



# National Roadmap for Bamboo Sector

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Driving Ecosystem Restoration and Resilient  
Economic Growth by **Unlocking Nepal's Bamboo Sector**











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## Acronyms and Abbreviations

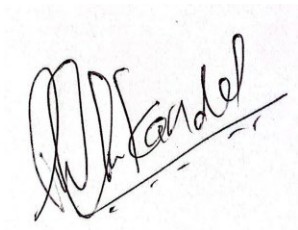
<b>CDM</b>	Clean Development Mechanism
<b>CSIO</b>	Cottage and Small Industries Office
<b>FAO</b>	Food and Agriculture Organization
<b>Ha</b>	Hectares
<b>HHs</b>	Households
<b>INBAR</b>	International Bamboo and Rattan Organization
<b>Masl</b>	Mean above sea level
<b>MoALD</b>	Ministry of Agriculture and Livestock Development
<b>MoEST</b>	Ministry of Education, Science and Technology
<b>MoFE</b>	Ministry of Forests and Environment
<b>MoICS</b>	Ministry of Industry, Commerce and Supply
<b>MoITFE</b>	Minister of Industry, Tourism, Forest and Environment
<b>MoLMAC</b>	Ministry of Land Management, Agriculture and Cooperatives
<b>PTMCDB</b>	The President Chure-Tarai Madhesh Conservation Development Committee
<b>SDGs</b>	Sustainable Development Goals
<b>SWCO</b>	Soil and Watershed Conservation Office
<b>TEPC</b>	Trade and Export Promotion Center
<b>TIS</b>	Tree Improvement and Silviculture Centre
<b>UN</b>	United Nations

## Foreword

Degradation of forest land, soil erosion, landslides are major environmental challenges both in hilly and plain terai region of Nepal. Bamboo sector development can maintain and restore ecosystem functions to create resilient and sustainable landscapes particularly to reduce soil erosion, maintain water supplies and livelihood opportunities. Bamboo-based enterprises is an option to reduce poverty by creating employment for both the rural and urban workforce. It is also an alternative for farmers to grow in their flood and landslide prone farmland as a disaster resilient farming option to address climate induced disaster on livelihoods and poverty reduction. Employment opportunities can be created through small scale handicraft production and large-scale bamboo industries.

Multiple benefits of bamboo place it at as a key priority for building a climate resilient future for Nepal and supporting national green growth. The Nepal bamboo sector is currently underdeveloped, with market potential yet to be explored and limited financing opportunities. The development of an internal market for bamboo will reduce the need for imports and through careful market development will generate revenues through exporting products.

I would like to thank the team that assembled this roadmap, including experts from the Ministry of Forests and Environment, the Department of Forest Research and Training Centre, provincial and local governments, and the Global Green Growth Institute, as well as private sector and civil society partners. As Nepal moves toward sustainable growth, this roadmap acts as an important guide for expanding the bamboo sector contribution in the national development.

A handwritten signature in black ink, reading 'Pem Narayan Kandel', with a horizontal line underneath.

**Pem Narayan Kandel, PhD**

*Secretary*

Ministry of Forests and Environment

## Foreword

With the realities of climate change becoming increasingly evident, bamboo offers some excellent examples of ‘win-win’ solutions to this challenge. Bamboo provides an important source of income, energy, food, and construction materials for rural communities, as well as a tool for restoring degraded land and addressing the world’s most pressing challenges, including climate emergencies, land degradation, deforestation, and rural poverty.

With its fast-growing, self-regenerating, and multipurpose uses, the bamboo sector has great potential for value-addition aimed at domestic and international markets. It provides entry points for resource-poor people to access sustainable development opportunities. In addition, bamboo has the potential to make a substantial contribution to combating climate change, acting as a significant carbon sink.

According to the recent Global Forest Resource Assessment report, a total of 35 million ha of bamboo resources exist across the globe, of which 24.9 million ha are in Asia (FAO, 2020), with a huge market potential waiting to be unleashed. There has been no updated resource inventory data for Nepal since 1995, but Nepal has a wide coverage of bamboo from the plains of Terai to the High Mountains (4000 masl) in both natural forests and farmland with 12 genera and more than 50 species.

Bamboo could constitute a key component of Nepal’s strategy to achieve its sustainable development goals, policies to adapt to and mitigate climate change, and recovery from the COVID-19 pandemic. In order to do this well, we need a better understanding of the bamboo sector, the people involved, and the major problems they face. Therefore, research on technical aspects related to the bamboo sector’s economic, policy, institutional, and social aspects is needed. Furthermore, clear and concrete visions are essential to address on-the-ground problems and opportunities that people face, and on this basis, a well-targeted development agenda can be designed.

In this regard, I welcome this first national roadmap for the bamboo sector – ‘driving ecosystem restoration and resilient economic growth by unlocking Nepal’s bamboo sector.’ The roadmap can provide a clear vision of a bamboo-based economic sector that generates sustainable income and employment opportunities for local people, thereby contributing towards ecosystem restoration, green, resilient, and inclusive development in Nepal. Furthermore, the roadmap envisions and assists policymakers, planners, and practitioners in overall bamboo sector development in the country. GGGI will continuously support the Government of Nepal to overcome the investment and development barriers to bamboo sector development, such as lacking data and the underutilization of various sources of sustainable and green finance to consolidate and upscale high-quality bamboo value chains.

Sincerely,



**Lasse Ringius**

*GGGI Nepal Country Representative*

GGGI

## Executive Summary

The national roadmap was prepared as a step towards the development of a strategic plan for overall bamboo sector development in Nepal. It provides a comprehensive picture of the status of the bamboo sector in Nepal, including distribution, cultivation and management, market trends and opportunities, roles in ecosystem restoration, and inclusive development. It is envisaged that the implementation of the roadmap will contribute towards strengthening institutional capacity, green, inclusive and resilient development, and ecosystem restoration.

The national roadmap has the following vision:

“A bamboo-based economic sector is developed that provides sustainable income and employment opportunities to local people thereby contributing towards ecosystem restoration, green, resilient and inclusive development”.

Four strategic pillars have been proposed in the roadmap to translate the vision into practice:

- policy and institutional framework,
- resilient and inclusive development,
- business development, and
- ecosystem restoration.

The interventions proposed in the roadmap will be implemented through the involvement of concerned state and non-state actors. The roadmap will assist policymakers, planners, and practitioners in overall bamboo sector development in Nepal.





## 1. Introduction

Out of the 35 million ha of bamboo resources across the globe, 24.9 million ha are in Asia (FAO, 2020). Approximately 63,000 ha of bamboo vegetation are found in Nepal (Karki and Karki, 1995). Bamboos are naturally distributed from the plains of Terai to the High Mountains (4000 masl) in both natural forests and farm land in Nepal, with 12 genera and more than 50 species (TIS, 2004). Bamboo is a popular species grown on private lands, and is also found in public land, river banks, and national forests.

Bamboo is a precious natural resource in Nepal that plays an important role in the rural economy and in supporting the livelihoods of rural people, particularly those from socially and economically disadvantaged groups. The establishment and promotion of bamboo-based enterprises have the potential to provide a good opportunity for improving the livelihoods of the poor segments of society in Nepal. There is also a great scope for women from disadvantaged groups to be involved in craft making. The export value of bamboo products to different countries from Nepal in the year 2019/20 was NRs 71.172 million (US\$587,882) (TEPC, 2020).

