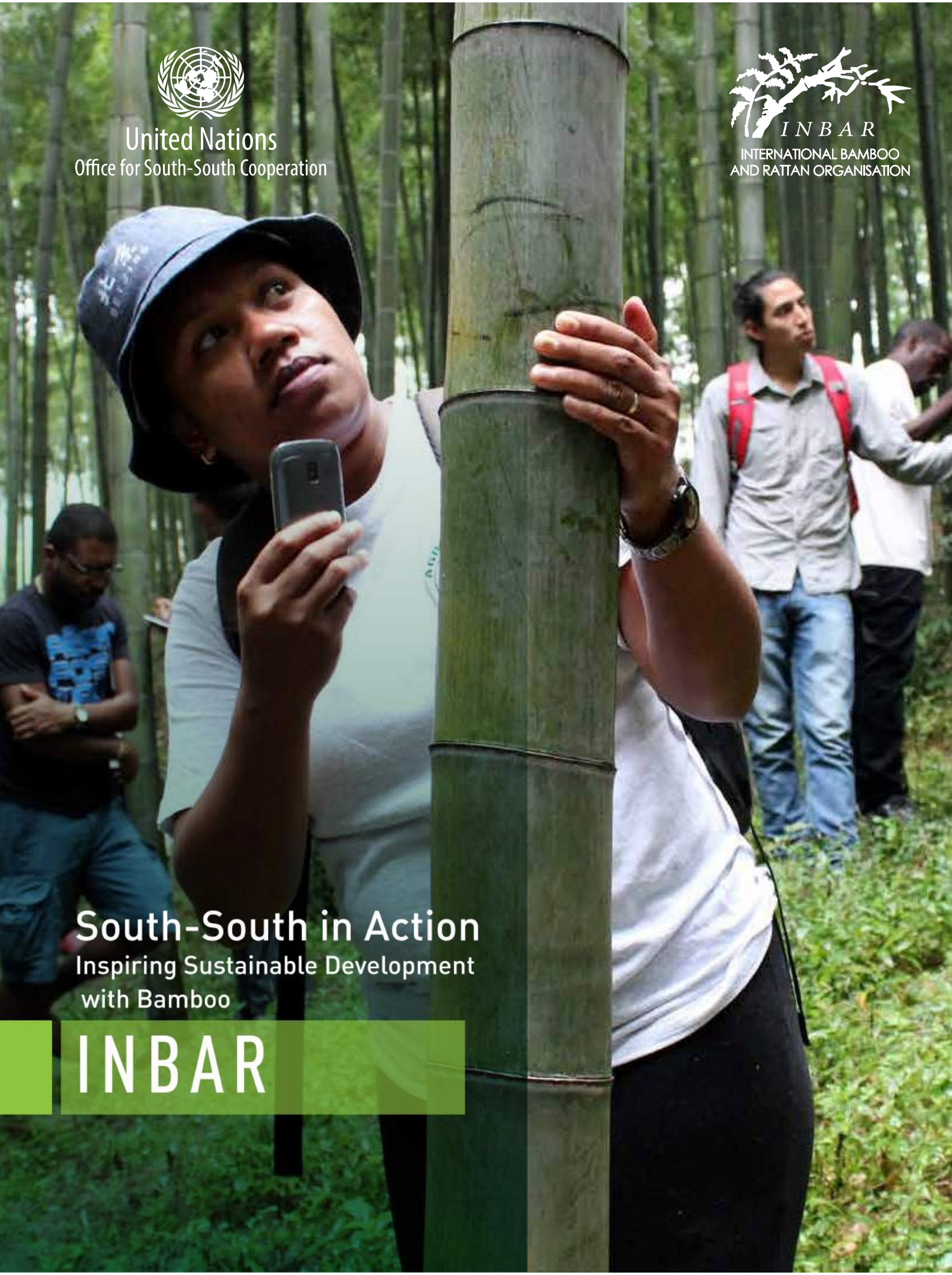
United Nations
Office for South-South Cooperation
INBAR
INTERNATIONAL BAMBOO
AND RATTAN ORGANISATION
South-South in Action
Inspiring Sustainable Development
with Bamboo
INBAR

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South-South in Action

Inspiring Sustainable Development With Bamboo

INBAR

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Abbreviations

CIBART	Centre for Indian Bamboo Resource and Technology
CFC	Common Fund for Commodities
COP	(UN) Conference of the Parties
FAO	Food and Agriculture Organization of the United Nations
GABAR	Global Assessment for Bamboo and Rattan
ICBR	International Center for Bamboo and Rattan
IDRC	International Development Research Centre
IFAD	International Fund for Agricultural Development
INBAR	International Bamboo and Rattan Organisation
ISO	International Organization for Standardization
NGO	Non-governmental organization
SDGs	Sustainable Development Goals
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
UNOSSC	United Nations Office for South-South Cooperation

Foreword

The International Bamboo and Rattan Organisation (INBAR) is a unique multilateral international organization. It is the only intergovernmental organization that focuses on bamboo and rattan – two groups of plants that grow naturally in the tropical belt, though bamboo grows in some sub-tropical areas too. It is also a network because it represents 43 countries of which 42 are from the global South. INBAR has evolved from the International Development Research Centre's (IDRC) Bamboo and Rattan Research Network in Asia that dates back to 1984. Thus, INBAR always was, and still remains, a network for South-South cooperation.

The knowledge about bamboo, its propagation, its management, its products and applications, are with one or another INBAR member State. The role of the Secretariat is to help facilitate exchange of this knowledge. In most projects, whether national, bilateral or multilateral, which are in one or more countries in the South, experts may come from another INBAR member State. This is true for INBAR staff as well, most of whom are from the South.

This is the raison d'étre of INBAR; the network was set up at a time when individual countries of the South were not able to deliver change based on the promise of bamboo for development. Moreover, the knowledge in a particular country often remained confined to the experts in that country, as there was no established means of sharing this information, and there was initially no expressed need to learn from each other.

China, the global powerhouse of bamboo and a developing country of the South, started growing economically in the 1980s, when the IDRC Bamboo and Rattan Research Network began growing as well. Now China is the major supporter to INBAR in economic, administrative and political terms, besides dominating global trade on bamboo products.

At that time, many countries did not know where to look for bamboo expertise; as a result several countries founded INBAR. INBAR is the institution that helps them connect the dots and assists in building strategic South-South cooperation partnerships. INBAR knows who knows what, and where the experts are based; it is a knowledge repository which its members can access; it provides training and facilitates field trips to bamboo development areas; it produces value-added policy briefs, working papers and other publications. INBAR is the honest broker of bamboo in the South, for the benefit of the South.

INBAR also helps to source funding where this is a constraint, and has carried out strategic and adaptive research in one or more member States to solve specific problems that have been flagged.

And because the global South founded INBAR, it was possible for them to realize the benefits from the Common Fund for Commodities by virtue of INBAR becoming the International Commodity Body on bamboo. INBAR's Council of member States and the Board of Trustees also spearheaded the development of relevant International Organization for Standardization standards and Harmonized System of custom codes for bamboo products which benefit its member States.

INBAR embodies South-South cooperation. Country-to-country bilateral cooperation is valuable for very many reasons, but a multilateral framework for facilitating South-South cooperation, like INBAR, can produce so much more added value. Has it worked? Twenty years is a relatively long time, and the following chapters

provide a reflection on the many achievements and success stories that can be attributed to INBAR member States and the Secretariat.

During this period, considerable capacity has been built up in many of the INBAR member States; many countries now know which other country knows and does what, and so INBAR does not need to carry on with some of the functions that were important when it was established 20 years ago. Although it has not really dropped anything, INBAR has refocused to position bamboo on the regional and global policy agenda as an important tool for addressing some of the most pressing problems the world is facing. Bamboo can help countries to reach their sustainable development goals, their Aichi Targets and their nationally determined contributions under the Paris Agreement on Climate Change. The INBAR Secretariat will continue to help its member States in this quest, and to position INBAR as an international development organization that plays an important role in the 2030 Agenda for Sustainable Development as detailed in this publication through South-South cooperation in the bamboo sector.

Hans Friederich

Director General
INBAR

Foreword

Launched in 2016, South-South in Action (SSiA) is one of UNOSSC's flagship reports. It is a space for our partners, including United Nations Member States, fellow United Nations entities, intergovernmental organizations, and civil society, to share their successful South-South and triangular cooperation activities. Through this series, we are creating a repository of best practices, case studies, and lessons learned that can be shared across the South, and from the South to the North.

I am pleased to present this latest edition developed in partnership with the International Bamboo and Rattan Organisation (INBAR). INBAR is an intergovernmental organization established by, and primarily comprised of, member States from the global South. It is, therefore, a perfect vehicle for promoting and supporting South-South cooperation and triangular cooperation because it was designed from the start as a platform for mutual demand-driven South-South learning and exchange. I extend my thanks to the staff of INBAR for their hard work preparing this publication.

At its heart, South-South cooperation is an acknowledgement that no one country, region or group of people hold a monopoly over knowledge and experience. Rather, it is only through acknowledging and celebrating our diverse and unique advantages that we will be able to meet the ambitious development goals that the international community has committed to achieving.

South-South cooperation celebrates the important contributions that have emerged from the developing world. These contributions – be they programmes, policies, technologies, or solutions – have grown from local knowledge, making use of local and contextually appropriate products. One such product – indigenous to many countries of the South – is bamboo.

I must admit that until our organizations began collaborating, I had no idea of the multitude of ways in which bamboo and rattan contribute to sustainable development efforts.

As the cases elaborated in this edition of SSiA make clear, bamboo has an important role to play in inspiring action and enabling development. Amongst many other benefits, through bamboo we can provide local employment opportunities, empower women, and contribute to adapting to and mitigating the impacts of a changing climate. I congratulate INBAR on their two-decade long contribution to South-South cooperation.

The cases presented in this publication represent an astonishingly diverse selection of ways in which one product – grown cheaply and abundantly in the South – can contribute to a better and more inclusive future. It is a reminder that often everyday products can inspire amazing actions.

Jorge Chediek
Envoy of the Secretary-General
on South-South Cooperation
and Director, United Nations Office
for South-South Cooperation

Introduction

Bamboo is a fast-growing, highly renewable resource which covers large parts of the tropics and sub-tropics in the global South. There are an estimated 31.5 million hectares of bamboo distributed across Asia and the Pacific, Australasia, Africa, the Americas and the Caribbean (FAO, 2010).

As well as being widely distributed, bamboo is also very varied: there are over 1600 bamboo species (Vorontsova et al. 2016), and two kinds: clumping bamboos (those that grow in tropical areas) and running (which grow in sub-tropical areas). All bamboo species are botanically a grass, although many are tall-statured and woody like trees, and grow much faster than trees.

Bamboo lends itself naturally to South-South cooperation: the plants grow throughout the tropical belt in all continents and there is the millenia-long history of bamboo use in several INBAR member States. There is much to share and there are common needs.

This introduction gives an idea of bamboo's wide range of applications, and what makes it such a powerful resource for the world.

A Key Part of Biodiverse Ecosystems

Bamboos are an essential part of biodiverse landscapes. They are a primary source of nutrition for the giant panda in China and the mountain gorillas in Uganda and Rwanda; they provide shelter, food and habitats for many animals across the world; as products, they also offer an alternative material to traditional hardwoods, thus reducing pressure on forest resources and primate habitats (INBAR, undated).

Often described as 'vegetal steel', 'green gold' or 'the wise man's timber', bamboo is a very strategic non-timber forest product

Bamboo can be a nutritious source of fodder

In their natural environment, bamboos have an important role protecting river banks and slopes of watersheds from erosion. Their extensive rhizome systems can bind soil, storing carbon and enabling it to hold more water. Bamboos are also resilient plants which can withstand difficult conditions, including fire and drought. Because of these unique characteristics, countries like Brazil, China, Ethiopia, the Philippines and Rwanda have been using bamboo for years as a means to manage soil and water.

Bamboo's ability to bind soil is particularly evident in places where land has been degraded. This was illustrated during a land restoration programme in Allahabad, India, and surrounding areas, where bamboo restored 85,000 hectares of infertile land to productivity. Within ten years of planting, bamboo was adding eight inches of humus to the soil annually and had raised the water table by over 15 metres (Benton, 2014).

Bamboo's role in these landscapes is critical, and understanding how to manage and maintain bamboo stocks is important. South-South cooperation has transferred knowledge which has enabled this, and involved rural communities in the protection and restoration of their environments.

Food and Fodder

Bamboo leaves do not just serve as a food source for the panda and the mountain gorilla; most animals can eat bamboo leaves if available, including ruminant livestock. Bamboo's nutritional potential is high: the body weight of chickens fed with bamboo leaves is significantly greater than the weight of similar chickens fed with traditional chickenfeed (INBAR, 2013).

Bamboo is also a traditional part of human farming and fishing practices around the world, and its shoots are eaten by local communities in many countries. Tea made from bamboo leaves is common in several traditional communities and is a good source of soluble silica. China makes several flavonoid-based medicines from leaves. Bamboo could make an important contribution to food security and farming practices.

