, require further improvements, with critical gaps in baseline data. Historical experience suggests that an overemphasis on bamboo expansion may trigger ecological risks, including biological invasions, so ecological restoration should prioritize native bamboo species to help maintain regional biodiversity and ecological balance.

Conclusion

From the long geological evolution to the urgent climate crises of the present, the relationship between bamboo and climate has always featured the interplay of natural forces and human wisdom. As a species that holds both carbon sequestration potential and powerful cultural symbolism, bamboo concerns not only the preservation of ecosystem services but also epitomizes the coordination between humans and nature as we adapt to a changing climate. The dialogue between science and tradition will require cross-disciplinary, multi-scalar research and practice to sustain the vitality of this "green gold" in a warming world.

FENG PENGFEI

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FEATURED ARTICLE

ROOTED IN RESILIENCE: ADAPTING TO CLIMATE CHANGE WITH BAMBOO

The ARAUCLIMA initiative is harnessing bamboo as a nature-based solution for climate adaptation and green development.

In the face of escalating climate chaos, Latin America is betting on an unlikely hero as a fast-growing force for resilience, regeneration and radical change.

In the hills of Pérez Zeledón, Costa Rica, a farmer named Carlos Castillo walks along the edge of a bamboo grove. The air is cooler under the arching green canopy, and the rustling culms seem to echo the rhythm of change — quiet, deliberate and growing.

Just a few years ago, this land looked different. Depleted soil, erratic rainfall and dwindling water sources marked the beginning of what many rural families in Latin America know too well to be rising climate uncertainty. But today, the area is part of a revolution rooted in one of nature's most surprising allies: Bamboo.

A green answer to a global crisis

Across Latin America and the Caribbean, climate change is no longer a distant threat. Hurricanes are more intense, droughts more frequent and agricultural systems more fragile. Further warming multiplies the risks, especially for communities with fewer resources to meaningfully adapt. Yet in the face of these mounting pressures, an ancient plant is offering modern hope.

Since 2023, INBAR has been working with the Spanish Agency for International Development Cooperation (AECID) to implement the Regional Bamboo-Based Solutions project across Costa Rica, Panama, Cuba and the Dominican Republic, with the support of best practices from Colombia, Ecuador and Perú. Funded through AECID's ARAUCLIMA program, the initiative harnesses bamboo as a nature-based solution that can boost climate adaptation and economic development.

Costa Rica: A living laboratory of possibility

At Finca La Esperanza, Carlos Castillo's 10-hectare farm has become a living example of climate-smart land management. With the help of the project, he planted five species of bamboo over one hectare, aiming to produce sustainable construction materials and diverse, high-quality products.

Beyond just generating new income streams, bamboo also acts as a powerful soil stabilizer and water protector. One half-acre section of the farm was planted near a vulnerable spring. The dense root systems of the bamboo are helping stabilize the soil, prevent erosion and filter water while it recharges the aquifer. In the dry season, the area is now home to greener foliage and clearer water.

But it's not just about the environment. The initiative has brought new roles for women and youth, who are participating in training, production and value chains that once excluded them, but now embrace them. Bamboo, therefore, can also play a role as a powerful catalyst for inclusion.

Another key farm activity is the production and management of edible bamboo shoots. Across five hectares, bamboo is carefully managed through selective harvesting, pruning and the use of organic fertilizers, boosting production. These shoots offer not only a nutritious food source but also an economic opportunity because they can be harvested sustainably and marketed locally. Edible shoots represent a new viable agroecological practice that combines food security with biodiversity protection and income diversification.

Cuba: Turning smoke into sustainable energy

Hundreds of kilometers away, in the quiet town of Viñales, Cuba, another transformation is taking place. It is here, at the Institute of Agroforestry Research, a group of farmers, researchers and technicians gather around a curious contraption: A rocket stove, modified to burn bamboo charcoal.

This pilot demonstration, supported by Brazilian experts from São Paulo State University and INBAR, is more than an experiment in clean cooking. It represents a prototype for advancing

Cooking on a rocket stove with bamboo charcoal.