To some extent, different policy and legislative instruments have been established regarding the development of the bamboo sector in Nepal. However, there is no dedicated policy or strategic document in relation to bamboo in Nepal. Nepal is one of the founding members of the International Bamboo and Rattan Organization (INBAR) based in China. The Forest Research and Training Centre, a focal government institution to INBAR, has formulated a draft Bamboo and Rattan Strategy and Action Plan that is yet to be endorsed by the Government of Nepal.

Despite the huge potential of bamboo resources, farmers and entrepreneurs lack the required knowledge on its various aspects, including cultivation and management, processing and value addition, financing, and marketing. Moreover, there is no comprehensive study that assesses the contribution of bamboo resources to socioeconomic development and employment generation. Until recently, the economic potential of bamboo has been largely under-estimated or ignored, and the Government of Nepal has yet to develop a coherent strategy for the bamboo sector. So far, the responsibility for looking after the bamboo sector has been scattered among several institutions.

Furthermore, the issues of the bamboo sector have not been mainstreamed into policies and programs of the three tiers of government and there are limited means of implementation (institutional capacity, financial resources, technology, and knowledge) to address these issues in the country. Similarly, investment from the government and private sector for promoting bamboo is negligible. Bamboo, which is widely used for household purposes and is prevalent at local markets, is gradually replaced with less environment-friendly materials such as plastics. The details of these problems and challenges explored during provincial and local level consultations are presented in Annex 2.

Bamboo is a valuable resource with enormous economic, social, and environmental benefits, including improved rural life, employment generation, and the mitigation of environmental concerns. The bamboo sector can support the achievement of the national objectives presented in the current 15th five-year periodic plan.

The plan aims to provide easily accessible, high-quality, and modern infrastructure, as well as the generation of productive employment and high-quality, inclusive economic growth through poverty alleviation. The development and commercialization of the bamboo sector can significantly contribute to this. In its many policies, acts, and regulations, the government of Nepal provides for a regulatory enforcement of a continuous national supply of forest products, including bamboo. The salient features of key policy and legislative instruments related to bamboos are presented in Box 1:

#### **Box 1: Policy and Legislative Instruments related to Bamboo in Nepal**

- **National Biodiversity Strategy and Action Plan (2014-2020)** The plan highlights the design and implementation of targeted programs to promote agroforestry and private forestry and enhance alternative livelihoods to reduce dependency on national forests.
- **Agriculture Development Strategy, 2014** One of the outputs mentioned in the strategy is that “subsistence production-based forestry is developed into competitive, agriculture friendly and inclusive forest management practice, with a holistic and community-based landscape approach to natural resource management and livelihoods”.
- **National Forest Policy, 2019** The policy emphasizes to promote NTFPs-based enterprises in the country in collaboration with user groups, cooperatives, private sector, banking and other financial institutions.
- **National Agroforestry Policy, 2019** The policy highlights development and promotion of different agroforestry models based on land suitability. Based on the policy provisions, there is an opportunity to work in development and promotion of bamboo-based agroforestry.
- **Forest Act, 2019** The Act has a provision of private forestry and agroforestry and establishment of forest-based enterprises.
- **Fifteenth Five-year Plan (2019/2020-2023/2024)** The plan mentions increased production of NTFPs, emphasis on agroforestry and forest-based enterprises through community forestry, commercialization of important herbs and NTFPs, promotion of private forestry, research and studies of endemic plants and important herbs and NTFPs.
- **Draft Bamboo and Rattan Strategy and Action Plan** This plan presents a vision of contributing to environment protection and prosperity through sustainable management of bamboo and rattan resources.



Similarly, bamboo sectors play an essential role in achieving the Sustainable Development Goals (SDGs). Out of the 17 SDGs, it makes notable contributions to the achievement of the following SDGs:

**Box 2: Bamboos and SDGs**



**SDG 1: No poverty.** Bamboo generates revenue through harvesting, collecting, processing, manufacturing, and trade, which helps to alleviate poverty and improve livelihoods.

**SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all.** There is a potential to establish bamboo plantations for energy-related activities on land that is not productive, especially degraded or marginal lands that cannot be used for food crops.

**SDG 8: Decent work and economic growth.** The bamboo sector provides economic growth opportunities through diversification and the development of micro, small, and medium-sized firms.

**SDG 9: Industry, Innovation and Infrastructure.** The bamboo sector offers contemporary infrastructure, technological development, and new product added value opportunities.

**SDG 11: Sustainable cities and communities.** Bamboo provides material for appropriate, safe, and economical housing while drastically reducing the number of people affected by calamities.

**SDG 12: Responsible consumption and production.** Bamboo is an effective material and resource for waste reduction due to its potential for sustainable management, biodegradability and effective use.

**SDG 13: Climate Action.** Bamboo can contribute to enhanced resilience to climate-related threats, and contribute to landscape restoration and carbon sequestration hence providing climate-change mitigation ecosystem services.

**SDG 15: Life on land.** One of ecosystem services provided by bamboo vegetation is the supply of habitat, maintenance of biodiversity, and erosion control.

Bamboo is a fast growing and high yielding renewable natural resource and can play a useful role in climate change mitigation and adaptation. Moreover, the development of bamboo resources can greatly support the environment and ecological balance, thereby contributing towards maintaining the people’s quality of life. With

the cultivation and management of bamboo on a sustained basis, the bamboo sector can play a significant role in ecosystem restoration and support overall economic development. Bamboo can also serve as an alternative to many forest products and other less environment-friendly products.

Realizing the potential instrumental role of the bamboo sector in Nepal, a strategy is required that focuses on ecological, social, and economic aspects of bamboo. We suggest that the national roadmap should comprise comprehensive information focusing on four strategic pillars for the overall bamboo sector development in Nepal. It is expected that the national roadmap will act as a basis for devising and implementing interventions on the bamboo sector in future.

The approach of formulating the roadmap ensures inclusiveness in the process by mobilizing three tiers of government, civil society including the private sector, farmers, entrepreneurs, and community-based organizations. The roadmap development was primarily based on stocktaking of existing situations through extensive review of relevant published and unpublished literature at national and international levels. Consultations with stakeholders at the central, provincial, and local level were carried out to seek feedback on possible focal regions and areas to be included in the roadmap. For this purpose, three districts each from Province 1 and Madhesh Province were selected, and two farmers/forest users groups and one traders' group were selected from each district. Similarly, focus group discussions were carried out with representatives of two municipalities from each district. Consultations to seek the expert opinion of concerned officials and experts were implemented at the provincial and central level during the study. This roadmap has been drafted in close consultation with government officials, development partners, and donors.

The national roadmap is comprised of seven chapters. Chapter one outlines the background information, problems and challenges, justification for formulation of roadmap, the roadmap formulation process, and organization of the policy document. Chapter two highlights the existing situation of the bamboo sector in Nepal, including the distribution, cultivation and management, and marketing. Chapter three presents the vision, goals, strategic pillars, and priority actions for four strategic pillars. Chapter four describes the indicative resources and responsible institutions for translating the roadmap into practice. Chapter five concludes by highlighting the potential risks for the implementation of the roadmap.