Products

Although bamboo species are 'grasses', many are tall and woody like trees. This unique combination of tree and grass properties makes bamboo relevant in most economic sectors. There are over 10,000 documented uses of bamboo, with a long history. The first rockets from China were made with bamboo casings and bamboo; this plant was used as the primary material for nearly 750 years until Indians started using started using iron casings with bamboo rods in 1792. More recently, the first electric bulb filament was from bamboo

Bamboo is used for construction and flooring. Credit: MOSO Bamboo Products by Awood

– Edison found this out after trying out 6000 other materials. The first gramophone needle was also from bamboo.

Today, bamboo is already among the world's most valuable non-timber forest products. In China alone, annual trade in bamboo reaches $US30 billion (INBAR, 2014). Traditionally, bamboo has been used to weave baskets, mats and make furniture. With the advent of industrial processing for bamboo in the 1990s, the range of possible products has expanded dramatically. Bamboo is being used as a material in everything from drainage pipes to wind turbine blades and cooling towers in power plants. It has a key role to play in growing markets such as biomass-based power, solid biofuels, cellulosic bio-ethanol, textile fibre and other volume applications. There is huge potential for rural smallholder communities to benefit from these markets and use bamboo as a way to diversify or improve their livelihoods.

Bamboo's lightweight and high natural strength make it an excellent construction material, earning it the name "vegetal steel" among architects around the world (Roach, 1996; Ogunbiyi et al. 2015). Many an engineer has used bamboo in place of steel for reinforcing concrete (Brink & Rush, 1996; Ghavami, 2005). As well as being strong, bamboos are flexible and light: this makes them excellent

Not just panda food: bamboo shoots are a delicacy to eat


Bamboo handicrafts provide a source of livelihoods for many

construction material for earthquake resistant buildings, as shall be seen later in the report.

The Local Challenges Facing the South

In many countries of the South, who form the majority of INBAR's membership, agriculture is the main occupation, land the main asset, and large populations and high population growth rates the norm. The overarching importance of agriculture underlines a paradoxical point - although it is the source of livelihood for over two-thirds of the world's population, it now accounts for less than 5 per cent of the gross world product (World Bank, 2017). Even this is under stress - land degradation is increasing at an alarming rate, and unviable farming pushes many poor marginal/small farmers to abandon their farms. Climate change is increasing the unpredictability of weather and thus increasing risks of erratic rainfall or natural hazards.

To address the above imperatives, solutions need to be (a) land-based, capitalizing upon an asset the majority of rural poor already have, and capable of application to most soil conditions, including degraded lands; (b) natural resource-based, enabling people to grow a hardy and preferably perennial crop that lends itself to year-round harvest; (c) labour-based, enabling employment of large numbers; (d) relatively climate independent and drought tolerant; and (e) linked to market opportunities that offer the corresponding scale, growth and income.

Bamboo ticks all the above boxes. This strategic plant can be part of the solution to major problems, notably climate change, water and degraded land, and poverty. The International Bamboo and Rattan Organisation (INBAR) has identified at least seven sustainable development goals (SDGs) were bamboo can make, and already is making, a real difference.

INBAR has been working for 20 years to realize the full potential of this amazing resource. Chapter I introduces INBAR, and describes how its policy framework and structure have increased the flow of knowledge about bamboo across its network of 42 member States. Chapter II shows how this works in practice, giving practical examples of INBAR's work in using South-South cooperation to build livelihoods, increase access to markets, restore degraded land and learn new skills: from building earthquake-resistant houses to making energy from bamboo biomass. In Chapter III, these efforts are linked to wider regional initiatives and the global development agenda: showing how INBAR's member States facilitate knowledge sharing within the United Nations and other organizations. Finally, the Conclusion reflects on the key lessons which INBAR has learned across its two decades.


Engineered bamboo can be used to make many durable products. Credit: China Engineering Research Center for Bamboo Winding Composites

Bamboo is an important part of countries' heritage and culture

> There are over 10,000 documented uses of bamboo, with a long history


As of 2017, INBAR has 43 member States, almost all of whom are from the global South

Chapter I

INBAR's Policy Framework and Structure for Delivering South-South and Triangular Cooperation

INBAR's Policy Framework and Structure for Delivering South-South and Triangular Cooperation

History of INBAR

INBAR is the only intergovernmental organization which promotes the use of bamboo and rattan for environmentally sustainable rural development. Between 1997 and 2017 it has grown from nine to 43 member States, almost all of which are countries from the global South.

INBAR is a historical outcome of a network of partners from the South, where bamboo is found. The story began nearly 40 years ago, with two workshops on bamboo and rattan organized by IDRC of Canada. Held in in 1979 and 1980 in Singapore, these workshops brought together experts from countries in South and South-East Asia. Following this, a series of individual member country programmes were instituted and knowledge partnerships built among them.

By 1984, the momentum was such that a network to manage the programmes and partnerships was put into place as the IDRC Bamboo and Rattan Research Network in Asia.

Three Information Centers were set up, one on tropical bamboos in India, another on sub-tropical bamboos in China, and a third on rattan in Malaysia. A robust publication programme was instituted such that for the first time, a body of publications that brought together technical and other information on bamboo started to be built. The philosophy was that the Network would not only cover bamboo programmes and activities within the network but also what was happening elsewhere in the world, since that knowledge was important to share within the South-South network. During this period, the International Plant Genetic Resources Institute (which later became Bioversity International) joined hands with the IDRC Bamboo and Rattan Research Network.

Map showing the distribution of INBAR member States

International workshops on bamboo were instituted every three years to bring together the partners in the network's programmes.

By 1990, there were calls by the South Asian and South-East Asian country programmes participating in the IDRC Bamboo and Rattan Research Network to change the informal network into a formal one. As a first step, the International Fund for Agricultural Development (IFAD) joined hands with IDRC in 1993, and the Network was set up as an international secretariat under the legal umbrella of IDRC, with the name INBAR and with its Executive Director.

The IDRC Bamboo and Rattan Research Network's series of International Bamboo Workshops of the South was merged with the International Bamboo Congress organized by various country bamboo societies. A joint International Bamboo Workshop and Congress was organized that expanded the partnership and brought the wider bamboo community together.

In November 1997, INBAR became an intergovernmental international agency with its Headquarters in Beijing, China, supported by IDRC, IFAD, Directorate General for International Cooperation (part of the Ministry of Foreign Affairs for the Netherlands) and the Government of the People's Republic of China. Starting with nine founding member States, INBAR has grown over the 20 years of its existence into a body with 43 member States. INBAR has regional offices in South Asia (India), East Africa (Ethiopia), West Africa (Ghana), and Latin America (Ecuador). A Council of member States that meets biannually provides

oversight and policy direction while a Board of Trustees oversees the programme of work and budget and key appointments.

INBAR as a Mechanism for South-South Cooperation

INBAR is a multilateral institutional home for information and expertise on bamboo, enabling it to act as a development knowledge broker for the global South. This has been highly effective at breaking down barriers to sharing knowledge, skills, technologies, and strategies on bamboo resource management and utilization across our membership.

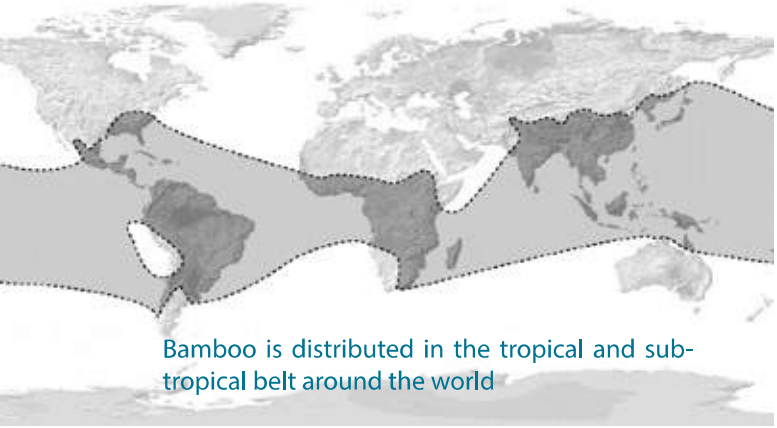
Over the years, INBAR put in place several mechanisms to facilitate South-South knowledge-sharing. Below are the institutional systems and mechanisms which INBAR has built up and iteratively validated over its 20-year history to facilitate increased cooperation, knowledge sharing and technical transfer among its member States:

Living Collections

Support was provided over 1984 to 1993 to several countries to establish living collections of bamboo with the support of national research institutions in China, India, Indonesia, Kenya, Malaysia, Nepal, the Philippines, Sri Lanka, and Thailand. In China, the bamboo living collection was established in Anji, Zhejiang Province. Since then, INBAR's national research partner institute, the International Center for Bamboo and Rattan (ICBR) has also established germplasm collections for bamboo in Taiping, Anhui Province and Sanya, Hainan Province. These collections have been established to preserve and collect bamboo genetic resources from across China, as well as other INBAR member States.

Living collections are an important way to preserve and collect bamboo resources

"INBAR is a multilateral institutional home for information and expertise on bamboo, enabling it to act as a development knowledge broker for the global South"



Bamboo is distributed in the tropical and sub-tropical belt around the world

National and Global Bamboo Resources Inventories

The Forest Resource Assessment compiled by the Food and Agriculture Organization of the United Nations (FAO) in 2005 and 2010, with support from INBAR, estimated that there are over 30 million hectares of bamboo distributed around the world. The actual figure is likely to be much larger than the Forest Resources Assessment estimates, as many countries are yet to develop inventories for bamboo. Furthermore, current inventories in most countries do not adequately cover bamboo grown outside of forests, as the data is collected by the Forest Departments. Yet, in areas where bamboo is a part of the culture, a large percentage of bamboo resources are actually grown in homesteads, farm boundaries and even as block plantings on farms.

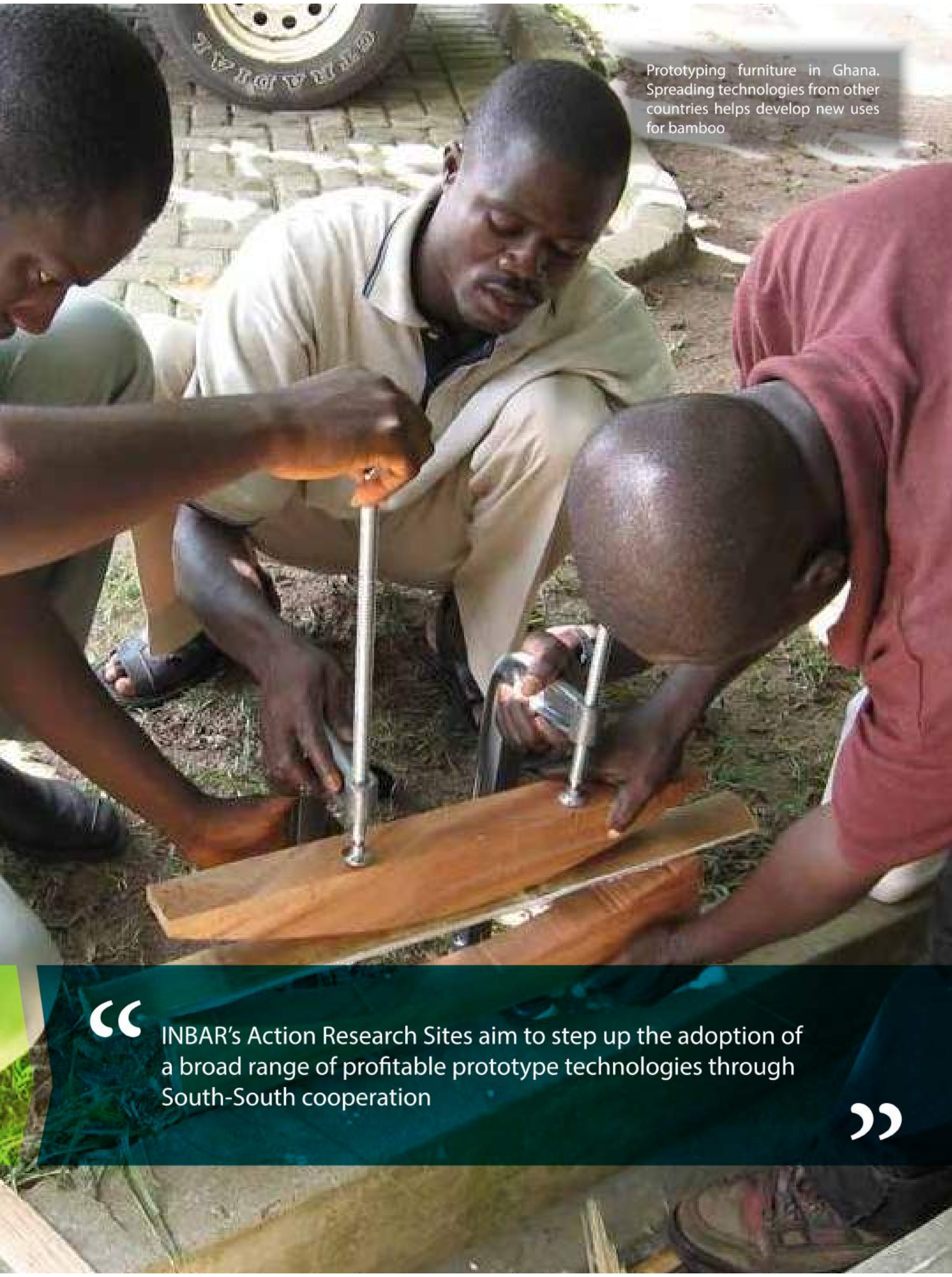
In Bangladesh, for example, over 80 per cent of bamboo production comes from such private plantings and in Kerala state, India, the figure is 63 per cent (FAO, 2005; KFRI 2009). In north-eastern India alone, an estimated 80 per cent of the 9.4 million households grow bamboo in their homesteads and/or farms (CIBART, 2017). In The United Republic of Tanzania, over 264,762 households (1.1 million people) have privately raised block bamboo plantations that are the largest in the country (Kijazi & Kadala, 2008). In China, it is farmers who are driving bamboo production and productivity, which has increased several-fold since the household management system of bamboo was introduced. China now has more than 3 million hectares of bamboo plantations.