INBAR works with communities to map and explore the sustainable utilization of their bamboo resources.

green energy in a country where traditional charcoal production often contributes to deforestation. The team harvested 10 culms of dry bamboo, carbonized them using a simple but efficient tank system and tested the resulting charcoal alongside traditional oak charcoal. The outcome? The bamboo charcoal heated water faster, burned more cleanly and emitted less smoke. If scaled up, bamboo-based energy could reduce pressure on native forests, cut household air pollution and offer a renewable energy source for rural communities.

Learning together: Bamboo field schools

One of the most powerful aspects of the project lies not in planting, but in sharing. Through the Bamboo Farmer Field Schools (ECA Bambú), more than 500 producers across the four countries have learned to propagate, manage, harvest and process bamboo. They've also been trained in climate-smart practices like agroforestry, riverbank restoration and water source protection.

These schools are more than classrooms. They have become shared spaces of collective innovation, where tradition meets technology, and where resilience is cultivated.

A vision spreading its roots

The story of bamboo in Latin America is still being written. But what is already clear is that this plant is revealing to us the myriad ways in which nature can be an integral part of the solution.

Through targeted demonstrations, South-South cooperation, and an unwavering belief in local knowledge, the Regional Bamboo-Based Solutions project is cultivating more than groves of green stalks. It is nurturing ecosystems, empowering communities and helping to draw up a blueprint for what adaptation can look like when guided by sustainable principles.

As climate risks accelerate, perhaps the world would do well to listen to the rustling leaves of bamboo and follow their steady growth skyward.

PABLO JÁCOME ESTRELLA
Pablo Jácome Estrella is the INBAR Regional Director for Latin America and the Caribbean.

Collating the latest international news and activities around bamboo and rattan sectors development

Bamboo straws made of small-diameter round bamboo culms or branches. Credit: International Centre for Bamboo and Rattan.

New durable bamboo straws

Researchers from the International Centre for Bamboo and Rattan in China have developed biodegradable bamboo drinking straw as a sustainable alternative to plastic straws. Made from ultra-thin slices of Moso bamboo treated with a specialized soaking and ultrasonic process, these straws exhibit high tensile strength, flexibility and durability. Compared to paper and PLA straws, they demonstrate superior mechanical properties, including greater compressive and bending strength, while maintaining their integrity in various beverages. Their production cost is also remarkably low, making them a viable and eco-friendly option for large-scale adoption.

Consumer testing has shown strong approval for bamboo straws, with over 90% of surveyed beverage shop customers expressing satisfaction. Unlike paper straws, they absorb significantly less water and retain much higher wet strength, enhancing their usability. Given their low cost, durable nature and high level of consumer acceptance, bamboo straws have the potential to replace traditional plastic straws and contribute to reducing global plastic pollution.

Source: Fox56news, 31 March s

Fighting climate change with bamboo

Kenya is embracing the cultivation of bamboo as a powerful instrument to fight climate change, strengthen rural livelihoods and restore degraded landscapes, with an ambitious target to increase forest cover from 12.13% to 30% by 2032. The government is urging citizens to plant

at least 50 trees per person, and bamboo is being hailed as a sustainable and fast-growing solution, despite being technically classified as a grass. Bamboo matures quickly, produces multiple culms and offers a range of benefits, including erosion control, water purification and generating an alternative income source. This is especially important for tea farmers in areas like Kiambu who have been adversely affected by fluctuating crop prices.

In addition to its environmental advantages, bamboo supports local economies and women's empowerment by boosting up smaller cottage industries. Organizations like Back to Basics are helping women make and sell bamboo-based products, turning the plant into a pathway for economic growth. Bamboo's high carbon sequestration capacity at 30% more than broad-leaf trees also makes it a key plant resource for lowering Kenya's carbon footprint. Experts from the Kenya Forest Research Institute stress bamboo's role in land restoration and recommend strategic planting at 5-by-5-meter intervals to allow space for native trees, reinforcing bamboo's potential in sustainable reforestation and climate mitigation schemes.

Source: africanews, 4 April

Why don't pandas eat more meat?