## 2. Situation Analysis

### 2.1 Resource Availability

The recently published Global Forest Resource Assessment report estimated there to be a total of 35 million ha of bamboo resources across the globe, of which 24.9 million ha is in Asia (FAO, 2020). The total area of bamboo has increased by almost 50 percent between 1990 and 2020, largely because of increases in China and India (FAO, 2020).

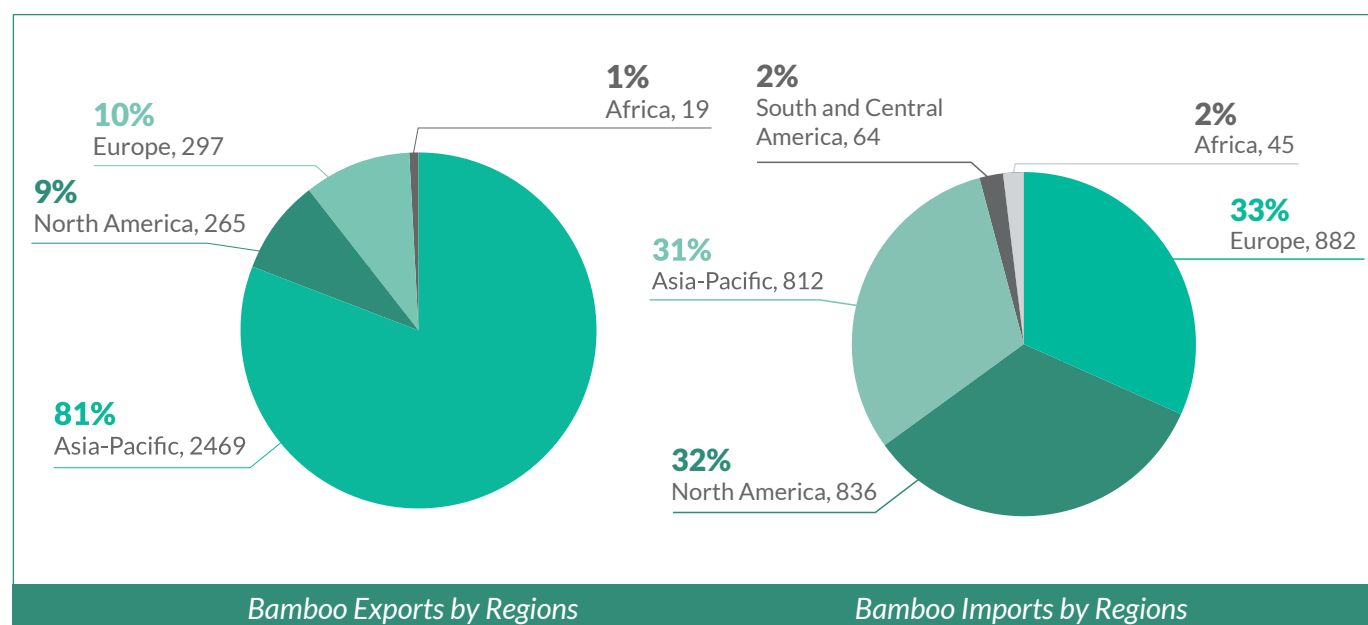
In Nepal, 12 genera and more than 50 species of bamboo have been recorded so far (TIS, 2004). The genera found in Nepal are *Dendrocalamus*, *Bambusa*, *Thamnocalamus*, *Borinda*, *Ampelocalamus*, *Cephalostachyum*, *Drepanostachyum*, *Himalayacalamus*, *Melocanna*, *Yushania*, *Arundinaria* and *Phyllostachys* (Stapleton, 1994). Occurrence of bamboo is more common in the eastern half of the country from Dhaulagiri to Sikkim Boarder, as high as 4000 masl (Stapleton, 1994). Out of the 77 districts of Nepal, 73 are known to have one or more species of bamboo. It has been estimated that the total growing stock of bamboo in Nepal is around 15 million cubic meters with an approximate biomass value of 1060 million tons (Karki and Karki, 1995). Approximately 63,000 ha of bamboo coverage is found in Nepal (Karki and Karki, 1995).

### 2.2 Market Trend and Opportunities

Globally, the export of bamboo and rattan commodities reached US\$ 3.4 billion in the year 2019, as per the data from the UN Comtrade database. Bamboo products were traded in bulk worth US\$ 3.054 billion in 2021. In 2019, three regions — the Asia-Pacific, Europe, and North America — comprised the primary trading areas for bamboo commodities. In particular, the Asia-Pacific region dominated the export of both traditional and new bamboo products.

Europe and North America were the main importers of bamboo products. In particular, China's exports accounted for 67% of the global total: the country exported more than US\$ 2 billion in bamboo products in 2019 (INBAR, 2019).

**Figure 1. Exports and Imports of bamboo products by region in 2019 (USD million, % of total)**



Nepal has been marketing bamboo and rattan products on the international market since 2001. The export of bamboo products to different countries from Nepal in the year 2019/20 was valued at NRs 71.172 million (US \$ 587,882) (Table 1) (TEPC, 2020).

There are nearly 600 processors and traders involved in bamboo sector in Nepal (Das, 2007). Most of the bamboo-based entrepreneurs operate at the micro-level and are scattered, especially in rural and remote areas of Nepal (GTZ, 2008). Most of the bamboo resources and their products are consumed in domestic markets. However, some items are exported abroad as well. The exact demand and supply situation of bamboo products has not been estimated yet, however, approximately 50 to 60 MT of bamboo is supplied daily to the Kathmandu valley (DFRS, 2010). It has been estimated that production, consumption, and export of bamboo culms are 3.01 million stems, 2.64 million stems, and 0.46 million stems (Das, 2007). Out of total production of 3 million culms, it is estimated that around 20% to 23% are traded commercially in the domestic market, 63% are consumed locally and 17% are traded to India annually (GTZ, 2008). The most commonly traded bamboo species in the Terai region of Nepal are *Bambusa nutans* subspecies *cupulata* (Mal Bans), *Bambusa tulda* (Japhta Bans), *Bambusa balcooa* (Bholka bans), and *Bambusa nutans* subspecies *nutans* (Taru bans). Similarly, *Dendrocalamus hamiltonii* (Tama bans), *Dendrocalamus hamiltonii* var. *undulatus* (Choya bans), and *Dendrocalamus hookeri* (Bhalu bans) are some of the important bamboo species in the mid-hills.

Nepal exports bamboo items such as bamboo painting materials, wood charcoal, bamboo plywood and laminated products, bamboo baskets, and bamboo furniture to countries all over the world. According to the Trade and Export Promotion Center, the value of bamboo product exports has risen progressively from US\$ 5,927 in the year 2015/16 to US \$ 13,545 in year 2019/20.