INBAR has embarked on a participatory programme called GABAR (Global Assessment of Bamboo and Rattan) to get a better understanding of these strategic resources, with individual countries subscribing to the programme and contributing their part related to the resource in their country. A first global assessment report will be published in 2020, as a sister publication to the FAO Forest Resources Assessment report.

Action Research Sites

A policy decision was taken in 1998 to develop Action Research Sites (ARS) for fostering knowledge development, networking and South-South partnerships. From the year 2000, INBAR facilitated the setting up of ARS in its member States that were networked with each other. These became in-country research, demonstration and training sites with iterative action-research, conducted together with rural communities. The overall aim was to step up the adoption of a broad range of profitable prototype technologies based on South-South cooperation and support from the Secretariat and networked technical assistance.

The long-term ARS have helped in the development and validation of new technologies, tools and machines, processes, institutional systems and supportive policy; identifying funding sources and financing options; and establishing market linkages, thus making these into financially viable economic models. There has been a progressive identification of constraints and opportunities and new bottlenecks to development that are addressed in a technical and methodical manner in collaboration with the community, while documenting the learning for adaptive replication elsewhere. New ARS continue to be established and are mentored by older and advanced ARS, resulting in a faster start up and a quicker trend towards self-sustaining operations.



Prototyping furniture in Ghana. Spreading technologies from other countries helps develop new uses for bamboo

> “INBAR’s Action Research Sites aim to step up the adoption of a broad range of profitable prototype technologies through South-South cooperation”

Since 2007, 21 ARS have been established in seven countries, and those which remain open have progressed considerably in achieving the objectives set out. INBAR's partners in member States at several ARS made good progress by providing shared institutional support, promoting product development and in establishing small and medium enterprises. The independent evaluation of INBAR in 2007 concluded that "the global set of ARS are generating a vast amount of experience and knowledge that is potentially valuable for work in Africa" (Horton, 2007). The review noted that "INBAR and its partners are actively innovating in the crucial area of marketing, and many of the innovations seem quite promising. INBAR and its partners have fostered important innovations in markets, technology, and institutions, and they are achieving important practical results, particularly in Asia and Latin America."

ARS-linked Non-governmental Organizations

Another important gap was that there were few non-governmental organizations (NGO) dealing with the technicalities of the many various value chains of bamboo that cut across most economic sectors. Hence, NGOs that specialized in bamboo were set up, followed by for-profit enterprises, many of which are still active (see Annex 1 for a full list). The ARS are essentially "managed" by the NGO in the country, which are responsible for sourcing funds, setting up social enterprises and facilitating continuity. Over time several of these NGOs have built up considerable capacity and together are the second tier of institutions at the country level in the INBAR network.

The ARS are now an activity pursued by local NGOs whose capacity has been enhanced over the years, and which have become good South-South partners in bamboo development in their own stead. INBAR is now focused on helping member States in their efforts to reach the SDGs, including support to the nationally determined contributions under the Paris Agreement on Climate Change. The INBAR Secretariat is also more actively communicating about the achievements of its member States and the existing ARS work, and

Training in bamboo nursery establishment and management is key to ensuring communities have access to stable stocks of bamboo

using this to influence national, regional and global policy.

International Conferences and Congresses

- The first International Bamboo Workshop was organized in 1980 by IDRC in Singapore. This soon expanded into a major global forum on bamboo as the International Bamboo Workshop, with a subsequent meeting in 1985 (China), 1988 (India) as the Third Workshop, and in 1991 (Thailand) as the Fourth event.
- From 1995 onwards, the International Bamboo Workshop and the International Bamboo Congress (independently organized by the International Bamboo Association) were merged into a single event and the Fifth International Bamboo Workshop & Congress was jointly organized in Bali, Indonesia in 1995. After the establishment of INBAR, the 1998 Sixth Workshop & Congress was held in Costa Rica, also jointly organized, which was attended by nearly 550 people from 47 countries and served to network and build critical mass across the globe.

H.E. Mr. Peter Thomson, President of the 71st session of the United Nations General Assembly, takes a tour around a demonstration bamboo house in 2016

- The Seventh World Bamboo Congress organized by the World Bamboo Organization (WBO) was then held in New Delhi, India in 2003. Subsequent events were in Thailand, the Republic of Korea and the next one will be in Mexico.
- In 2010, INBAR organized a combined Bamboo & Rattan conference, and the next one is planned to be held in 2018.

Publications

Hundreds of proceedings, technical reports, working papers, policy briefs and other reports are produced by INBAR and are available on its website. Several Transfer of Technology Models or 'TOTEMs' are also available. These are accessed by its member States and others from the global South and global North. The INBAR website's 'Resource Centre' offers a hub for information. From 2015, INBAR also established a Chinese communications team to focus on Chinese-language communications.

Global Trade Data

One of the functions of INBAR is to collate and analyze global trade data and present it to its member States and the world. INBAR is the recognized International Commodity Body for bamboo and rattan under the Common Fund for Commodities and works with its member States and the World Customs Organization to set Harmonized System codes for bamboo and rattan products. This has resulted in separate customs codes being developed for 24 categories of bamboo and rattan products, benefiting members across the global South through access to better trade data. Before INBAR, there was no separation of bamboo and rattan products, which were all classified as timber products and vegetables, and so a sizeable proportion of bamboo and rattan trade likely goes undocumented every year.

Codes and Standards Development

Developing and monitoring standards for bamboo products – to ensure they are safe, reliable and have a consistently good quality

– improves consumer and supplier confidence. In turn, this increases bamboo's marketability and helps build value chains in international markets. INBAR has played a major role in helping get International Organization for Standardization (ISO) standards into place, and working with its member States to get these into national standards and building codes. It has done this through its work with ISO Technical Committee (TC) 165 on timber structures. Work on developing standards for bamboo construction began through technical cooperation with partners from across the global South and culminated in 2004 in the publication of three international standards (ISO 22156, 22157-1 and 22157-2). These standards have subsequently been used to help four INBAR member States develop their own national building codes for bamboo. In 2016, INBAR also worked effectively with China and other member States to establish the world's first ISO Technical Committee dedicated to Bamboo and Rattan - TC 296.

Policy and Institutional Development Support

In the early days of INBAR, missions were undertaken by senior staff and experts from China to several countries for policy and technical advice. In 2000, missions were made to Chile, Ecuador and Peru, and in 2001 to Ghana, Kenya and the United Republic of Tanzania. In 2002, an expert group travelled to Ghana on a follow-up mission. Another follow-up mission was to Latin America in 2005 to the Plurinational State of Bolivia, Colombia and Ecuador. Since then, INBAR has helped its member States to develop supportive bamboo policies.

INBAR's work to introduce standards for bamboo and rattan products should play a key role in stimulating international trade, and helping artisans access larger markets

"Developing and monitoring standards for bamboo products… increases bamboo's marketability"

INBAR has provided inputs, policy briefs, and has helped to facilitate and assist the drafting process, of several important bamboo policies (see table).

2011	Rwanda draft National Bamboo Policy formulated
2016	Draft Bamboo Policy formulated for Madagascar with technical assistance from India, China and Ethiopia Thanh Hoa Provincial Policy (Viet Nam) developed with technical assistance from China
2011	Rwanda draft National Bamboo Policy formulated
2014	Madhya Pradesh State Bamboo Policy (India) drafted Comparative analysis of policy frameworks in China and India prepared
2013	Madagascar Bamboo Policy paper produced the United Republic of Tanzania Bamboo Policy paper produced
2012	Amhara (Ethiopia) Bamboo Policy developed and adopted
2011	Rwanda draft National Bamboo Policy formulated
2010	Philippines Executive Order 879 requiring that 25per cent of school desks should be made from bamboo
2004	Ghana Bamboo Policy and BARADEP programme launched
2003	National Bamboo Policy of adopted in India, with support of INBAR
2001	State bamboo policy documents developed for 8 states in India Market opportunity analysis and policy framework for India developed

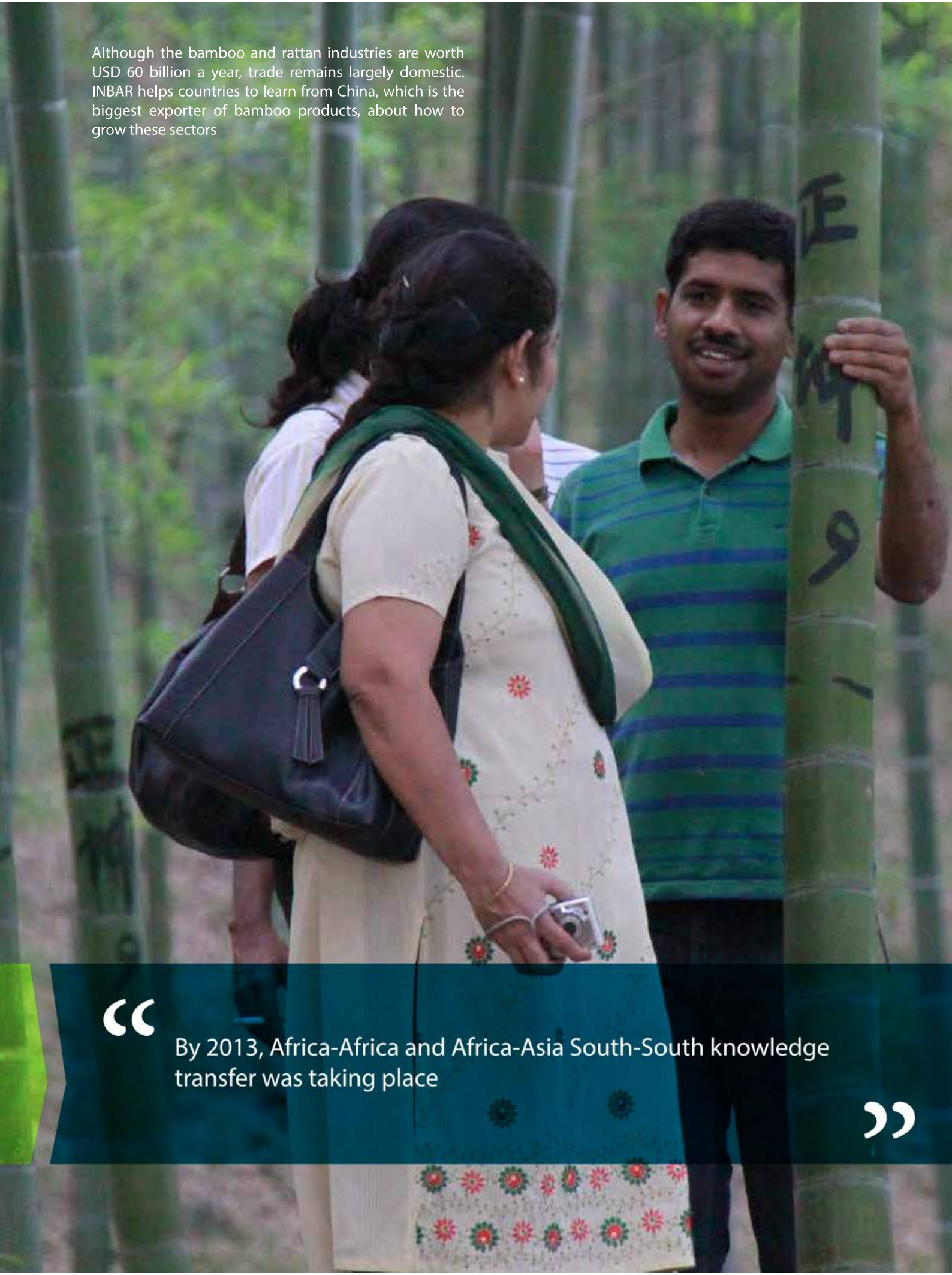
INBAR has also provided policy support to governments and state-owned businesses in Cameroon, Ecuador, Ethiopia, and Nigeria. As well as this, INBAR has made significant contributions to help countries formulate standards for bamboo construction, and has helped the Government of China create a Methodology for Carbon Accounting and Monitoring of Bamboo Afforestation Projects in China (Zhou et al., 2013).