Chinese researchers have discovered a potential explanation for how giant pandas, despite having digestive systems typical of carnivores, subsist solely on a bamboo-based diet. The key may lie in plant-derived microRNAs (miRNAs) that pandas absorb through food. These small RNA molecules have been found in the blood samples of pandas of different ages and sexes. It is believed that they can influence gene expression connected to feeding habits, sense of taste and smell and even dopamine pathways. This adaptation may help pandas identify and seek out fresh, nutritious bamboo, supporting their plant-based diet despite their carnivorous ancestry.

The study not only highlights the role of bamboo-derived miRNAs in helping pandas adapt to their diet but also opens new research avenues. The fact that plant miRNAs can enter an animal's system and affect gene expression may have potentially wider implications, such as in improving disease resistance or assessing the safety of plant-based diets for animals and humans. Researchers hope to further study younger pandas that have not yet consumed bamboo to better understand how miRNA exposure shapes these developmental adaptations over time.

Source: Frontiers, 28 February

Workshop empowers women through bamboo cultivation

Odisha State in India is making strategic efforts to empower women farmers by promoting bamboo cultivation as a sustainable and economically viable livelihood. A state-level workshop held in Bhubaneswar emphasized the role bamboo farming can play in uplifting women, particularly through the Lakhpati Didi program, which aims to financially empower 100,000 women. Inaugurated by Deputy Chief Minister Pravati Parida, the workshop showcased how bamboo-based industries could offer major economic opportunities for women entrepreneurs, leveraging Odisha's favorable climate and natural resources.

The event brought together diverse stakeholders from the Odisha Livelihood Mission, Industree Foundation, and other organizations to train participants in various facets of bamboo farming, ranging from planting and processing to marketing, export strategies, and sustainability practices like carbon credit monetization. Interactive sessions also went over plantation techniques, innovations in design and collaborations with national programs. With active involvement from self-help group leaders and rural program stakeholders, the workshop marks a key step for transforming Odisha into a hub for bamboo-driven, women-led rural economic development.

Source: Pragativadi, 26 April

INBAR commissions research, conducts project work and raises awareness about bamboo and rattan across its 52 Member States.

Workshop on bamboo nursery establishment that took place in Cameroon in late 2024 as part of the PADFAII-INBAR initiative.

Bamboo-based solutions transforming a region

The Regional Bamboo-Based Solutions project is a collaborative effort led by INBAR and the Spanish Agency for International Development Cooperation (AECID), aimed at using bamboo as a nature-based solution to combat climate change in Costa Rica, Panama, Cuba and the Dominican Republic. Since 2023, the initiative has focused on enhancing the resilience of rural communities by integrating bamboo into national policies, fostering research and promoting sustainable management practices. The project builds on lessons from Colombia, Ecuador and Peru, adapting successful strategies to the participating countries. Key components include governance improvements, training programs, demonstration models and cross-border knowledge exchange, all working together to elevate bamboo's role in sustainable development.

This initiative has already made a significant impact, with national bamboo networks established, policies revised and over 360 producers trained in sustainable bamboo management. Demonstration sites in all four countries showcase bamboo's versatility in construction, soil restoration and agrotourism. Regional exchanges and events have also significantly strengthened cooperation, enabling participants to explore innovative bamboo applications. The project ultimately exemplifies how strategic partnerships and South-South collaboration can drive environmental resilience, positioning bamboo as a vital resource for climate adaptation in Latin America and the Caribbean.

From seeds to success, bamboo nurseries spread across Cameroon

The ACREGIR project, led by INBAR, is making significant strides in restoring degraded landscapes and improving livelihoods in Cameroon's Far North Region—a region severely affected by desertification, flooding and an influx of refugees. Launched in 2023, the initiative focuses on establishing bamboo nurseries around the national parks of Benoué and Waza, aiming to

reverse land degradation while promoting eco-entrepreneurship, particularly among women and youth. Through the creation of three nurseries and the production of over 30,000 bamboo plants, the project has empowered local communities with training, resources, and sustainable income opportunities, positioning them as stewards of their environment.