**Table 1. Bamboo exports (2015/16- 2019/20)**

Description	Unit	2019/20		2018/19		2017/18		2016/17		2015/16	
		Quantity	Value (NRs. '000)	Quantity	Value (NRs. '000)	Quantity	Value (NRs. '000)	Quantity	Value (NRs. '000)	Quantity	Value (NRs. '000)
Bamboos, painting material	PCS	15884	69064	12665	3399.5	16585	1754				
Wood charcoal whether or not agglomerated of bamboo	kg	1437	534	160	20.16	330	80				
Plywood, Veneered Panels and similar laminated wood of bamboo	SQM	3264	767	3980	291.609	2410	244				
Basket work, wicker work & other articles of bamboo	kg	4280	749	55220	7257.97	32685	2611	23450	2250	4596	590
Furniture of bamboo or rattan	PCS	203	58			184	39	5971	322	13515	1049
<b>Total</b>		<b>25,068</b>	<b>71,172</b>	<b>72,025</b>	<b>10,969</b>	<b>52,194</b>	<b>4,728</b>	<b>29,421</b>	<b>2,572</b>	<b>18,111</b>	<b>1,639</b>

Source: TEPC; Note : 1 US\$ is worth NRs. 121.07

## 2.3 Ecosystem restoration and economic growth potential of bamboo

Bamboo has the potential to provide employment and economic growth prospects for Nepal's rural and urban populations. More than 25,000 households from poor and ethnic groups are participating in bamboo craft production and product selling in order to preserve their livelihoods (Das, 2007). Making bamboo-based crafts can be a significant source of revenue for Nepal's socially and economically disadvantaged groups and women. Bamboo has been used as a building material, home furniture, food, income, and a source of living. Bamboo has been applied to reduce erosion, conserve soil and water, prevent landslides, and protect riverbanks. It is one of the most productive and fast-growing plants, making it one of the most potent plants for consideration in the Clean Development Mechanism (CDM). It is ideal for biomass production as it rapidly self-propagates after harvesting. Bamboo requires minimal maintenance to grow. The woody nature of the bamboo stem contributes to its high calorific value. Despite its socioeconomic and environmental value, Nepal has a low level of bamboo cultivation and processing.

## 2.4 Climate change mitigation and adaptation of bamboo

Bamboo has the potential to make a substantial contribution to combating climate change in the developing world, particularly in rural populations. This is because bamboo has the potential to contribute to the restoration of degraded landscapes and turn them into significant carbon sinks. Simultaneously, it enhances the water retention capacity of the landscape, which can contribute to climate change adaptation in e.g. landscapes that are vulnerable to desiccation and/or erosion. Carbon is stored in bamboo plants as well as a variety of

long-lasting items, such as furniture and flooring, once harvested. Even after harvesting, a significant carbon store remains in the landscape in the form of the below-ground biomass from which new bamboo shoots will self-propagate for the next harvest. INBAR (2015) highlights five main ways that bamboo may assist countries in mitigating and adapting to the effects of climate change:

- Bamboo's fast-growing and renewable stands sequester carbon in their biomass -at rates comparable, or even superior to, a number of tree species.
- Bamboo helps avoid fossil fuel use and reduce deforestation by offering an alternative, highly renewable source of biomass energy.
- Bamboo's rapid establishment and self-propagation allows for frequent harvesting. This allows farmers to flexibly adapt their management and harvesting practices to new growing conditions as they emerge under climate change.
- It is useful for restoring degraded lands as it thrives on problem soils and steep slopes that are unsuitable for other crops, it is an effective windbreak, and its sturdy rhizomes and roots regulate water flows and prevent erosion.
- Bamboo resources offer practical solutions to climate change mitigation and adaptation and are a proven tool to fight rural poverty and restore the natural resource base that is the foundation for economic sustainability.

The estimated global bamboo carbon stock accounts for 0.43%-0.61% of the total global forest carbon stock (Yuen *et al.*, 2017). Living bamboo stores around 100 to 400 tons of carbon per hectare whereas tree plantations store between 90 to 420 tons (Van der Lugt *et al.*, 2018). Bamboos can sequester more carbon than fast-growing tropical and subtropical trees under comparable conditions. Carbon stock is higher in tree forests than bamboo forests, whereas the annual rate of carbon sequestration was reported to be 24.7 tons per ha in bamboo forests under annual selective harvest practice, or about two times the rate of montane temperate and pine plantations and six times the rate of tropical deciduous forests (Thokchom and Yadava, 2015). In China, the above ground carbon stock of 9-10 years old *moso* bamboo (*Phyllostachys pubescens*) plantation ranges between 25 to 32 tons carbon per ha (Lou *et al.*, 2010). Furthermore, another study shows that in *P. pubescens* and *P. bambusoides* from natural forests in Japan have an aboveground carbon stock of 78.6 tons per ha and 52.3 tons per ha, respectively (Isagi, 1994). Study from India shows that the aboveground carbon stock from a four-year mixed bamboo plantation (*Bambusa vulgaris*, *B. balcooa*, and *B. cacharensis*) is about 61.05 tons per ha (Nath *et al.*, 2009). Bamboo can also help the climate-vulnerable households in adapting to climate change by bringing in new off-farm income and coping with potential climate shocks.

## 2.5 Projects/programs for bamboo sector development

So far no dedicated policies have been developed for the bamboo sector development in Nepal. However, the government is in the process of finalizing a Bamboo and Rattan Strategy and Action Plan, which is envisaged to support the bamboo and rattan sector to a great extent. Regarding programs and activities, the federal and provincial governments have allocated budget for implementing few activities in relation to the bamboo sector development, particularly in bamboo seedling production and plantation. The federal government has allocated a total budget of NRs 3,35,75,000 (US\$ 277330) for procurement of 21,500 bamboo seedlings and a bamboo plantation of 148 hectares in the Fiscal Year 2021/22. Province 1 has allocated budgets of NRs 61,00,000 (US\$ 50386) and NRs 75,00,000 (US\$ 61950) for bamboo plantations respectively. Madhesh Province has allocated NRs 1,00,00,000 (US\$ 82600) budget for the procurement and planting of bamboo.





## 3. National Roadmap

### 3.1 Vision

*"A bamboo-based economic sector is developed that provides sustainable income and employment opportunities to local people thereby contributing towards ecosystem restoration, green, resilient and inclusive development".*

### 3.2 Goal

*"To promote the bamboo sector through cultivation, management and value addition on a sustained basis for providing goods and services to the local people and contributing towards ecosystem restoration, institutional strengthening and resilient and inclusive development".*

### 3.3 Guiding principles

- Adopt the concept of green, inclusive, and resilient development.
- Achieve ecological restoration and ecosystem services from bamboo sector development.
- Collaboration and partnership with three tiers of governments, development partners, private sector, and communities.
- Coherent with national priorities and international obligations related to bamboos.
- Ensure inclusive participation amongst all concerned stakeholders in the implementation of programs and activities.

### 3.4. Strategic pillars

In order to achieve above-mentioned vision and goal, the national roadmap comprises following four strategic pillars:

- Policy and institutional framework
- Resilient and inclusive development
- Business development
- Ecosystem restoration

### 3.5 Priority actions

Based on literature review and key findings from consultations with concerned stakeholders and experts, the following priority actions under the four strategic pillars have been proposed, involving 13 outputs and 45 strategic actions.