Awareness Raising and Capacity Building including Technology Transfer

A number of South-South awareness-raising and capacity-building programmes are organized each year. Most of the programmes under INBAR share knowledge and experiences in a series of country-country programmes between, respectively: China to Asia, Africa, and Latin America and the Caribbean; India to Asia and Africa; the Philippines to Asia and Africa; and amongst Colombia, Ecuador and Peru. By 2013, Africa-Africa and Africa-Asia South-South knowledge transfer was also taking place, using innovations in charcoal pulverizing that has been replicated in India, and charcoal-producing stoves that were rivalling the best kilns (INBAR, 2013).

Institutional Markets

INBAR is continually working to secure governments' support in order to build momentum in a new market. This support is crucial to convince other member States of the need to create consistent market demand and to gain market acceptability. Efforts are needed to facilitate the introduction of bamboo products into the government's schedule of rates for preferential purchase of bamboo products by government agencies (institutional markets). If the bamboo products are listed in the government schedule of rates, it will be possible for the government agencies, contractors, architects and designers to start using bamboo and bamboo products. The most important of institutional markets targeted by INBAR to date cover education and



Although the bamboo and rattan industries are worth USD 60 billion a year, trade remains largely domestic. INBAR helps countries to learn from China, which is the biggest exporter of bamboo products, about how to grow these sectors

> By 2013, Africa-Africa and Africa-Asia South-South knowledge transfer was taking place

social housing. In both cases, most countries have strong national bamboo programmes, either nationally funded or donor funded. Choosing bamboo can make a big difference since the bamboo is commonly grown by the rural households in their respective countries on their homesteads or farms, made into furniture by the people, and used by their children - this literally makes it of the people, by the people, for the people.

Despite this, projects often encounter initial problems to do with expense or a lack of access to markets. One of the challenges faced by INBAR is the informality of bamboo value chains, which conceals the value created by each of the links and therefore reduces their attractiveness for governments to take them into account in their decision-making. Working on these challenges will provide strategies to improve the appeal of bamboo value chains to both private investors and governments. One key example of INBAR's work with this is the set of projects to introduce bamboo school furniture in the Philippines, Gujarat in India and Madagascar presented in Chapter II.

Building institutional markets can help individuals employed in bamboo

Chapter II

South-South Cooperation in Action

South-South Cooperation in Action

Education: Creating an Institutional Market for Bamboo School Desks

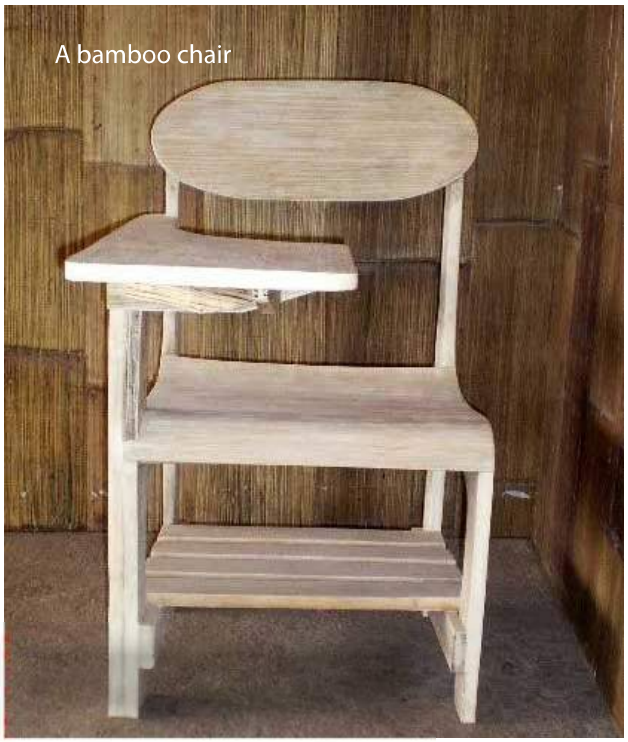
Related SDGs	SDG 1: No Poverty SDG 12: Responsible Consumption and Production
Countries Involved	China, Ghana, India, Madagascar, the Philippines
Summary	The success of a bamboo furniture processing project in Ghana led to similar initiatives in the Philippines, Madagascar, and Gujarat, India.
Lessons Learned for South-South Cooperation	The importance of political awareness-raising and policy change which accompanies the trialling of new products; the role of international visits for spreading technology; the importance of an international network to facilitate connections and spread ideas; recognition of the importance of support from national and regional governments, as this creates strong market support.

There are several SDGs for which bamboo and rattan can be strategic tools. These include SDG 1, which aims to end poverty, and SDG 12, which promotes sustainable consumption and production. Both of these SDGs are addressed through INBAR's work on school desks: work which not only improves market links for producers of bamboo furniture, but is also promoting the public procurement of this renewable, low-carbon material.

In 2006, an INBAR project was initiated in Ghana to purchase bamboo furniture with INBAR's Philippine partner, In-Hand Abra, as the knowledge provider. The project partners in Ghana were the Ejisu District represented by the District Chief Executive, the Kwame Nkrumah University of Science and Technology, INBAR, and the Akyamkrom Bamboo Furniture Makers Association. The government provided funding and land for a work shed, in which panel boards were made and laminated. These were then used to produce school desks.

Initially, the market for school desks was limited. The large-scale government purchase of such school desks was the market that had to be cracked, but government policy stated that only hardwood desks could be purchased for schools. A campaign to bring policy change based on the equivalent strength of bamboo eventually succeeded, and the government included bamboo as a flexible material to produce laminated bamboo school desks. This sparked a wider initiative to introduce bamboo school desks into public policy procurement in Ghana.

Following this success, an INBAR-led project assisted with spreading this technology to the Philippines. This project facilitated the supply of bamboo mat-board panels from India and bamboo wafer board panels from China to the Philippines for making desks. InHand Abra then produced quality school desks at competitive prices. These were presented to the Secretary, Department of Education, and a process was started to engage the ministries involved with bamboo to bring together those involved in the growing of bamboo, its processing, and technology support. After a long process, the President of the


A bamboo chair

Philippines issued Executive Order EO 879 in 2010, mandating that 25 per cent of all school desks purchased by government were to be made from bamboo. The Executive Order also established the Philippine Bamboo Industry Development Council. This was a huge stimulus to the bamboo sector, with the new market opportunity promoting enterprises to make the desks, with backward linkages to primary and secondary processing and treatment, and bamboo planting. The entire value chain was transformed.

Staff from the Centre for Indian Bamboo Resource and Technology (CIBART, INBAR's partner in India) in the Gujarat ARS had visited the Philippines in 2009 and one of the products discussed was school desks. In 2011, CIBART produced school desks using different technologies in a project supported by the Tribal Development Department of the Gujarat. The government agreed to try out the desks and gave an order for one school. Following positive feedback from teachers and students, the government then mandated that all tribal schools would henceforth procure bamboo school desks from CIBART, and in time, this was a resounding success. Nineteen schools were equipped with bamboo school desks and furniture. In more recent discussions, the Gujarat government is willing to allow participation in open government tenders, subject to specifications and a scale-up in production. This is a new and welcome development.

Subsequently, policy makers from Madagascar visited the Gujarat project to see school desks in use, and replicated the desks in their own country with technical support from CIBART in India. This is now being scaled up through the expansion of production centres to different regions of the country. The leveraging of such government institutional market is one of the tenets of the government of Madagascar's draft national bamboo policy as a means of building up momentum in the market.

Several factors were key to success in these initiatives: match-making; bridging the gap between the networking/convergence of resources of government agencies and bamboo stakeholders like non-government organizations and producers (community and furniture makers); a range of technologies that allow for production of desks from different


Bamboo school desks in Ghana

kinds of bamboos; production of prototypes; designing and fabrication of machines; sourcing financing of government of machines/ equipment and workshops; working with wood furniture makers and converting them into bamboo furniture makers. Working with policy makers and carrying them along the process is key to scaling up.

This project had a transformational impact on the communities involved. School desks constitute a mainstream product which can be used in schools anywhere. This is therefore a market that is not going anywhere, which mainly needs the application of existing skills, and is replicable and scalable. As such, many local families benefit along the value chain, from growing bamboo to processing to product marketing. The steadiness of income is paramount which is what a market mandated by government offers.

Construction: Bamboo Houses

Related SDGs	SDG 11: Sustainable Cities and Communities
Countries Involved	Bhutan, China, Colombia, Ecuador, Ethiopia, India, Jamaica, the Netherlands, Nepal, Peru, the Philippines, Viet Nam.
Summary	INBAR's work with bamboo housing shows how diverse South-South cooperation strategies can be. INBAR has: demonstrated the life-saving potential of earthquake-proof bamboo housing through award-winning project work and research; worked to set and improve adherence to international building standards to improve the safety and marketability of construction materials; and shared techniques from specific parts of the world, such as Latin American 'bahareque' construction, in other member States.
Lessons Learned for South-South Cooperation	Pilot projects (such as building earthquake-resistant demonstration houses) have an important role in raising awareness and building markets for new products; good, clear training and communications products can spread the impact of a project; cross-border work such as the setting of international standards is a very important way to bring about change; intra-regional knowledge sharing can generate particularly useful and practical advice.

SDG 11 promotes the creation of safe, resilient and sustainable settlements. This includes ensuring access to "adequate, safe and affordable housing." Through its work with bamboo construction, INBAR promotes the use of this material as a strong, flexible and accessible material. Because of its resilience in natural disasters such as earthquakes, bamboo housing can also help communities adapt to the more extreme and unpredictable weather patterns caused by climate change.

Bamboo has been widely used for millennia as a traditional rural construction material, long

before the advent of brick and mortar, steel reinforcement and concrete. Families across Asia, Latin America and Africa live in houses built of bamboo with differing construction technologies. In Latin America, several heritage bamboo buildings are well over a century old. Advantages of bamboo include its low entry-point cost, and the fact that the material can be used both in rigid and flexible ways.

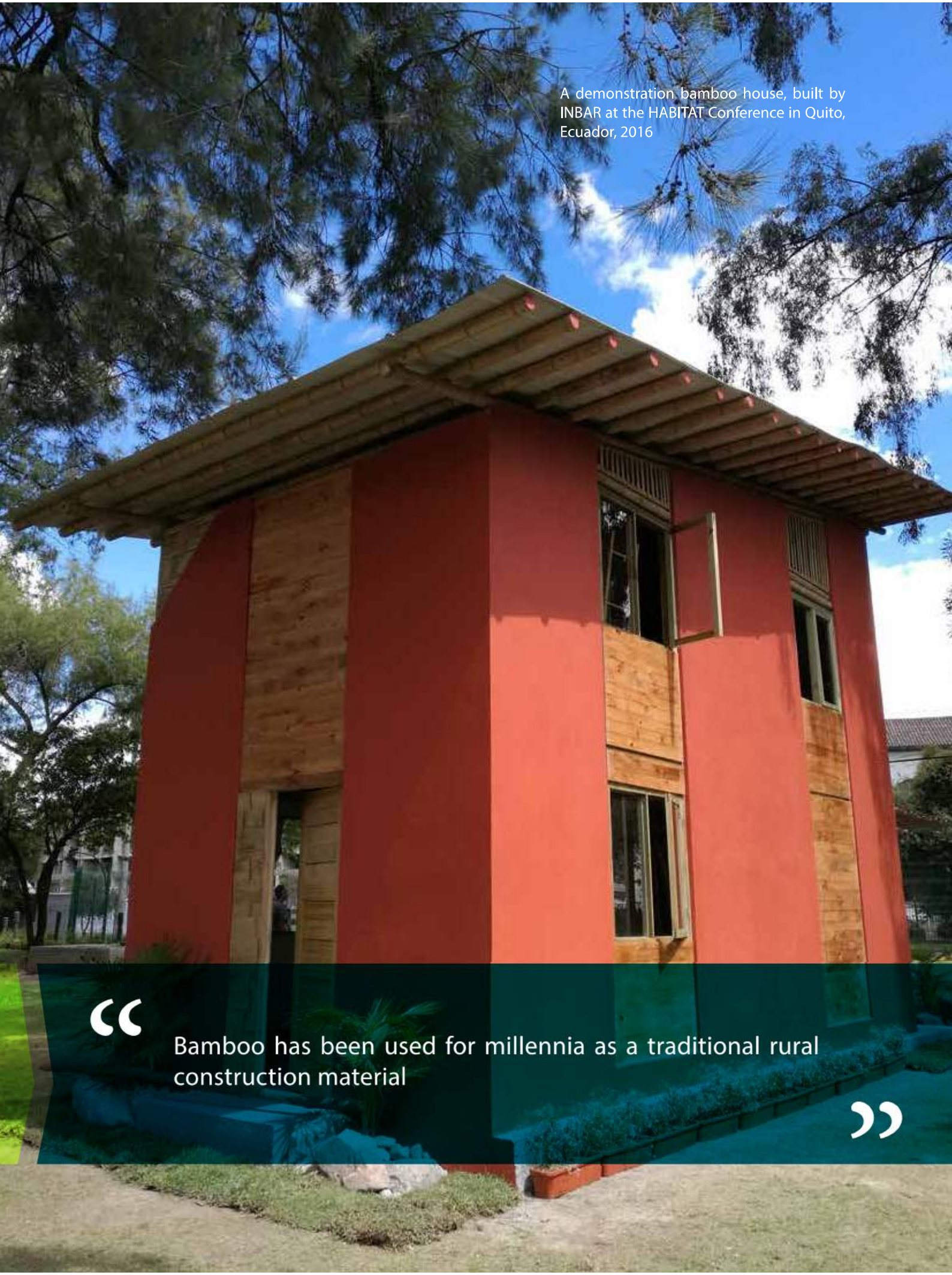
In recent years, concerns over environmental sustainability and carbon emissions of the construction sector have given new impetus to building with bamboo. Bamboo is a renewable material which stores carbon and can have a low or even negative carbon footprint over its product lifecycle (Vogtlaender & van der Lugt, 2014). At the same time, bamboo's lightweight and high natural strength make it an excellent construction material (Liu & Frith, 2013). For this reason, a lot of INBAR's work concerns bamboo construction: sharing knowledge and lessons learned; improving the safety of these structures; and providing inputs which help standardize bamboo building work at an international and national level.