With strong community support and a gender-sensitive approach, the ACREGIR project addresses both ecological and socio-economic issues. Women comprise 55% of participants, playing a vital role in restoration efforts and benefiting from income-generating activities. The project also enhances the protection of national parks by using bamboo as natural barriers and training communities in bamboo domestication. As enthusiasm for the nurseries grows, INBAR plans to expand production and deepen collaboration with local stakeholders. After just one year, ACREGIR has demonstrated the transformative potential of community-based, nature-driven solutions in combating climate change and fostering sustainable development.

Capacity-building workshop empowers stewards to better serve communities

In celebration of Women's Rights Month, the ACREGIR project hosted a two-day capacity-building workshop in Cameroon aimed at empowering community stewards with gender-transformative knowledge and practices. Held in collaboration with stakeholders including INBAR, the Commodity Value Chain Development Support Project – Phase II (PADFA II), and the International Union for Conservation of Nature, the workshop brought together 26 participants from Kimbi-Fumgom, Waza and Bénoué National Parks. The event focused on raising awareness about gender issues, encouraging inclusive practices in fieldwork, and integrating gender considerations into all aspects of community development. Participants engaged in discussions on youth engagement, indigenous inclusion, and the risks of overlooking gender equity in project activities.

The workshop emphasized the importance of tackling structural barriers such as entrenched social norms and highlighted the need for institutionalizing gender-sensitive practices. Real-world success stories were shared, including female participation in Bénoué's cooperative nursery efforts, while also addressing ongoing challenges, particularly in Kimbi-Fumgom, where traditional beliefs hinder women's involvement. Speakers underscored the importance of collective action and continuous learning to promote gender equality and improve community resilience. Participants left the workshop equipped with practical tools and a renewed commitment to fostering inclusive, community-driven development that uplifts women and vulnerable groups.

Bringing bamboo to Cameroon's smallholders

A recent initiative in Cameroon, spearheaded by INBAR and PADFA II along with support from the International Fund for Agricultural Development, is striving to bring bamboo to the forefront of sustainable agriculture. Through a series of training workshops held in late 2024, smallholder farmers across the North, Far North, West and Northwest learned about bamboo nursery establishment, propagation techniques and integration into agroforestry systems. Aimed primarily at rice and onion farmers vulnerable to climate change and post-harvest losses, the workshops emphasized bamboo's versatility in environmental protection and income generation. Participants gained hands-on experience in nursery establishment, propagation methods, plantation development and agroforestry integration. There was also knowledge exchange facilitated by successful cooperatives, bringing additional experience to the workshop.

The training sessions were attended by 76 participants, including many women and youth. Overall, the sessions highlighted bamboo's latent potential to reduce post-harvest losses, generate income and strengthen climate resilience. Farmers were enthusiastic about the prospect of using their new skills in pursuit of bamboo-based solutions like drying racks and pallets. This utilization would have the important knock-on effect of reducing pressures on local wood resources and mitigating deforestation. But beyond only improving agricultural productivity, the initiative is also expected to create resilient green jobs and foster

A Flag-Raising Ceremony for the Dominican Republic was held at INBAR Headquarters on 22 May.

community-driven stewardship of the natural environment. In the future, the program plans to grow through expanding and upgrading farmer field schools, advanced bamboo product training, income diversification and study tours to deepen knowledge sharing and amplify impacts across rural communities.

Spanish Ambassador to Ecuador and AECID visit Manabí to review bamboo projects

On 6 May, the Spanish Ambassador to Ecuador, H.E. Enrique Yturriaga Saldanha, alongside representatives from AECID, visited Manabí to review bamboo-based development projects supported by Spanish Cooperation since 2018. Led by INBAR, these initiatives promote sustainable development through bamboo, focusing on green economy goals, post-COVID recovery, and building local capacities. The delegation toured several projects, including sustainable bamboo forest management, technical training schools for bamboo construction, a bamboo processing center and model bamboo-roofed housing. The visit highlighted how these commendable projects have empowered local communities and contributed to economic and environmental resilience in the province.