**Table 2: Strategic Pillars, Outputs and Strategic Actions**

Policy and Institutional framework	
Output	Strategic action
Output 1.1: Institutions are strengthened collaboration between key actors enhanced	1.1.1 Strengthen the relevant existing institutions at province level. 1.1.2 Arrange the institutional mechanisms at local level in areas with good potential for bamboo production. 1.1.3 Develop institutional guidelines to enhance collaboration between bamboo growers, craft makers, business entrepreneurs and policy makers. 1.1.4 Enhance awareness of the local governments and other key stakeholders regarding the potential of the bamboo sector 1.1.5 Devise capacity development programs for a range of key stakeholders, including government officials, bamboo growers, craft makers, and entrepreneurs.
Output 1.2: Bamboo sector in curricula of Nepal's education system is integrated	1.2.1 Develop course curricula regarding bamboo production, utilization and trade in school curricula. 1.2.2 Develop curricula in Technical Education and Vocational Training institutions regarding bamboo
Output 1.3: National bamboo policy and guidelines are prepared	1.3.1 Review policy and legislative instruments in relation to bamboo. Formulate a Bamboo and Rattan Strategy and Action Plan. Impart an orientation program to DFO/Forest users for inclusion of bamboo cultivation, conservation, management and utilization programs and activities in their respective plans

Inclusive and Resilient Development	
Output	Strategic action
Output 2.1: Livelihood of pro-poor family is uplifted	2.1.1 Form a pro-poor group for targeted bamboo-based activities. 2.1.2 Promote bamboo plantation on farm land, public land, open and degraded patches of forest area, river banks. 2.1.3 Lease out the potential land/forest for bamboo plantation to pro-poor families. 2.1.4 Impart training on making diversified bamboo products, including handicrafts and furniture. 2.1.5 Form cooperatives of bamboo entrepreneurs for production and marketing of bamboo commodities.

Output 2.2: Different bamboo-based enterprises are developed	<p>2.2.1 Introduce appropriate and innovative technology and impart training on bamboo weaving, handicraft and furniture making to craft makers and entrepreneurs.</p> <p>2.2.2 Impart training on institutional development and business plan preparation from concerned organizations to make quality products considering local and international market demand.</p> <p>2.2.3 Establish common facility centers at the local level.</p>
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Business development	
Output	Strategic action
Output 3.1: Value chain of bamboo-based enterprise is developed	<p>3.1.1 Improve vertical integration between farmers, primary processors, enterprises and industries to ensure sustainable supply of bamboo and its products.</p> <p>3.1.2 Provide innovative technology and subsidy for bamboo-based enterprises for development of modern technology for production of diversified products that can trap national and international markets.</p>
Output 3.2: Bamboo resources certification system is introduced	<p>3.2.1 Establish a certification system for bamboo production and processing to make bamboo investors more competitive in global markets.</p> <p>3.2.2 Develop bamboo product standards, code of practice, and guidelines to facilitate domestic, regional, and international trade.</p>
Output 3.3: Supportive business environment is created.	<p>3.3.1 Encourage private sector to invest in the bamboo-based agroforestry business by offering inclusive finance solution.</p> <p>3.3.2 Invest in infrastructure to attract private sector investment in bamboo-based enterprises.</p> <p>3.3.3 Improve access to finance for cooperatives and groups who want to engage in bamboo-based enterprises.</p>
Output 3.4: Market opportunities and outlets are created	<p>3.4.1 Expand and develop bamboo and its products' access to national and international markets through trade promotion/fair.</p> <p>3.4.2 Foster market and trade development through regular assessments of market potential.</p> <p>3.4.3 Develop business models and support branding (new products, contemporary designs, improvement of manufacture, climate-friendly production).</p> <p>3.4.4 Provide incentives to "Souvenir shops" for selling bamboo products in the places of tourist attraction.</p> <p>3.4.5 Endorse commercial and trade agreements for the sale of bamboo of products by holding business conferences, fairs.</p>
Output 3.5: Sustainable management of existing bamboo resources is achieved	<p>3.5.1 Conduct research/study on bamboo resources, value-chain, ecosystem services, market trends and identify the technical, policy, institutional gaps and opportunities.</p> <p>3.5.2 Manage and improve bamboo nurseries, plantations, and establish processing facilities in collaboration with farmers to enhance bamboo production and commercialization.</p>



Ecosystem restoration	
Output	Strategic action
Output 4.1: Bamboo is propagated effectively	<p>4.1.1 Build capacity of bamboo growers on various propagation and grafting methods, such as rhizome planting, bamboo seeds, and bamboo culm or branch cuttings, with technical assistance from the various concerned authorities.</p> <p>4.1.2 Provide technical knowledge to bamboo growers on bamboo propagation, nursery techniques, cultivation/plantation and management.</p> <p>4.1.3 Make the access easy to bamboo growers on planting materials and tools.</p> <p>4.1.4 Establish high-tech nurseries and small and large nurseries in accordance with the need to supply quality planting materials.</p>
Output 4.2: Bamboo plantation is extended	<p>4.2.1 Promote bamboo plantation development in degraded/open forest patches, wastelands, river banks, public and private lands, either as a block plantation or as home gardens.</p> <p>4.2.2 Prioritize bamboo-based bioengineering technology for natural disaster prone areas, soil erosion, and river cutting management in barren land, fallow land, degraded, sloping riverbank areas, steep slope regions, and other sensitive areas.</p>
Output 4.3: Bamboo plantation is conserved through sustainable management	<p>4.3.1 Enhance bamboo yield by providing training in bamboo farm management (thinning, cutting, pest control, manuring, etc.).</p> <p>4.3.2 Collaborate with development partners for cultivation and management of bamboo resources.</p> <p>4.3.3 Establish model bamboo growth and management demonstration plots for bamboo growers to learn.</p> <p>4.3.4 Carry out inventory of bamboo resources covering both on farm land, public land and natural forests.</p> <p>4.3.5 Collaborate with research/academic institutions on carrying out need-based bamboo research/studies.</p>



## 4. Moving Forward Together

Overall, 13 outputs and 45 strategic actions have been proposed in 4 strategic pillars. It is estimated that approximately US \$5.1 million is required to translate the provisions mentioned in the roadmap into practice. The interventions proposed in the roadmap will be implemented through the involvement of concerned state and non-state actors. Therefore, strengthening institutions at the federal, provincial and local level is needed, as the existing institutional arrangements may not be sufficient for effective implementation of the interventions proposed in the document. Similarly, financial resources allocated mainly by federal and provincial governments for bamboo sector development are limited and international development assistance from bilateral and multilateral agencies will be needed.

## Annex 1. Indicative Resource

It is estimated that approximately 5.1 million US\$ is required to translate the provisions mentioned in the roadmap into practice.