Bamboo Housing in Earthquake-prone Areas

The flexibility and lightness of bamboos make them excellent construction material for earthquake resistant buildings, as we have seen during earthquakes in Costa Rica (1991), Colombia (1999), and Ecuador (2016). In all three cases, bamboo houses often stayed standing while others fell.

INBAR has done a lot to promote bamboo construction in earthquake-prone areas. As early as 1998, INBAR had already begun to the highlight the need for wider use of bamboo in earthquake prone areas. In 2008, following the devastating Sichuan earthquake which killed as many as 80,000 and displaced more than 5.5 million people, INBAR worked with the International Center for Bamboo and Rattan and the Chinese Academy of Forestry on a project to develop pre-fabricated modular bamboo houses in the affected areas of Sichuan. The success of this project – which was given an Innovation Award by the United Nations and World Bank's 'World Conference on

Bamboo is a traditional material for housing across much of Latin America



A demonstration bamboo house, built by INBAR at the HABITAT Conference in Quito, Ecuador, 2016

> “Bamboo has been used for millennia as a traditional rural construction material”

Post-Disaster Reconstruction' - led directly to the establishment of INBAR's 'Bamboo Housing Project', in partnership with the Common Fund for Commodities (CFC). The project spread the Chinese technology - modular bamboo housing solutions - to Ethiopia and Nepal in several ways: the establishment of pre-fabricated housing production centres; capacity building training; and promotion of bamboo as a viable material in national housing markets.

Chinese training was also key to an INBAR project in Bhutan. Between 2012 and 2014, INBAR worked in Bhutan to establish bamboo housing as an alternative to traditional woods. This is a timely intervention, as the Government's commitment to maintain forest cover at 60 per cent was creating a shortage of materials for construction. INBAR trained numerous participants from Bhutan's forestry extension services and community farmer groups on Chinese methods of bamboo construction.

More recently, INBAR has published technical advice which makes clear how bamboo can be used to build "very sustainable, low-cost structures for… earthquake-resistant housing" (INBAR, 2014a). The report, based on research in Ecuador, has relevance to those seeking to build earthquake-resilient, durable structures across the world.

International Standardization

The main drawback to building with bamboo is the lack of standards and building codes for bamboo. Standardization is an inherently South-South activity: it requires collaboration between countries, and the adoption of specific regulations across borders. With its large network of members, INBAR continues to play a key role in driving standardization of bamboo structures.

INBAR has worked with ISO for years to develop international standards. In 2004, INBAR created three ISO codes as part of the Technical Committee on 'Timber Structures' (TC165). These codes have since been adopted as the national standards in Colombia, Ecuador, Jamaica, the Netherlands, Peru, the Philippines and Viet Nam (see Annex 2). In addition, Colombia, Ecuador, India, Nepal and Peru have national standards relating specifically to bamboo – based at least in part on awareness-raising by INBAR.

At the country level, INBAR continues to work with its members to encourage the adoption of these standards into national practices. Based on bahareque's apparent resilience in the strong 1999 earthquake, Colombia decided to undertake research into bamboo strength and eventually had the standard for bahareque houses included in its national regulation for construction (2002). The creation of this code was based on ISO standards for bamboo. Colombia's actions had a considerable influence in Peru, whose Ministry of Housing published their own code in 2009 based on the Colombian standards. Following this, INBAR's Ecuador-based office kicked off a similar process in Ecuador, and the published codes have adapted and improved upon the original Colombian version. These examples from Latin America show the importance and potential of intraregional sharing: something which INBAR's regional offices are uniquely positioned to facilitate.

Bamboo structures are resilient yet flexible, meaning they can withstand earthquakes

Existing standards and codes deal only with round pole bamboo. One new area which requires standardization is engineered bamboo. This is particularly important, given the increase in international demand for products made using engineered bamboo. INBAR is working with the Shanghai Research Institute of Building Sciences to develop design codes for engineered bamboo structures. Meanwhile, an international expert group led by INBAR Construction Task Force is planning to start work on developing international standards of engineered bamboo structures in ISO165. In addition, the INBAR-led 'Strength Grading Project' between Colombia, Ecuador and the United Kingdom has developed a grading protocol for the structural use of bamboo. This should give designers more confidence when building and designing modern structures. The methodology is expected to become an ISO standard in 2018.

Improving Safety

Finally, INBAR has worked to share expertise that improves the safety and security of bamboo structures. Bamboo scaffolding is a ubiquitous sight in Hong Kong SAR. Although relatively safe, the lack of standard design and assembly guidelines has hampered the development of this cheap, lightweight scaffolding material elsewhere.

In 1999, INBAR supported a research and development project on 'Bamboo Scaffolds in Building Construction', undertaken by Hong Kong Polytechnic University. The project aimed to promote the effective use of bamboo scaffolding in building construction through the advancement and dissemination of structural bamboo technology. Both the established knowledge and the proven practice of bamboo scaffolding in Hong Kong SAR were formalized and documented in two parts: advice on the erection of bamboo scaffolds for builders and scaffolding practitioners, and information on the design of safe bamboo scaffolds (Chung & Chan, 2002; Chung & Siu, 2002). This was followed by a training and certification programme for bamboo scaffolding workers, as well as an international seminar in 2002. The seminar provided a technical forum for researchers, engineers, contractors and regulatory agents to exchange basic design data, scientifically developed analysis and design methods, and established construction practices for safe and effective bamboo scaffolding.

Scaffolding made from bamboo is still a common sight in Hong Kong SAR

Within Latin America, INBAR has worked extensively with its member States Colombia,

Ecuador and Peru to support each other in developing their bamboo sectors. This is made easier by the fact that all three countries work predominantly with the same bamboo species, Guadua angustifolia. This South-South collaboration has already resulted in several major achievements, such as the inclusion of bamboo in building codes of Ecuador and Peru; the establishment of National Bamboo Development Roundtables and supporting bamboo industry policies; the strengthening of professional capacities resulting from knowledge exchange; and the development of numerous publications which can be applied across all three countries. Using the INBAR platform and this strong history of previous collaboration among these countries as a basis, the INBAR Secretariat is now proposing to the Governments of Colombia, Ecuador and Peru to form an official South-South partnership for bamboo development cooperation.

Building with Bahareque

Andean countries traditionally use large-diameter bamboos and bamboo splits in a system called bahareque construction. Bahareque construction is seen to be particularly durable and more resilient to weather effects and hazards (González & Gutiérrez, 2005), and yet this technology is not seen in most of Asia and Africa, where traditional construction technologies use small diameter bamboos. INBAR shared this important technology with the Indian Plywood Industries Research and Training Institute in India, and trained a small number of individuals from India and the United Republic of Tanzania. All individuals went on to make great use of the bahareque techniques. One trainee has since contributed to building capacity in bamboo constructions in their home state of India; another trainee has built a large number of constructions, including those which could withstand the force of rivers in spate; and a third is participating in a multi-billion-dollar social housing programme of the Government of India.

Reliable energy services are a prerequisite for much development work. INBAR has worked with rural communities across the world to raise awareness and increase the uptake of bamboo biomass, which can be used directly

Bamboo for Energy as Charcoal

Related SDGs	SDG 1: No Poverty SDG 7: Affordable and Clean Energy
Countries Involved	China, Ethiopia, Ghana, India, Madagascar, Mozambique, the Philippines, the United Republic of Tanzania, Viet Nam,
Summary	Bamboo can provide a renewable, clean-burning source of fuel, but its potential is rarely realized. By helping to develop and spread the use of innovative, useable bamboo charcoal-making kilns, INBAR has helped spread this practice further and introduced necessary amendments based on the place of use.
Lessons Learned for South-South Cooperation	Innovative technology can provide new solutions which are applicable for many different countries, but does not spread by itself – awareness-raising and active technology sharing and training is required; variations on technologies will make them more applicable for other places; when using natural resources as part of development programmes, training in how to produce and sustainably manage these resources is just as important as learning how to use or convert them.

as fuelwood; modified into charcoal for cooking and heating; or converted into gas for thermal and electrical energy generation. This feeds directly into the United Nation's commitment to "Ensure access to affordable, reliable, sustainable and modern energy for all" under SDG 7.

Charcoal is an important fuel for cooking in Africa, which underpins millions of rural livelihoods for the poorest of the poor who do not have an alternative. However, the wood for production of charcoal is harvested unsustainably, often illegally, and is a principal driver of deforestation in some countries. The move to sustainably sourced and legal wood collection is a key part of sustainable development in these areas.

Charcoal from bamboo can be a viable and sustainable alternative to that from wood. Tropical bamboo is the most prolific producer of biomass in the world and when farmed, can produce up to 125 tons (air-dry)/hectare/year on a complete plant basis or 100 tons for poles alone. Such high figures are not surprising; sugarcane produces 113 tons (air-dry)/ha.[1] Cutting bamboos does not lead to deforestation since new poles are produced each year; the charcoal produced from bamboo is sustainable since only the incremental annual production needs to be harvested. Bamboo charcoal can be visibly recognized as different from wood charcoal: it is nearly impossible to cheat. In addition, bamboo cultivation and conversion into charcoal offers great potential for income generating options: a rural household could earn over $1,000 a year from producing bamboo charcoal (INBAR, 2008; Seboka & Duraisamy, 2008).


A bamboo charcoal burner


Making bamboo charcoal can provide a valuable source of income as well as a renewable source of fuel

The technology of converting oil-drums into charcoal kilns as developed in the Indian Institute of Technology, Delhi, was transferred to Mozambique through an IFAD-funded project where it was used to produce bamboo charcoal. This technology won the Peer Award at the World Bank Development Marketplace. This was later replicated in Ethiopia, Madagascar, and the United Republic of Tanzania through another IFAD project for production of bamboo charcoal. Drum kilns have been developed elsewhere too, such as in China, the Philippines, and Viet Nam. In the Philippines, the same technology was refined with an emphasis on vinegar production, which

[1] Data provided by Dr N.Barathi of Growmore Biotech, Hosur, India. See also Barathi, 2017

is a by-product of bamboo charcoal making. Bamboo vinegar is used as a spray against plant diseases and insects, in cosmetics, and for diseases such as psoriasis.

The charcoal kiln and stove technologies from China and other countries were replicated in Ethiopia and Ghana by the European Commission-funded project, 'Bamboo as Sustainable Biomass Energy: A Suitable Alternative for Firewood and Charcoal Production in Africa'. This project trained more than 4,000 individuals in bamboo cultivation, plantation management and bamboo charcoal producing technologies. The project introduced 10 bamboo species, raised more than 200,000 seedlings, and established 148 micro- and small enterprises.

Most recently, as part of INBAR's 'South-South Knowledge Transfer Strategies' project, a total number of six charcoal dome kilns were constructed in five regions of Madagascar with linkages to 140 smallholders. Likewise, in Mbeya and Iringa in the United Republic of Tanzania, dome kiln technology was introduced to use up the waste produced from the creation of bamboo wine. Meanwhile, in Ethiopia, Madagascar and the United Republic of Tanzania a household charcoal briquetting unit has been installed in each country. The dome charcoal model, briquetting machine and bamboo gasifier model are all based on experience from India, and experiences gained in each area will feed into the wider sharing and application of these technologies across all countries.

Case Study

In Ethiopia, an INBAR supported entrepreneur manufactured an appropriately sized small scale charcoal pulverizer with a cyclone dust collector made from an oil drum which worked very effectively. A production unit was then made which won a regional prize and offer of facilities by the government to manufacture more of them. In an Africa-Asia South-South cooperation project, this technology was transferred to Gujarat, India and a model unit made locally.

A bamboo charcoal kiln being constructed

Bamboo for Energy as Biomass and Power

Related SDGs	SDG 1: No Poverty SDG 7: Affordable and Clean Energy
Countries Involved	China, Ethiopia, Ghana, India, Madagascar, Mozambique, the Philippines, the United Republic of Tanzania, Viet Nam
Summary	An innovative new bamboo gasifier technology was set up in Rajasthan, India and later replicated in Madagascar. It will be spread to Ethiopia, Madagascar and the United Republic of Tanzania.
Lessons Learned for South-South Cooperation	Piloting new technologies can create wider awareness, particularly if coupled with training and good publications and communications about lessons learned.