The Spanish delegation praised the progress of these initiatives and emphasized bamboo's value as a tool for sustainable and inclusive development. Ambassador Yturriaga noted bamboo's role in advancing the circular economy and sustainability goals central to Spanish Cooperation, while AECID Country Coordinator Elena Palomar commended the comprehensive bamboo value chain and the growing participation of women entrepreneurs. INBAR's Regional Director Pablo Jácome Estrella reaffirmed the organization's long-term commitment to the region. The visit concluded with a shared optimism about the power of international collaboration, technical education and bamboo as a catalyst for climate-resilient, community-driven development in Manabí.

Flag-Raising Ceremony for the Dominican Republic held in Beijing

On 22 May, a Flag-Raising Ceremony was held at INBAR Headquarters in Beijing to celebrate the accession of the Dominican Republic to the INBAR family. The event was part of the 13th INBAR Council Session and featured remarks from high-level representatives, including the Minister of Forests and Environment of Nepal, Chinese forestry officials and the Dominican Ambassador to China. Speakers highlighted the importance of bamboo and rattan in promoting sustainable development, enhancing ecological resilience and creating economic opportunities. They noted

the Dominican Republic's strategic commitment to sustainable resource use and emphasized the potential for expanded cooperation, particularly under global frameworks like the Global Development Initiative and Belt and Road Initiative.

The Dominican Republic's entry into INBAR marks a significant step toward advancing bamboo and rattan development in Latin America and the Caribbean. The country pledged to incorporate these resources into national development policies, promote green investment and collaborate on public policy and technological exchange. The 13th INBAR Council Session convened after the ceremony, with Panama elected as the next Chair and Uganda as Vice-Chair. This session had the highest participation in INBAR's history, reinforcing the organization's growing global influence and commitment to sustainable development through international collaboration. INBAR reaffirmed its mission to support green, low-carbon growth by continuing to foster South-South cooperation and expanding its global partnerships.

INBAR showcases bamboo and rattan for green development at SARA 2025

From 27 to 31 May, INBAR showcased the potential of bamboo and rattan as sustainable resources at the 7th Salon International de l'Agriculture et des Ressources Animales in Côte d'Ivoire. Invited by the Ministry of Water and Forests, INBAR's booth featured 37 bamboo and rattan products, including eco-friendly alternatives to plastics and textiles, emphasizing their relevance to the country's Forest Products Valorization Strategy (SVPF) and broader green development goals. The exhibit attracted high-level attention, including a visit from Minister Laurent Tchagba, and received media coverage highlighting strong public interest in sustainable materials.

During a panel discussion on opportunities within the SVPF, INBAR's Regional Director for Central Africa, Rene Kaam, outlined bamboo and rattan's value in economic diversification, job creation and environmental protection. He also identified key obstacles hindering the sector's growth in Côte d'Ivoire, such as weak structural organization and limited technical capacity. To overcome these, INBAR proposed policy recommendations including the development of a national bamboo and rattan strategy, increased technical training, improved research efforts and support for public-private partnerships. The organization also used the event to advance dialogue on Côte d'Ivoire potentially joining INBAR, underscoring the role of regional collaboration in promoting sustainable forest management.

Joint workplan signed by Cameroon's Ministry of Employment and Vocational Training and INBAR

On 22 May, Cameroon's Ministry of Employment and Vocational Training and INBAR formalized a joint workplan to strengthen vocational training and promote eco-entrepreneurship in bamboo and rattan sectors. This agreement builds on their long-standing partnership and supports the ACREGIR project, which aims to increase climate resilience through youth entrepreneurship and sustainable natural resource management. The workplan targets vocational centers in Mora, Dschang and Gamba, providing them with modern equipment and training aligned with market needs, while also enhancing the economic value of bamboo and rattan in local communities.

The initiative focuses on equipping training centers to benefit youth and women, fostering the growth of bamboo and rattan-based eco-enterprises. The agreement also emphasizes the need to secure additional funding to sustain these efforts long-term. During the ceremony, INBAR's Central Africa Director René Kaam reaffirmed the organization's commitment to Cameroon's national bamboo and rattan strategy, while Minister Issa Tchiroma Bakary highlighted the partnership's role in modernizing vocational education. Attended by senior government officials and international partners, the signing marked a strategic step forward in advancing sustainable development and employment opportunities through green innovation in Cameroon.