**Table 3: Strategic actions, time line, indicative resources and responsible agencies**

Strategic pillar	Strategic Activities	Indicators	Time frame (Years)										Budget (000) (Nrs)	Responsible agency	Supporting agencies
			1	2	3	4	5	6	7	8	9	10			
1.Policy and Institutional framework	Output 1.1: Institutions are strengthened and linkage among key actors is established														
	Strengthen the existing institution at province level.	Formation of institution	2										2000	Local government	PTMCDB, MoFE, MoALD, MoITFE
	Arrange the institutional mechanism at local level where there is great potential for bamboo.	Provision of institutional arrangement for bamboo	2										2000	Local government	PTMCDB, MoFE, MoALD, MoITFE
	Develop institutional guidelines to establish linkages among bamboo growers, craft makers, business entrepreneurs and policy makers.	Formation of guideline	1										1000	Local government/ DFO	PTMCDB, MoFE, MoALD, MoITFE
	Make aware the local governments and other key stakeholders regarding the potential of the bamboo sector	No. of training	2	2	2	2	2	2	2	2	2	2	10000	Local government	PTMCDB, MoFE, MoALD, MoITFE



1. Policy and Institutional framework	Devise capacity development programs for a range of key stakeholders, including government officials, bamboo growers, craft makers, entrepreneurs.	No. of training	2	2	2	2	2	2	2	2	2	2	2	20000	Local government/ DFO	PTMCDB, MoFE, MoALD, MoITFE
	<b>Output 1.2: Bamboo sector in curricula of Nepal's education system is integrated</b>															
	Develop course curriculum regarding bamboos in school curricula.	Curriculums of schools	1											1000	Ministry of Education, Science and Technology	PTMCDB, MoFE, MoALD, MoITFE
	Develop curricula regarding bamboos in Technical Education and Vocational Training institutions.	Curriculums of schools	1											1000	Ministry of Education, Science and Technology	PTMCDB, MoFE, MoALD, MoITFE
	<b>Output 1.3: National bamboo policy and guidelines are prepared</b>															
	Review policy and legislative instruments in relation to bamboos.	Document of national bamboo policy and guidelines	1											1000	DFO, Department of Agriculture	PTMCDB, MoFE, MoALD, MoITFE

1. Policy and Institutional framework	Formulate Bamboo and Rattan Strategy and Action Plan.	Document of Bamboo and Rattan Strategy and Action Plan.	1											1000	DFO, Department of Agriculture	PTMCDB, MoFE, MoALD, MoITFE
	Impart orientation program to DFO/ Forest users for inclusion of bamboo cultivation, conservation, management and utilization programs and activities in their respective plans	No. of orientation	2		2		2		2		2			10000	Local government	PTMCDB, MoFE, MoALD, MoITFE
2. Inclusive and Resilient Development	<b>Output 2.1: Livelihood of pro-poor family is uplifted</b>															
	Form pro-poor group for targeted bamboo-based activities.	No. of groups	2	2	2	2	2	2	2	2	2			1800	DFO, Local government	PTMCDB, MoFE, MoALD, MoITFE
	Promote bamboo plantation on farm land, public land, open and degraded patches of forest area, river banks.	No. of HHs	50	50	50	50	50	50	50	50	50	50		25000	Local government/ CFUGs/DFO	PTMCDB, MoFE, MoALD, MoITFE
	Lease out the potential land/forest for bamboo plantation to pro-poor families.	No. of HHs	50	50	50	50	50	50	50	50	50	50		2500	Local government/ DFO/CFUGs	PTMCDB, MoFE, MoALD, MoITFE

2. Inclusive and Resilient Development	Impart training on making diversified bamboo products, including handicraft, furniture.	No. of training	2	2	2	2	2	2	2	2	2	2	1000	Local government, CSIO	PTMCDB, MoFE, MoALD, MoITFE
	Form cooperatives of bamboo entrepreneurs for production and marketing of bamboo commodities.	Establishment of bamboo enterprise cooperatives	2		2		2		2		2		5000	Local government/ DFO	PTMCDB, MoFE, MoALD, MoITFE
	Output 2.2: Different Bamboo based enterprises are developed														
	Introduce appropriate and innovative technology and impart training on bamboo weaving, handicraft and furniture making to craft makers and entrepreneurs.	No. of training	2	2	2	2	2	2	2	2	2	2		DFO, Local government	MolCS, MoALD, MoITFE
	Impart training on institutional development and business plan preparation from concerned organizations to make quality products considering local and international market demand.	No. of training	7	7	7	7	7	7	7	7	7	7	70000	DFO, Local government	MolCS, MoALD, MoITFE
	Establish common facility centers at the local level.	Establishment of common facility center	2										2000	Local government	MolCS, MoALD, MoITFE



3.Business development	Output 3.1: Value chain of bamboo-based enterprise is developed														
	Improve vertical integration between farmers, primary processors, enterprises and industries through provincial workshops to ensure sustainable supply of bamboo and its products.	No. of workshop	7					7					5000	DFO, Local government	MolCS, MoALD, MolTFE, MoFE
	Provide innovative technology and subsidy for bamboo-based enterprises for development of modern technology for production of diversified products that can trap national and international markets.	Establishment of industry	2	2	2	2	2	2	2	2	2	2	100000	Local/ Provincial government	MolCS, MolTFE
	Output 3.2: Bamboo resources certification system is introduced														
	Establish a certification system for bamboo production and processing to make bamboo investors more competitive in global markets.	Implementa- tion of certifi- cation system	1										1000	FRTC, MoFE	MolCS, MolTFE
	Develop bamboo product standards, code of practice and guidelines to facilitate domestic, regional and international trade.	Bamboo product standards, code of practice and guidelines documents	1										1000	FRTC, MoFE	MolCS, MolTFE

3.Business development	<b>Output 3.3: Supportive business environment is created.</b>														
	Encourage private sector to invest in the bamboo-based agroforestry business by offering an inclusive finance solution.	Provision of inclusive finance	2		2		2		2		2		10000	Federal/ Province/ Local government	MoICS, MoITFE
	Invest in infrastructure to attract private sector investment in bamboo-based enterprises.	Investment in bamboo-based infrastructure	2		2		2		2		2		50000	Province/ Local government	MoICS, MoITFE
	Improve access to finance for cooperatives and groups who want to engage in bamboo-based enterprises.	Provision of financial assistant	2		2		2		2		2		10000	Local, Provincial government	MoICS, MoITFE
	<b>Output 3.4: Market opportunities and outlets are created</b>														
	Expand and develop bamboo and its products' access to national and international markets through trade promotion/ fair.	No. of exhibition and trade fair		1		1		1		1		1	12500	FRTC, MoFE	MoICS, MoITFE
	Foster market and trade development through regular assessment on market potential.	Document on trade potential	1			1				1			1500	FRTC, DFO, Local government	MoICS, MoITFE

3.Business development	Develop business models and support branding (new products, contemporary designs, improvement of manufacture, climate-friendly production).	New bamboo-based products in market	1					1					2000	DFO, Local government	MoICS, MoITFE
	Provide incentives to “Souvenir shops” for selling bamboo products in the places of tourist attraction.	No. of “Souvenir shops”	11					11					4400	Local government	MoICS, MoITFE
	Endorse commercial and trade agreements for the sale of bamboo of products by holding business conferences, fairs.	No. of business conference		1					1				10000	Local/ Provincial government	MoICS, MoITFE
	<b>Output 3.5: Sustainable management of existing bamboo resources is achieved</b>														
	Conduct research on bamboo resources, value-chain, ecosystem services, market trend and identify the technical, policy, institutional gaps and opportunities.	Research report	1	1	1	1	1	1	1	1	1	1	20000	FRTC, DFO	PTMCDB, MoFE, MoALD, MoITFE
	Manage bamboo nurseries, plantations, and establish processing facilities in collaboration with farmers to enhance bamboo production and commercialization.	Establishment of processing unit	2		2		2		2		2		50000	Local government/ DFO	PTMCDB, MoFE, MoALD, MoITFE