A clean-burning, sustainable source of charcoal can improve the lives of individuals who rely on this resource for cooking and heating. In the same way, generating thermal and electrical power from a sustainable source will help develop livelihoods and industries. INBAR's innovative work with bamboo biomass for energy generation is a key part of efforts to achieve SDG 7: 'providing affordable, sustainable and reliable modern energy services for all.'

Recognizing the importance of energy for sustainable development, the United Nations designated 2012 as the International Year of Sustainable Energy for All. More than two billion people depend on wood energy for cooking and/or heating, particularly in households in developing countries: an energy source that is polluting, difficult to source and a leading cause of deforestation (FAO, 2017).

Solid pellets and briquettes made from sustainable biomass are a good alternative to traditional fuel sources. Importantly, of all the renewable energy options on the table, only biomass solid biofuels sequester atmospheric carbon dioxide. Thus, sustainably produced biomass solid biofuel is both a good source of energy for the rural poor, and mitigates climate change by reducing the amount of carbon dioxide in the atmosphere. What is needed is to use a renewable woody biomass resource such as bamboo instead of wood from trees. This is the game-changer since bamboo is the most prolific producer of woody biomass.

Biomass gasifiers produce syngas or synthesis gas from biomass, which is a fuel gas mixture consisting primarily of hydrogen, carbon monoxide, and some carbon dioxide. This is also called "producer gas". This can be used to run a gas engine coupled with a generator to produce electricity. A by-product of biomass gasifiers is charcoal production which can be between 5 and 20 per cent of the biomass used. Crucially, the charcoal produced by bamboo biomass is already 'activated'. Activated charcoal is a form of porous carbon with a wide number of industrial and other applications. Bamboo charcoal is a value-added product, and adds to income generation. This does not happen when wood is used.

A 20-kW gasifier was set up in Rajasthan, India, by CIBART, through an IFAD-funded INBAR project which is being replicated in Madagascar. 1.2kg of bamboo produces one kilowatt hour of electricity - this is similar to the biomass requirement for wood or timber, and better than other types of powdered biomass such as saw dust or peanut, coffee

A bamboo gasifier in Madagascar

> Sustainably produced biomass fuel is both a good source of energy for the rural poor, and mitigates climate change

and rice husk (Seboka & Duraisamy, 2008). As part of INBAR's project, 'South-South Knowledge Transfer Strategies' taking place in Ethiopia, Madagascar and the United Republic of Tanzania, results and lessons from this pilot will be replicated elsewhere.

Land Degradation, Watershed and Riverbank Protection

Related SDGs	SDG 13: Climate Action
Countries Involved	China, Colombia, Costa Rica, Ecuador, Ethiopia, India, Kenya, Madagascar, Peru, the Philippines, Rwanda, Sri Lanka, Uganda, the United Republic of Tanzania. INBAR's contribution to the Bonn Challenge, pledged in 2014, involves all INBAR member States.
Summary	INBAR has done a wide range of activities in support of bamboo's role for land restoration and reforestation. It has managed large scale projects, established training and production centres and shared success stories and lessons between its member States. INBAR has set up strategic networks for particularly strong sharing of knowledge on land restoration, including a partnership between China, the Netherlands and East Africa, as well as intra-regional discussions in Latin America. INBAR member States have also pledged to reforest 5 million hectares of degraded land using bamboo.
Lessons Learned for South-South Cooperation	The importance of training and production centres; the value of some very good projects to raise awareness and increase uptake of certain practices; the power of a member-based organiation to make large commitments and have a role in international proceedings.

Land degradation is an increasing problem. Every year we lose 15 billion trees and 24 billion tonnes of fertile soil (UNCCD, 2015). This is due to mining, deforestation, fires, over-production, over-watering or no water, and with much of the land being left fallow and abandoned by farmers due to non-viability. INBAR uses bamboo as a key strategic resource to help with achieving SDG 15: protecting and restoring terrestrial ecosystems.

Bamboo is an excellent natural resource to support restoration and reduce land degradation. Its fast-growing nature means that communities can begin harvesting annually and receive an early return on investment. Bamboo has an extensive root and rhizome system that binds topsoil, reducing landslide risk. It is used extensively in many countries to restore watersheds and stabilize riverbanks.

In addition, bamboo is a very adaptable and resilient woody plant that can grow in poor soils and even sodic soils (soils characterized by having a high level of sodium) and restore them to a state where agricultural crops can be grown. A very successful project by the Utthan

A bamboo forest in Chishui, China

> Chinese expertise in bamboo restoration is being harnessed widely in Ethiopia, Kenya, and Uganda as part of their sustainable land management

Centre over 1997 to 2007 supported by IDRC and INBAR resulted in the rehabilitation of tens of thousands of hectares of used brickfields and other degraded lands by growing bamboo in India. This was internationally audited and won the $1 million Alcan Prize for Sustainability for the year 2007. This approach is now being replicated through partnerships in Ethiopia, Madagascar, and the United Republic of Tanzania.

China has a long-term ongoing project that has rehabilitated over 3 million hectares of land with bamboo since the 1980s. Since the late 1990s, bamboo has been one of the main afforestation species used in China as part of the national Conversion of Cropland to Forest Programme, also known as Grain for Green. China's experience in using bamboo for landscape restoration at scale is now being shared with other INBAR member States such as Ethiopia.

Traditionally, bamboo has been used by communities across the world to reduce soil erosion and protect riverbanks. Work in China has demonstrated the success of this approach – two rivers subject to much siltation and river bank erosion now have bamboo protected slopes and banks and clear water.

School children in the United Republic of Tanzania planting bamboo in a watershed

Work in Costa Rica and Peru has shown similar success. INBAR broadcast these and similar successes to its member States to enable them to learn from each other. The Philippines and Sri Lanka doubled up their ongoing efforts and now have extensive lengths of their key rivers protected with bamboo. Rwanda has a regulation that 10 metres of each riverbank and 30 metres of lake shores should be planted with bamboo. Other countries, such as Kenya, are considering similar policy enactments.

The 'Ethiopia-Madagascar-Tanzania-India South-South Smallholder Livelihoods Project' (funded by IFAD and the European Union) has done extensive work on watershed protection, and operationalized common production and training centres in Madagascar and the United Republic of Tanzania benefiting over 1,500 women in the United Republic of Tanzania alone. The project includes technical assistance from the Indian Institute of Soil & Water Conservation which is working to quantify the various observed benefits of bamboo in soil and water conservation. Personnel in Ethiopia, Madagascar and the United Republic of Tanzania would be subsequently trained in situ.

Chinese expertise in bamboo restoration is being harnessed widely in East Africa to support afforestation in Ethiopia, Kenya and Uganda as part of their sustainable land management programmes. INBAR's 'Dutch-Sino-East Africa Bamboo Development Project' (co-funded by the Governments of the Netherlands and China, and Ethiopia's Sustainable Land Management Programme) is enabling the development of bamboo for restoration and industrial development with technical assistance from China and the Netherlands. Fifteen land management experts and 11 policy makers from Ethiopia including the State Minister of the Ministry of Agriculture, parliament members, the German development agency (GIZ) programme manager and others visited China in 2013 for

a first-hand understanding of the Chinese experience with bamboo for sustainable watershed and land management. An agreement was signed between the Ethiopia and INBAR to invite INBAR's involvement in the large 'Sustainable Land Management Project' programme of the World Bank. INBAR is in discussion with TerraAfrica which is a regional partnership programme on sustainable land management of the World Bank led by the New Partnership for Africa's Development. This includes several INBAR member States such as Cameroon, Ethiopia, Ghana and Madagascar.

In Latin America, there are initiatives to use bamboo in restoration under the World Resources Institute's '20X20' programme. Colombia, Ecuador and Peru have different and complementary experiences on the subject. Peru has thousands of hectares of bamboo planted in micro-watersheds that are being leveraged in the north of the country; Ecuador has experience of recovery of degraded soils on its north-west using its native species of bamboo and Colombia has a similar programme to protect river banks in the coffee-growing area.

Bonn Challenge

In Bonn in September 2011, an international assembly of representatives from governments, indigenous peoples and conservation groups launched a target to restore 150 million hectares of degraded and deforested lands by 2020. The member States meeting at the INBAR's Ninth Council Session in November 2014 in Addis Ababa, Ethiopia agreed to work towards a plan to restore at least 5 million hectares of degraded land and areas of low quality bamboo production, transforming them into productive, healthy bamboo forests.

Bamboo Commodities for Livelihoods and Industry

Related SDGs	SDG 1: No Poverty
Countries Involved	China, India, the Philippines, countries across East Africa and Latin America
Summary	Over 20 years, INBAR's work in countries across the world has demonstrated how bamboo can generate new income streams and a better quality of life for rural people, through the creation of small businesses, social enterprises, and women's and community groups. INBAR's projects have tested models for local livelihoods improvement, and created a large number of rural collectives and enterprises. In addition, many countries learn from INBAR's host government, China, which has a large international trade and long history in creating bamboo products.
Lessons Learned for South-South Cooperation	Rural collectives and enterprises and clusters are powerful tools for rural development; if done well, training can be an excellent way to perpetuate and expand engagement in specific industries; technology transfer from China to other countries willing to know about bamboo production and trade worked very well.

Creating new livelihood options and increasing the marketability of existing livelihoods are all ways to improve the incomes of rural communities. INBAR has worked across the world to promote bamboo's use in this regard, most recently under SDG 1: No Poverty.

Bamboo has an important role to play in rural development. With its lightweight and linear-splitting nature, bamboo is comparatively easier to process than timber. This provides farmers, many of whom are women, with opportunities to engage in initial processing, and this increases their share in value addition. Moreover, bamboo has a multiple array of high-value end uses as commodities, such as laminated plywood, flat-pack furniture and activated charcoal. This allows for non-competitive diversification within a region.

Over 20 years, INBAR's work in countries across the world has demonstrated how bamboo can generate new income streams and a better quality of life for rural people, through the creation of small businesses, social enterprises, and women's and community groups. INBAR's projects have tested models for local livelihoods improvement, and created a large number of rural collectives and enterprises. Enterprises are operating today at various levels in India, the Philippines, East Africa and Latin America, producing small household items and furniture, incense sticks, bamboo and household charcoal, construction materials for low-cost housing, and even electricity from bamboo and other agri-waste biomass. Funding from IFAD alone has resulted in the creation of an estimated 50 enterprises and cooperatives, and generated an estimated 250,000 jobs (INBAR, 2014b).

While these amounts are small compared to what is needed to bring 2.2 billion people out of poverty and achieve the SDGs, such developments do provide proof of concept of the innovative ways that bamboo can bring new income to rural communities. These are approaches that can work for more than 50 bamboo resource countries across the world's tropical and sub-tropical belts.

Mira Das, a bamboo incense stick maker and leader of a production group in Tripura, India. Credit: Center for Indian Bamboo Resource and Technology

Some of the below examples of bamboo's potential for job creation and livelihoods diversification give an idea of the huge scope for upscaling and knowledge-sharing.

In Tripura, India, a small investment of $10,000 to support women self-help groups to organize and produce higher value-added incense stick products has since grown to create 150,000 jobs. The strategy was to evolve this women's enterprise from a low-skill bamboo cutting activity, to integrate product creation, branding, packaging and marketing for local and national markets. The salary of one group has risen from $17 a day to five times higher for many of the participating women. In 2014, the incense stick enterprises in Tripura generated revenue with a seventeen-fold increase between 2005 and 2008 (Benton, 2014).

In the United Republic of Tanzania, bamboo has improved the lives of several thousand people. One hundred bamboo nurseries were created, some 1,000 people received training in a specially created bamboo training centre, and micro-enterprises were set up. These activities created new income streams in several rural areas, where communities today produce crafts and desks for local schools. Charcoal briquette production and selling that generate income and slow deforestation employ 5,000 women, many of them single mothers, who now have stable incomes. To improve women's access to other types of bamboo production jobs, the processes were modified for bamboo furniture and construction materials (INBAR, 2014b).

In Ecuador, IFAD bamboo grants have sparked a number of public-private partnerships that make furniture, flooring, crafts and construction products. These models have now also been shared with neighbouring regions in northern Peru, with some 2,000 people in 2014 employed in value chains and enterprises that produce housing that is affordable and resistant to earthquakes and floods. This housing reduces risks to climate change and transforms coastal and peri-urban areas with better quality homes for low-income communities (INBAR, 2014b)

There is huge potential to increase the flow of knowledge and expertise about bamboo commodities around the world. Bamboo plywood for construction makes a good example. Bamboo plywood has huge potential to gain market share in a number of western countries, where timber is currently used as a construction material. Although bamboo plywood has a growing international export market, worth $111 million in 2009, the main producer is China – meaning there is huge potential for other countries to start producing. With funding support from the CFC, INBAR and other partners recently helped to transfer this technology to Ethiopia. This involves setting up a workshop for structural grade bamboo plywood panels, beams and building components; establishing pre-processing units; and setting up an agreement with the Addis Ababa Housing Authority, to purchase panels produced by the centre to use for accommodation.

Similar initiatives, which take advantage of future bamboo innovations, will continue to spread experiences and livelihood opportunities from bamboo around the tropical and subtropical South.