Bamboo Genomics: Driving Global Sustainable Development and the Bamboo as a Substitute for Plastic Initiative

Plastic waste and climate change are global threats. Over 430 million tons of plastic are produced annually, with 36% used for single-use products and less than 10% recycled. Climate change is also destabilizing ecosystems. Bamboo is an appealing alternative. It grows rapidly, breaks down naturally and absorbs about 5.1 tons of CO_2 per hectare per year — more than fir forests. Bamboo products also emit only 20% of the carbon footprint of plastics. These characteristics make bamboo a strong candidate for both carbon reduction and pollution control. Yet progress has been limited by a lack of genomic understanding. The recent pangenome published by Hou et al. (2024) sheds light on the genetic basis of bamboo's climate adaptability, offering a scientific foundation for the future of the Bamboo as a Substitute for Plastic (BASP) Initiative.

Why bamboo matters—Ecologically and economically

Often called "green gold," bamboo contributes to both ecosystems and economies. It supports carbon storage, prevents soil erosion and sustains forest biodiversity. Countries now include bamboo in their carbon neutrality goals under the Paris Agreement. Economically, bamboo's impact is increasing. China's 7.5 million hectares of bamboo forest generated USD 75 billion in 2023, creating 15 million jobs. Bamboo-based materials are expanding into construction and packaging, replacing up to 50% of single-use plastics in some countries. The BASP Initiative is now gaining global policy attention as a dual-purpose solution.

Genomic breakthrough

Hou et al. (2024) created the first haplotype-resolved pangenome of Moso bamboo, revealing rich genetic variation. Unlike traditional genomes that only contain information from a single individual, a pangenome includes the genetic information from almost all individuals of the species. This approach reveals hidden genetic diversity and help researchers better identify genes that influence important traits in bamboo. Enabled by the pangenome, over 1000 variants linked to climate traits, such as temperature and rainfall tolerance, were identified. Populations in western and northern China were found to be especially vulnerable. This genetic map provides a tool for adaptive conservation, placing the right bamboo in the right environment, and helps breeders develop resilient, high-yielding varieties.

Using genomics to shape bamboo's future

- **Better breeding techniques**
  Traditional bamboo breeding takes a long time. Now, with this pangenome, scientists can quickly find genes that influence important traits like fiber strength and growth speed. This allows them to develop bamboo varieties that are better suited for industrial uses, especially for plastic-substitute applications.