4.Ecosystem restoration	Output 4.1: Bamboo is propagated effectively															
	Build capacity of bamboo growers on various propagation methods, such as rhizome planting, bamboo seeds, and bamboo culm or branch cuttings, with technical assistance from the various concerned authorities.	No. of training and agenda of training	2	2	2	2	2	2	2	2	2	2	2	1000	DFO/local government	PTMCDB, MoFE, MoALD, MoITFE
	Provide technical knowledge to bamboo growers on bamboo propagation, nursery techniques, cultivation/ plantation and management.	No. of training and agenda of training	2	2	2	2	2	2	2	2	2	2	2	1000	DFO/local government	PTMCDB, MoFE, MoALD, MoITFE
	Make the access easy to bamboo growers on planting materials and tools.	No. of farmers/ group	100	100	100	100	100	100	100	100	100	100	100	5000	DFO/local government	PTMCDB, MoFE, MoALD, MoITFE
	Establishment of hi-tech nurseries, small and large nurseries in accordance with the need to supply quality planting materials.	Establishment of hi-tech nursery	2					2						50000	DFO/local government	MoALD, MoFE

4.Ecosystem restoration	Establishment of hi-tech nurseries, small and large nurseries in accordance with the need to supply quality planting materials.	Establishment of large nursery		2					2				4000	DFO/local government	MoALD, MoFE
		Establishment of small nursery		2					2				2000	DFO/local government	MoALD, MoFE
	<b>Output 4.2: Bamboo plantation is extended</b>														
	Promote bamboo plantation in degraded/ open forest patches, wastelands, river banks, public and private lands, either as a block plantation or as home gardens.	Distribution of bamboo in large areas (ha)	20	20	20	20	20	20	20	20	20	20	20000	DFO/local government	PTMCDB, MoFE, MoALD, MoITFE
	Prioritize bamboo-based bioengineering technology for natural disaster, soil erosion, and river cutting management in barren land, fallow land, degraded, sloping riverbank areas, steep slope regions, and sensitive areas.	Area of restoration (ha)	5	5	5	5	5	5	5	5	5	5	5000	SWCO, DFO/local government	PTMCDB, MoFE, MoALD, MoITFE

4.Ecosystem restoration	<b>Output 4.3: Bamboo plantation is conserved through scientific management</b>														
	Enhance bamboo yield by providing training in bamboo farm management (thinning, cutting, pest control, manuring, etc.).	No. of training	2	2	2	2	2	2	2	2	2	2	1000	DFO/local government	PTMCDB, MoFE, MoALD, MoITFE
	Collaborate with development partners for cultivation and management of bamboo resources.	No. of training	2	2	2	2	2	2	2	2	2	2	1000	FRTC, DFO	PTMCDB, MoFE, MoALD, MoITFE
	Establish model bamboo growth and management demonstration plots for bamboo growers to learn.	No. of Demonstration plot		1		1		1		1			10000	FRTC, DFO	PTMCDB, MoFE, MoALD, MoITFE
	Carry out inventory of bamboo resources covering both on farm land, public land and natural forests.	Research report	2	2	2	2	2	2	2	2	2	2	50000	FRTC	PTMCDB, MoFE, MoALD, MoITFE
	Collaborate with research/academic institutions on carrying out need-based bamboo research/studies.	Research report	2	2	2	2	2	2	2	2	2	2	20000	FRTC/DFO	PTMCDB, MoFE, MoALD, MoITFE



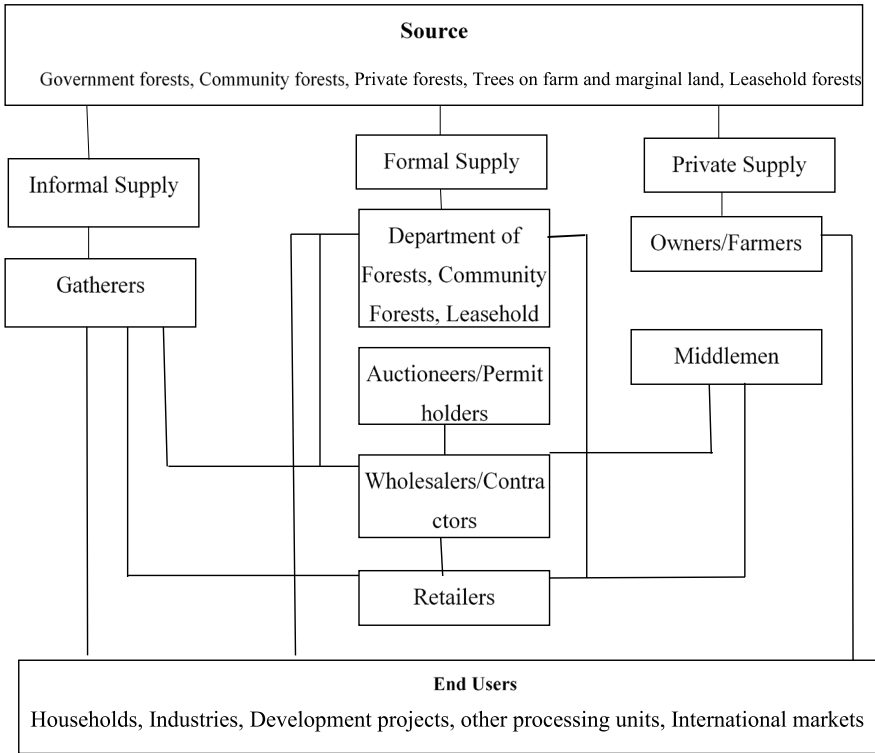
## Annex 2. Bamboo based Business Model

Bamboo has been used primarily for subsistence in Nepal. Its contemporary market is underdeveloped. The bamboo growers are still using traditional techniques of production, management, and marketing of their products (TIS, 2004). Most producers are impoverished and unable to invest in commercial production and marketing.