Ghanaian woman selling bamboo products

Raising Awareness and Building Capacity

Related SDGs	SDG 17: Partnerships for the Goals
Countries Involved	China, India, the Philippines, countries across East Africa and Latin America
Summary	INBAR has put a real emphasis on training as a mechanism for sharing knowledge and best practices. It has trained somewhere between 13,000 to 24,000 people in a wide range of skills across the bamboo value chain.
Lessons Learned for South-South Cooperation	Training can take place either in the host country of specific experts or abroad; field trips are a good way to engage trainees and help them learn from experts in the field; training should target the right people in the right sectors in order to have the most impact; following up on training ensures future sessions can be further improved or amended.

Training across the value chain – in everything from establishing and maintaining healthy bamboo and rattan reserves, to product making and trade – is an essential way to spread knowledge, best practices and build capacity for sector development. This is an activity which requires South-South knowledge exchange, between experts in the bamboo and rattan sectors and those countries with plentiful bamboo resources. China has a large role to play in this regard. It is the host country of INBAR, its largest donor, and the major beneficiary of global trade in bamboo – currently making up 60 per cent of the global export trade in bamboo and rattan (INBAR, 2017) – China's contribution in assisting other member States in building up their capacity is very important.

By leveraging its 42-strong network of member States to share technology and experiences, INBAR contributes directly to the achievement of SDG 17: Partnerships for the Goals.

INBAR's training activities have been carried out for 20 years in partnership with a wide range of donors. From 1999 to 2015, China's Ministry of Science and Technology (MOST) supported training; from 2005, the Ministry of Commerce (MOFCOM) has supported training. Many partners contributed to support MOST training, including FAO, UNIDO, GIZ, USAid, Save the Children, SNV, the International Centre for Integrated Mountain Development (ICIMOD) and more.

The content of MOST and MOFCOM training covers a wide range of topics. MOST workshops cover biodiversity conservation, ecological reconstruction, sustainable forest

Training on micro-tissue culture unit operation in Madagascar

management, non-timber forestry products development, and more. MOFCOM training has covered issues such as sustainable management, cultivation and propagation; bamboo engineered product development; bamboo charcoal and fibre product technologies; bamboo for climate change and more.

The impacts of these training programmes are widespread. INBAR training has reached beyond member countries of INBAR, to facilitate in membership development. In particular, MOST training has harnessed a large network of alumni who together have contributed to enhancing global bamboo and rattan development activities around the world. Training sessions have also done a lot to raise global awareness of the significance of bamboo and rattan in dealing with major issues: from poverty alleviation and ecology environment rehabilitation to fair trade, climate change and the sustainable development goals. Both MOFCOM and MOST training have provided a platform for international exchanges and cooperation in bamboo and rattan development.

People in the United Republic of Tanzania are being trained on sustainable land management using bamboo

Overall, INBAR has trained somewhere between 15,000 and 25,000 people from across the world.

Assessing the Impact of INBAR's Work

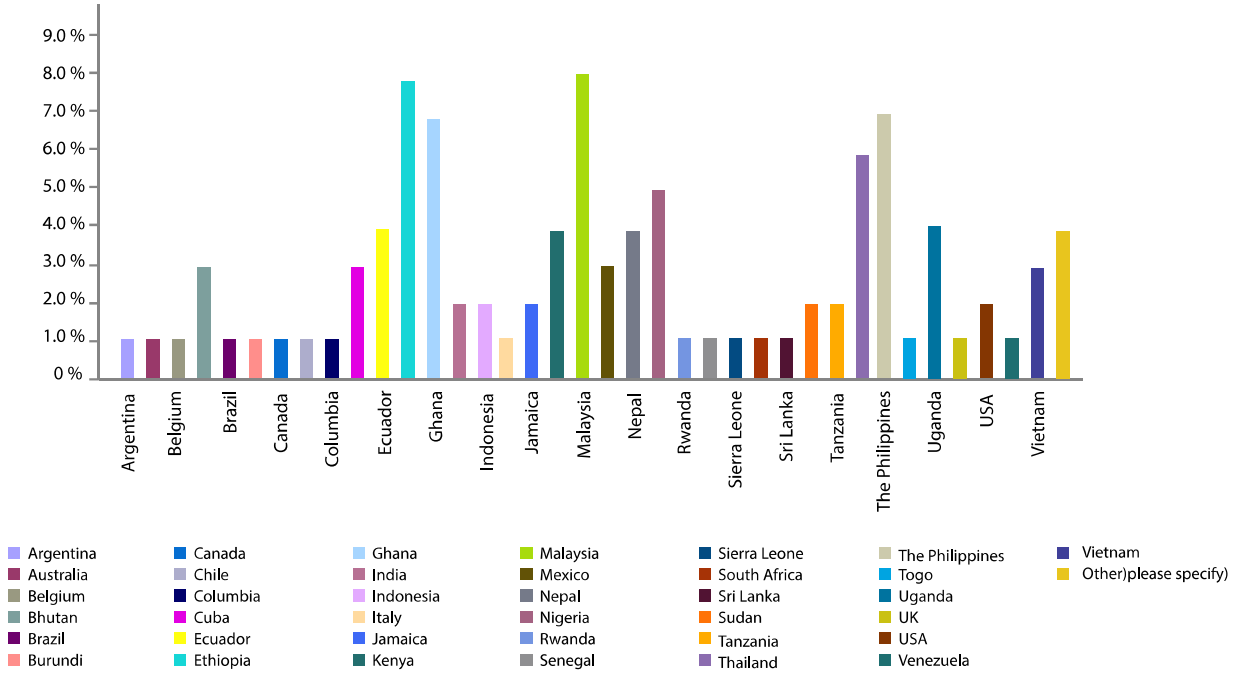
All good training is an iterative process, revised and refined following feedback from previous attempts. Data from several post-training surveys show that INBAR training has involved a wide number of people from different sectors – from commerce and trade to policy, energy, environment or forestry – and different institutions: researchers at universities, government representatives, architects and designers, forest engineers, programme managers and entrepreneurs.

Participants of MOST and MOFCOM training, surveyed over a two-year period, detailed that networking and partnership were the most important aspects of the training, followed by awareness-building and policy training. For MOST training in particular, teaching focused on practical issues: propagation and cultivation, construction and poverty alleviation. According to these trainees, their courses made contributions to several SDGs, relating to climate action (SDG 13); poverty reduction (SDG 1); industry growth and innovation (SDG 9) and sustainable housing and construction (SDG 11).

Following the training courses, a majority of INBAR trainees have since gone on to promote the advancement of the bamboo sector in various ways. These include project implementation and training, as well as providing policy advice and authoring publications. These have resulted in a perceived increase in awareness and knowledge raising; resource development; policy and development support; and job and income creation in the countries where respondents live.

There is still room for improvement. Feedback from surveys and anecdotal evidence from participants shows that a lack of adequate policy and government support still prevent people from putting their new skills into practice. In addition, there is a lack of finance to support projects in some areas. Further training on policy contexts, as well as practical support in how to receive and apply for funding, will further improve the impacts of INBAR training for future years.

The wide geographical spread of participants involved in China-based training, 2009 to 2011



Case Study

Dr. Ximena Lodono, President of the Colombian Bamboo Society, participated in the INBAR-MOST (China) training workshop in 1999. She has since been making efforts to extend the knowledge and technologies learned. She directly imparted this knowledge and information to more than 800 people with different background (students, professionals, craftsmen, architectures, workers, labor women, children, etc.) during seminars and workshops in Colombia and three other Latin American member countries of INBAR: Costa Rica, Ecuador and the Bolivarian Republic of Venezuela; she also provided the information brought from the workshop to 3 universities and 6 institutes; advised the President of Colombia on bamboo development projects; and used the training materials brought back from the workshop as references for developing self-made bamboo processing machines.

Case Study

In 2001, **Gloria Adu** from Ghana attended INBAR's 'International Training Workshop on Bamboo Handicrafts Techniques, Tools and Small Machines' in China. During the course of the workshop, which she described as an "eye opener", Ms. Adu learned about several diverse types and uses of bamboo, and was taken on several tours to see bamboo plantations and arts and crafts in different parts of the country. Following training, Ms. Adu was inspired to set up her own industry. 'Global Bamboo Products' makes custom items on demand, and is now beginning to focus on the production of bamboo briquettes and charcoal. The company has gone from strength to strength, with a 300-hectare bamboo plantation and several local and international awards. Gloria has used Global Bamboo Products to train other people: an estimated 400 people in alternative livelihood activities, and over 10,000 farmers in the cultivation, management, and primary processing of bamboo and bamboo charcoal.

The future of bamboo? Bamboo's resilience, flexibility and light weight make it perfect for wind turbine blades and other products

Chapter III

Links to Major Regional Initiatives and the Global Development Agenda

Links to Major Regional Initiatives and the Global Development Agenda

Global Initiatives

As capacity has developed in its member States over the 20 years since INBAR's establishment, partnerships have flourished and governments, development loan projects, bilateral and multilateral programmes are increasingly drawing upon the available growing expertise among INBAR member States. This allows INBAR to increasingly focus on larger regional and global issues and programmes, such as the 2030 Agenda for Sustainable Development and associated SDGs, as well as the outcomes of the Paris Agreement on Climate Change.

INBAR is Permanent Observer to the United Nations Convention to Combat Desertification (UNCCD), the United Nations Framework Convention on Climate Change (UNFCCC), and the United Nations Convention on Biological Diversity (UNCBD).

In a statement at the twelfth UNCCD Conference of Parties (COP12), INBAR highlighted bamboo as a strategic resource to achieve land degradation neutrality, noting its proven role in reversing land degradation in China and India, and now Ethiopia.

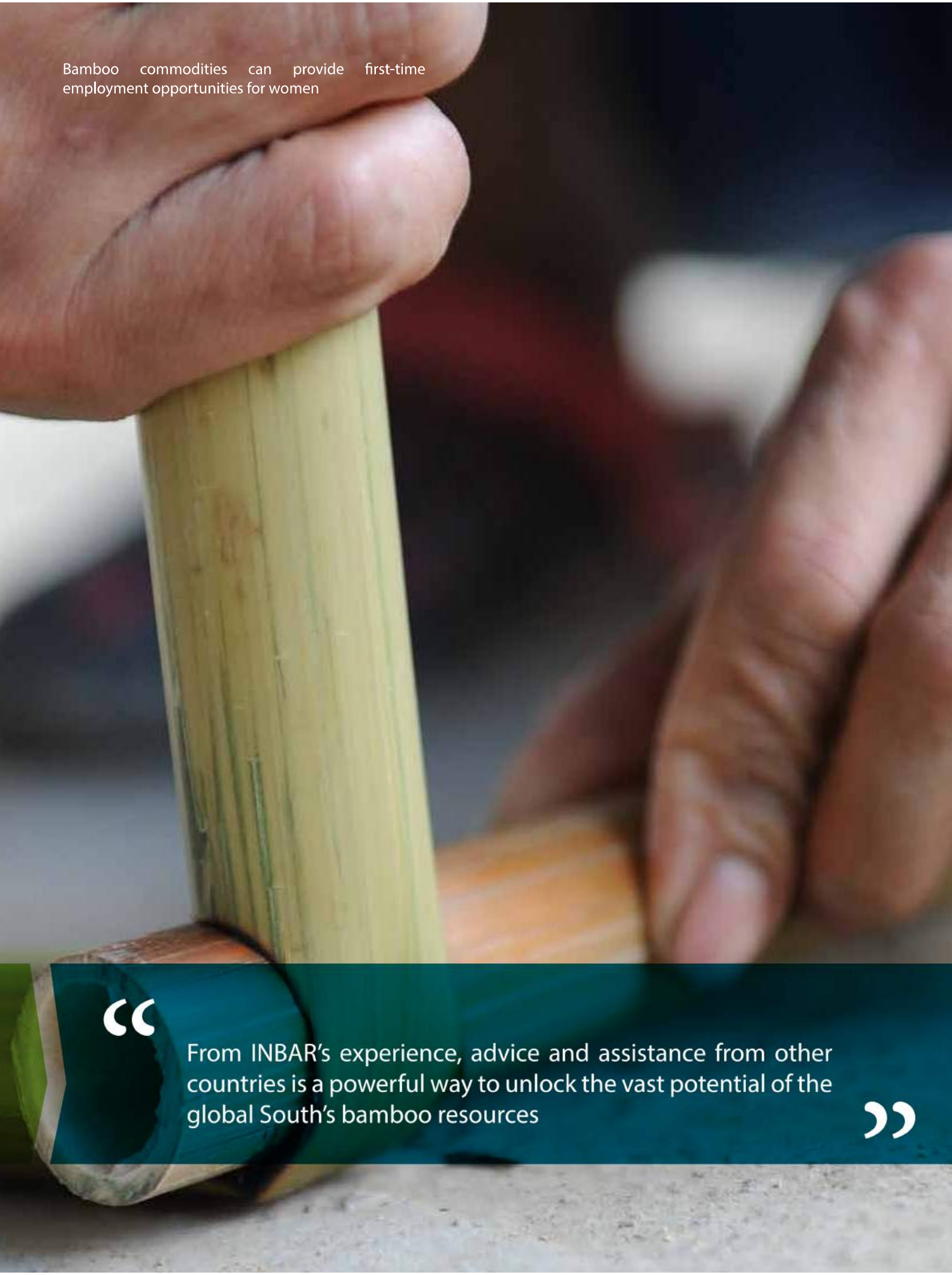
INBAR launched a synthesis report about bamboo for climate change at the twentieth Conference of the Parties to the UNFCCC (COP20) in Lima, Peru. At the twenty-second COP in Marrakesh in November 2016, INBAR together with the China National Development and Reform Council and the China State Forestry Administration launched a ministerial statement on the importance of bamboo as a unique vehicle for South-South and triangular collaboration on climate change and sustainable development.