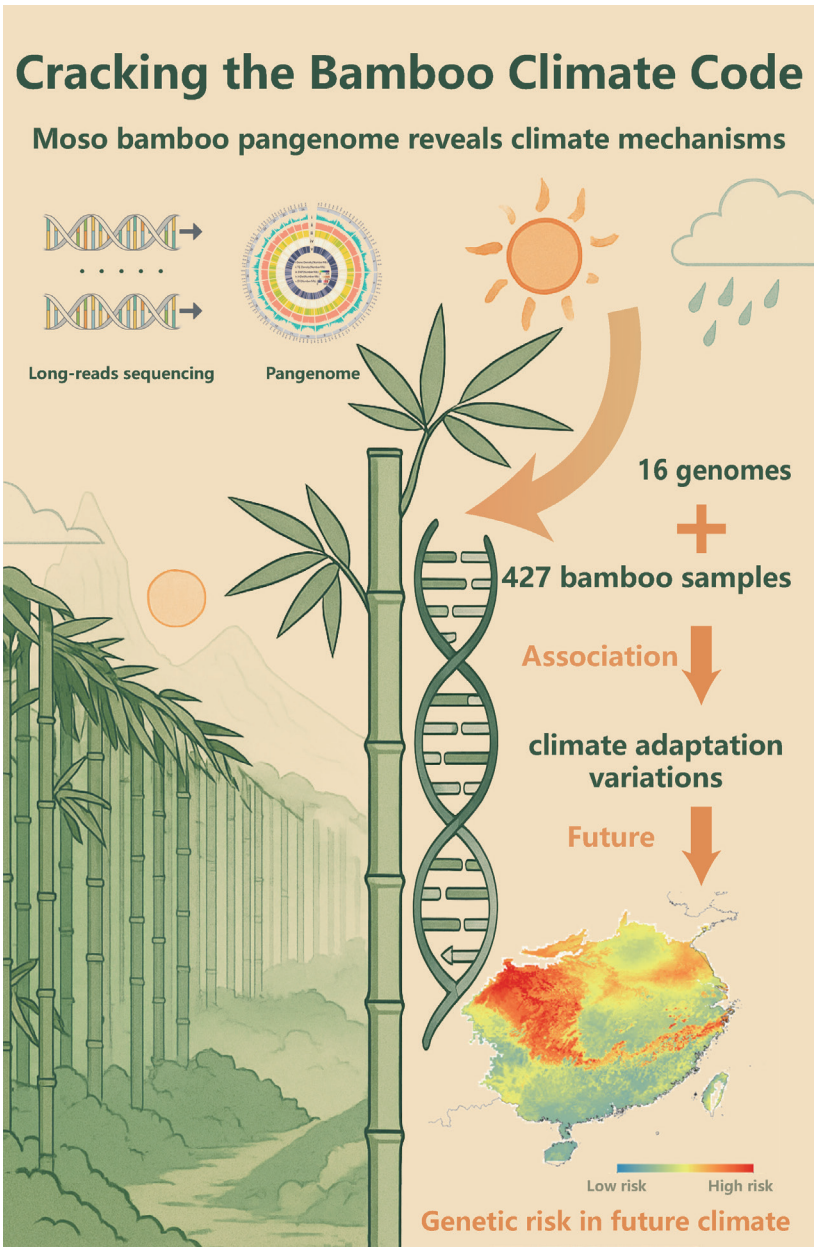
- **Adapting to a changing climate**
  The genetic data helps predict how bamboo will respond to future climate conditions. Farmers and land managers can use this information to plant varieties that are more likely to survive drought, heat or other stresses. This helps make bamboo production more resilient and efficient.

- **Protecting global bamboo diversity**
  To keep bamboo strong and healthy for the future, we need to protect its genetic diversity. This means storing seeds and plants in gene banks, tracking genetic variation over time and sharing data globally. Countries should prioritize sequencing important native species, such as *Oxytenanthera abyssinica* in Africa and *Guadua angustifolia* in Latin America. Organizations such as INBAR will be critical to this collaborative endeavor.

What comes next

The real power of bamboo lies at the intersection of science, policy and markets. To fully realize its potential:

- **Policymakers** should include genetic monitoring in forestry plans and offer



Pangenomes can help reveal the full breadth of genomic variation across bamboo populations.

incentives for using bamboo in plastics replacement.

- **Researchers** must continue to explore how bamboo's DNA shapes its growth and environmental benefits and measure the social and economic impacts of the bamboo sector.

- **Global partnerships,** especially under the BASP Initiative, need to share data, funding and technology so that all bamboo-growing countries can benefit.

When science and policy move together, bamboo can become a strategic weapon in the fight against climate change and plastic pollution. Studies like Hou et al. (2024) give us the roadmap to grow, protect and use bamboo with greater wisdom, transforming this fast-growing grass into a global engine for sustainable development.

This Comment was co-authored by Shyam K. Paudel, Ximena Londoño, and Maxim Lobovikov.

Genetic Code of *Phyllostachys Edulis*: Unlocking Climate-Resilient Survival Wisdom

Phyllostachys edulis, or Moso bamboo, is an ecologically and economically significant bamboo species found across East Asia. It plays a critical role in carbon fixation and climate change mitigation. However, global warming is putting the plant at serious risk.

Recently, a research team investigated how Moso bamboo adapts to its environment by studying its genes, examining the underlying mechanism of genetic variation and climate adaptation in the *P. edulis* population by constructing haplotype pangenomes. Researchers selected 16 representative Chinese *P. edulis* varieties and carried out detailed genome sequencing, generating 1.03 terabytes of data and assembling 16 high-precision genome assemblies, including three at the chromosome level.