Among other things, the Ministerial Statement recognized that bamboo is a strategic natural resource for South-South cooperation. It pointed out the importance of advanced economies as bamboo importers with experience in bamboo production, marketing, and standards who can provide triangular cooperation, and urged INBAR to work together with relevant United Nations bodies to mobilize funding and promote successful case studies of South-South and triangular cooperation. It concluded with a pledge to use the Ministerial Statement as a framework for launching a political commitment and a practical, detailed South-South and triangular action plan during the Global Bamboo and Rattan Congress to be held in 2018.

INBAR is also engaged in other United Nations global initiatives, and is a partner of FAO, the United Nations Environment Programme (UNEP), the United Nations Development Programme (UNDP), the United Nations Industrial Development Organization (UNIDO) and the United Nations Educational, Scientific and Cultural Organization (UNESCO). It also works closely with the United Nations Office for South-South Cooperation. INBAR is a member of United Nations Economic and Social Council (ECOSOC). It is in the process of applying for Permanent Observer status to the General Assembly of the United Nations.

INBAR is a founding member of the Association of International Research and Development centres for Agriculture, and works closely with several CGIAR Centers, especially the Centre for International Forestry Research and the World Agroforestry Centre.

In China, INBAR is a partner of the China Council for International Development on Environment and Development.



Bamboo commodities can provide first-time employment opportunities for women

> From INBAR's experience, advice and assistance from other countries is a powerful way to unlock the vast potential of the global South's bamboo resources

One beneficiary of a training course on bamboo nursery planting

Conclusion

Key Takeaways and Lessons Learned

Key Takeaways Including Lessons Learned

INBAR's experience over 20 years of operation has given the following insights into what is required for mutually beneficial, meaningful South-South cooperation.

Sharing Policy Frameworks

A supportive policy framework is a prerequisite for meaningful development of the bamboo sector. Sector-specific policies which integrate bamboo – into their construction, employment, or environmental protection plans, for example – are particularly powerful ways to scale up the sustainable uses of bamboo.

Rather than reinvent the wheel, bamboo-resource countries are increasingly learning from each other when they put together relevant policies. To take some examples: Rwanda's national bamboo strategy was based on experiences from India; Kenya's plans for riparian restoration in its flagship Vision 2030 built on experiences and knowledge-sharing from Ethiopia and Rwanda; Viet Nam's National Strategy and Provincial Strategy was developed by INBAR experts from China; the National Bamboo Mission in India was set up through INBAR advocacy and based on learning from experiences in INBAR's other member States, including China. Across Latin America, countries have developed bamboo building codes based on the success of similar codes in Colombia, and this in turn has influenced countries as far away as Nepal.

In all of the above cases, INBAR has acted as a facilitator or knowledge-sharer. Further action like this is necessary for the advancement of bamboo for use in development.

Knowledge and Technology Transfer

As this publication shows, training and knowledge transfer has helped individuals, communities and countries across the world to take up new ways of processing bamboo, access new markets and improve the image of their products. It has also influenced the formation of national policies on bamboo. The Philippines included bamboo in its national greening strategy following training provided by the Chinese Ministry of Science and Technology to over 100 Filipinos. Similarly, in Gujarat, India, INBAR-led training on how to build bamboo school furniture in Gujarat began with the success of bamboo furniture in the Philippines.

One particularly important result is the increased involvement of the private sector. In Nepal, bamboo construction codes for schools were developed based on technologies shared from Latin America and have since been adapted by Nepalese firms. Jamaica is developing a bamboo charcoal industry and relevant standards based on experiences from China and Ethiopia. And in Tripura, India, INBAR-led training in value-added bamboo incense stick production has given many workers, mainly women, access to massive regional markets in incense sticks.

Of course, no one species of bamboo is like another, and country contexts – growing conditions, markets, and technical capacity – differ hugely. Improved knowledge about bamboo resources – what we have and how to use it – is essential for countries to continue unlocking this potential and to ensure that training is up-to-date. In 2015, INBAR launched the Global Assessment for Bamboo and Rattan. GABAR aims to provide robust information about the state and potential of bamboo resources around the world, to help decision makers integrate these plants into environmental and socioeconomic policies. Outputs will include technical reports, policy advice and updated practical training materials.

Linking to Markets

Although the bamboo and rattan industry is worth $60 billion, the majority of trade in bamboo products is internal. Europe is the largest importer of bamboo products; however, low-value products and a lack of capacity to adhere to international standards prevent many rural communities in bamboo resource areas from accessing this lucrative market.

From INBAR's experience, advice and assistance from other countries is a powerful way to unlock the vast potential of the global South's indigenous bamboo resources for international trade.

Initiated in 2016, the INBAR-led 'Dutch-Sino-East Africa Bamboo Development Programme' aims to bring about an economic transformation of East Africa's bamboo sector by building on Chinese and Dutch expertise in bamboo value chain development, product design, marketing and standardization. Similar initiatives will help to link suppliers and producers with markets across the world.

Work still needs to be done to expand the international market for bamboo products

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Annexes

Annex 1 – Non-governmental Organizations and Social Enterprises Facilitated by INBAR

YEAR	ENTITY	TYPE	COUNTRY
2013	WODGRA BAMBOO & BRIQUETTING COMPANY LTD.	SE	UNITED REPUBLIC OF TANZANIA
	SAKHI BIO ENERGY PVT LTD	SE	INDIA
	CIBART-MG	NGO	MADAGASCAR
	TANZANIA BAMBOO DEVELOPMENT CENTRE	NGO	INDIA
	NATURE FRIENDLY BRIQUETTERS PVT LTD	SE	INDIA
2012	NATIVE BRIQUETTERS PVT LTD	SE	INDIA
2010	FAGNARINA	NGO	MADAGASCAR
	BARARATA	NGO	MADAGASCAR
	CENTRE FOR PRIMARY PROCESSING (CPP)	SE	COLOMBIA
	DEL SUR	SE	ECUADOR
2009	NATIVE KONBAC BAMBOO PRODUCTS PVT LTD	SE	INDIA
	NATIVE DEVELOPMENT SERVICES	NGO	INDIA
2008	MOZBAMBU	NGO	MOZAMBIQUE
2004	ECUABAMBOO	NGO	ECUADOR
	BAMBOO & RATTAN NETWORK OF GHANA (BARNET)	NGO	GHANA
	ISONGOLE BAMBOO SOCIETY (IBS)	NGO	TANZANIA
	KONKAN BAMBOO & CANE DEVELOPMENT CENTRE (KONBAC)	NGO	INDIA
2003	TRIPURA BAMBOO & CANE DEVELOPMENT CENTRE (TRIBAC)	NGO	INDIA
	TAMENGLONG BAMBOO & CANE DEVELOPMENT CENTRE (TAMBAC)	NGO	INDIA
2002	CENTRE FOR INDIAN BAMBOO RESOURCE & TECHNOLOGY (CIBART)	NGO	INDIA

Annex 2 – Construction Standards

1. Countries incorporating ISO standards designed by INBAR (ISO 22156:2004 – 'Bamboo structural design; ISO 22157-1:2004 – 'Bamboo – determination of physical and mechanical properties – Part I: Requirements'; ISO/TR 22157-2:2005 – 'Bamboo – Determination of physical and mechanical properties – Part II: Laboratory Manual' as their National Standards

Country	Title	Standard No.	Committee	Language	Note
Colombia	Métodos de Ensayo para Determinar las Propiedades Físicas y Mecánicas de la Guadua angustifolia Kunth (Methods and tests to determine the physical and mechanical properties of Guadua angustifolia Kunth)	NTC 5525	El Instituto Colombiano de Normas Técnicas y Certificación (ICONTEC)	Spanish	esta norma es una adopción modificada (MOD) de la norma ISO 22157-1:2004.
Ecuador	DISEÑO ESTRUCTURAL EN BAMBÚ	NTE INEN-ISO(DIS); 22156	INSTITUTO ECUATORIANO DE NORMALIZACIón (INEN): Standardization Institute of Ecuador	Spanish	ISO 22156:2004
Ecuador	DETERMINACIÓN DE PROPIEDADES FÍSICAS Y MECÁNICAS DEL BAMBÚ	NTE INEN-ISO(DIS); 22157	INSTITUTO ECUATORIANO DE NORMALIZACIón (INEN): Standardization Institute of Ecuador	Spanish	ISO 22157:2004
Jamaica	Bamboo - Structural design	JS ISO 22516 : 2004	Bureau of Standards Jamaica (BSJ)	English	ISO 22156:2004
Jamaica	Bamboo -- Determination of physical and mechanical properties -- Part 1: Requirements	JS ISO 22517- 1 : 2004	Bureau of Standards Jamaica (BSJ)	English	ISO 22157:2004
Vietnam	Bamboo. Structural design	TCVN 8573:2010	Directorate for Standards, Metrology and Quality	English	ISO 22156:2004
Vietnam	Bamboo. Determination of physical and mechanical properties. Part 1: Requirements	TCVN 8168-1:2009	Directorate for Standards, Metrology and Quality	English	ISO 22157-1:2004
Vietnam	Bamboo. Determination of physical and mechanical properties. Part 2: Laboratory manual	TCVN 8168-2:2010	Directorate for Standards, Metrology and Quality	English	ISO/TR 22157-2:2004
The Philippines	Bamboo-Structural design	PNS ISO 22156:2010	BUREAU OF P STANDARDS (BPS)	English	ISO 22156:2010
The Philippines	Bamboo -- Determination of physical and mechanical properties -- Part 1: Requirements	PNS ISO 22157-1:2010	BUREAU OF PRODUCT STANDARDS (BPS)	English	ISO 22157-1:2010
The Philippines	Bamboo -- Determination of physical and mechanical properties -- Part 2: Laboratory manual	PNS ISO/TR 22157-2:2010	BUREAU OF PRODUCT STANDARDS (BPS)	English	ISO/TR 22157-2:2010
Netherlands	Bamboo - Structural design	NEN-ISO 22156:2004	Netherlands Normalisatie-instituut (NEN)	English	ISO 22156:2010
Netherlands	Bamboo -- Determination of physical and mechanical properties -- Part 1: Requirements	NEN-ISO_22157-1:2004	NEN	English	ISO 22157-1:2010
Netherlands	Bamboo -- Determination of physical and mechanical properties -- Part 2: Laboratory manual	NEN-ISO_22157-2:2004	NEN	English	ISO/TR 22157-2:2010
Peru	Diseño estructural con bambú	Norma ISO/TC165/N313	ISO	English	ISO 22156:2004
Peru	Determinación de las propiedades físicas y mecánicas del bambú	Norma ISO/TC165/N314	ISO	English	ISO 22157-1:2004
Peru	Manual de laboratorio y métodos de pruebas para la determinación de características físicas y mecánicas del bambú	Norma ISO/TC165/N315	ISO	English	ISO/TR 22157-2:2004

Country	Title	Standard No.	Committee	Language
India	National Building Code of India, section 3 Timber and bamboo: 3B	NBC 2005	Bureau of India Standards (BIS)	English
India	Structural design using bamboo – code of practice	IS 15912 (2012)	BIS (CED 13)	English
Colombia	UNIONES DE ESTRUCTURAS CON GUADUA ANGUSTIFOLIA KUNTH	NTC 5407	ICONTEC	Spanish
Peru	Reglamento Nacional de Edificaciones, Section III. Code E100 – Diseño y Construcción con Bambú	ICG 2012	ICG	Spanish
Peru	Technical Standard - E. Bamboo (Spanish Name: Norma Técnica-E.100 Bambú)	No. 011-2012-Vivienda	Ministerio de Vivienda, Construcción y Saneamiento, The Republic of Peru	Spanish
Ecuador	Norma Ecuatoriana de la Construcción – chapter 17 Utilización de la Guadua Angustifolia Kunth en la Construcción (Use of Guadua angustifolia Kunth in construction)	INEN (2011)	INSTITUTO ECUATORIANO DE NORMALIZACIón (INEN): Standardization Institute of Ecuador	Spanish
Ecuador	MANUAL DE LABORATORIO SOBRE MÉTODOS DE ENSAYO PARA LA DETERMINACIÓN DE PROPIEDADES FÍSICAS Y MECÁNICAS DEL BAMBÚ	MTE INEN 2 (2004)	INEN	Spanish
Nepal	GUIDELINES FOR EARTHQUAKE RESISTANT BUILDING CONSTRUCTION: EARTHEN BUILDING (EB) (Part 3 Materials 3.4 Bamboo; Part 9 9.3 Bamboo for Flooring and Roofing; Part 10 Seismic-Resistant Components)	NBC 204 : 1994	Ministry of Physical Planning and Works, Department of Urban Development and Building Construction	English

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INTERNATIONAL BAMBOO
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