Using these data, the team predicted over 54,000 protein-coding genes, finding that 92,506 genes existed in a biallelic form and identifying 8,090 as monoallelic genes. The research further identified short variations and structural variations through graph-based pangenomic models. They discovered that approximately 97% of heterozygous variations resided between haplotypes rather than between varieties. This suggests that earlier traditional studies may have overestimated the genetic diversity among different varieties.

The researchers grouped the *P. edulis* genes into four categories: Core genes, soft core genes, dispensable genes, and private genes. It was found that core genes were universally present in all varieties, with their gene length and expression level significantly higher than private genes, and in most cases, the functions of core genes involved stress resistance, disease resistance and DNA repair, underscoring their crucial role in environmental adaptation. By analyzing allele-specific expression, the team identified 16,317 genes closely related to climate response. These genes displayed excellent tissue-specific functions such as wax synthesis of leaves and biosynthesis of stem cell walls. Partial differential gene expressions were driven by structural variations between haplotypes.

This study marks the first time scientists have built a complete haplotype-based pangenome for *P. edulis*. Moreover, it reveals how genetic differences within the plant help it adapt to environmental stress. The height variation between haplotypes provides the *P. edulis* population with genetic potential to cope with environmental changes, while the stable expression of core genes enables the *P. edulis* population to maintain its basic physiological functions. These findings offer a scientific basis for the conservation of *P. edulis* resources, the development of stress-resistant cultivars and the formulation of climate change mitigation strategies in the future.

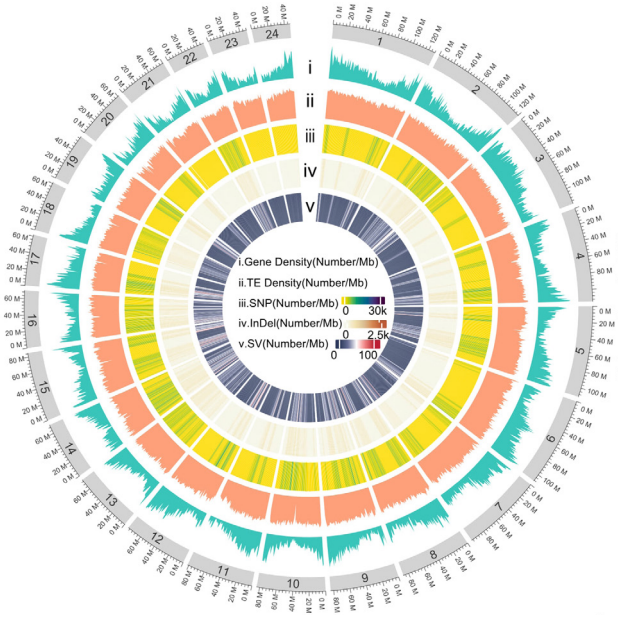


Figure 1 Characteristics of genetic variations in the P. edulis pangenome. *Credit: Hou et al. (2024).*

Summary of article published by Hou, Y., Gan, J., Fan, Z., Sun, L., Garg, V., Wang, Y., Li, S., Bao, P., Cao, B., Varshney, R., and Zhao, H. Haplotype-based pangenomes reveal genetic variations and climate adaptations in moso bamboo populations. *Nature Communications*, 15, 8085, September 2024.

EVENTS

9-11 April
Africa Regional Forum on Sustainable Development
Kampala, Uganda

22 April
International Mother Earth Day

5-9 May
20th session of the UN Forum on Forests
New York City, United States

22 May
International Day for Biological Diversity

22-24 May
European Bamboo Expo 2025
Dortmund, Germany

5 June
World Environment Day

8 June
World Oceans Day

17 June
World Day to Combat Desertification and Drought

17-20 June
6th International Conference on Bio-Based Building Materials

For more information, please see INBAR's event page: https://www.inbar.int/events/.

Production of bamboo seedlings Bambusa vulgaris *in Maranhão (Northeast Region), Brazil. Credit: Irrimar Agroflorestal.*

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