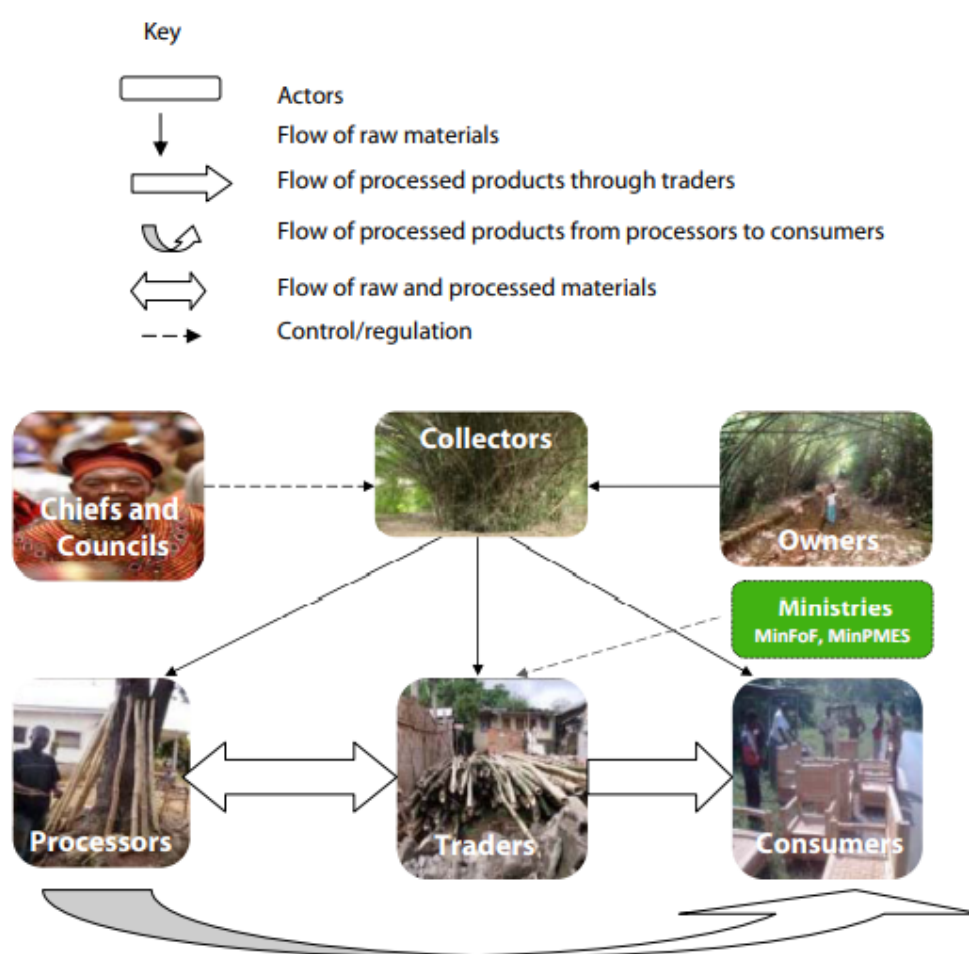
Locally manufactured bamboo products are readily bought and sold in the local market, but trading in the national market is still inadequate due to a lack of a transportation network and a well-established marketing system (Adhikari, 2008). However, only 10% of traditionally processed products are competitive in the global market. Because of a shortage of treatment technologies and skills to manufacture quality products to generate additional value, the remaining 90% of products face threats from other alternatives or foreign products (MDBRPP/DFRS, 2011).

Bamboo-based cottage industries and processing units are becoming increasingly popular throughout the country. However, the majority of bamboo-based entrepreneurs work on a micro scale and are scattered throughout Nepal, particularly in rural and isolated areas (GTZ, 2008). As the market structure of bamboo products is unorganized, estimation of the sales volume is very difficult. The exact demand and supply situation of bamboo products has not been estimated yet, however approximately 50 to 60 MT of bamboo are supplied daily to the Kathmandu valley (DFRS, 2010). It is estimated that current production of bamboo handicrafts has the capacity to employ around 250-300 individuals in the organized sector throughout the year (GTZ, 2008). In general, bamboo growers, traders, craft makers and entrepreneurs do not have sufficient information on the technical aspects of bamboo craft making and marketing. In addition, there is a lack of effective coordination among bamboo growers, craft makers, and traders. A functional linkage between them must be built to enhance cooperation. Market behavior research is required before making any investment decisions in these sectors. The business model for Nepal and a few other countries are presented below.

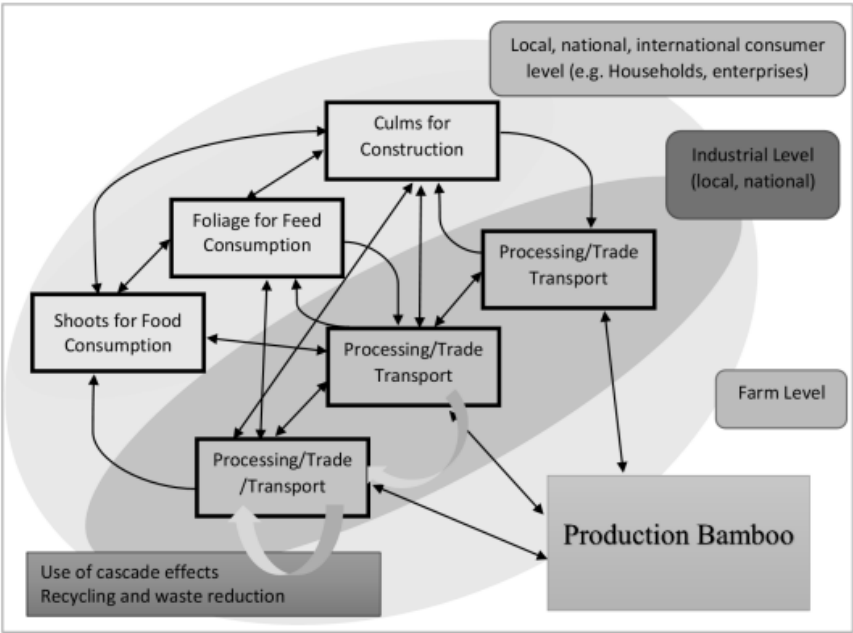
### Model of Nepal



The marketing channel of the bamboo products is simple, and both formal and informal supplies exist in the country. Marketing channels, through which the bamboo products are moved from producers to the users, are weak and still at the rudimentary stage. They are mostly controlled by the producers and the retailers. It was found that while 88% producers sell their products directly, 50% of them sell through retailers and 40% of them sell through wholesalers and retailers to the consumers (DFRS, 2010). As the majority of stakeholders in the bamboo chain operate informally, efforts are needed to professionalize the sector. Centers for selling bamboo products need to be developed in different cities. Marketing information geared towards producers and entrepreneurs has to be developed. The processing facilities, skill development training, and availability of modern equipment are also key areas in need of improvement.

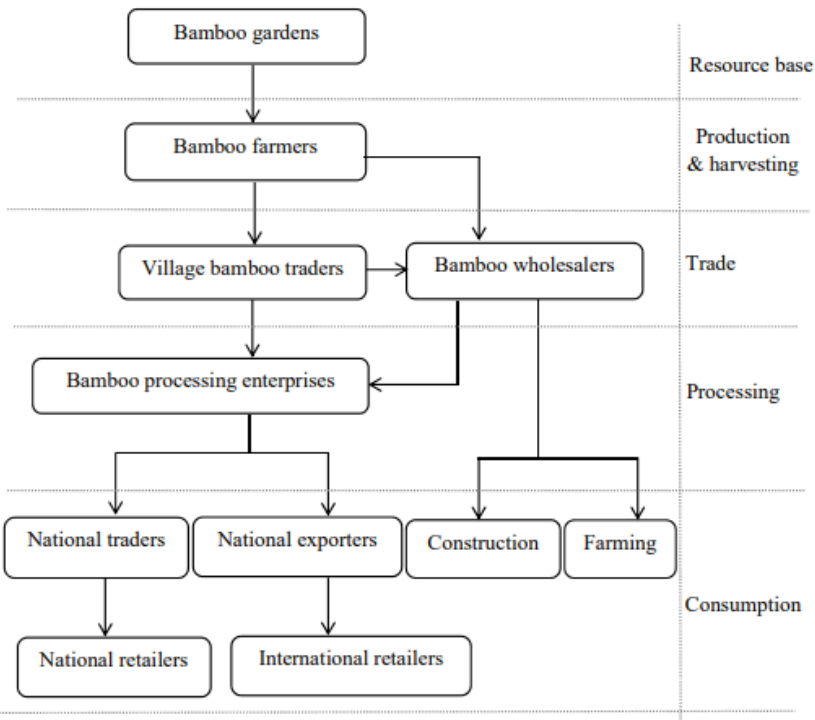


Model of Ethiopia



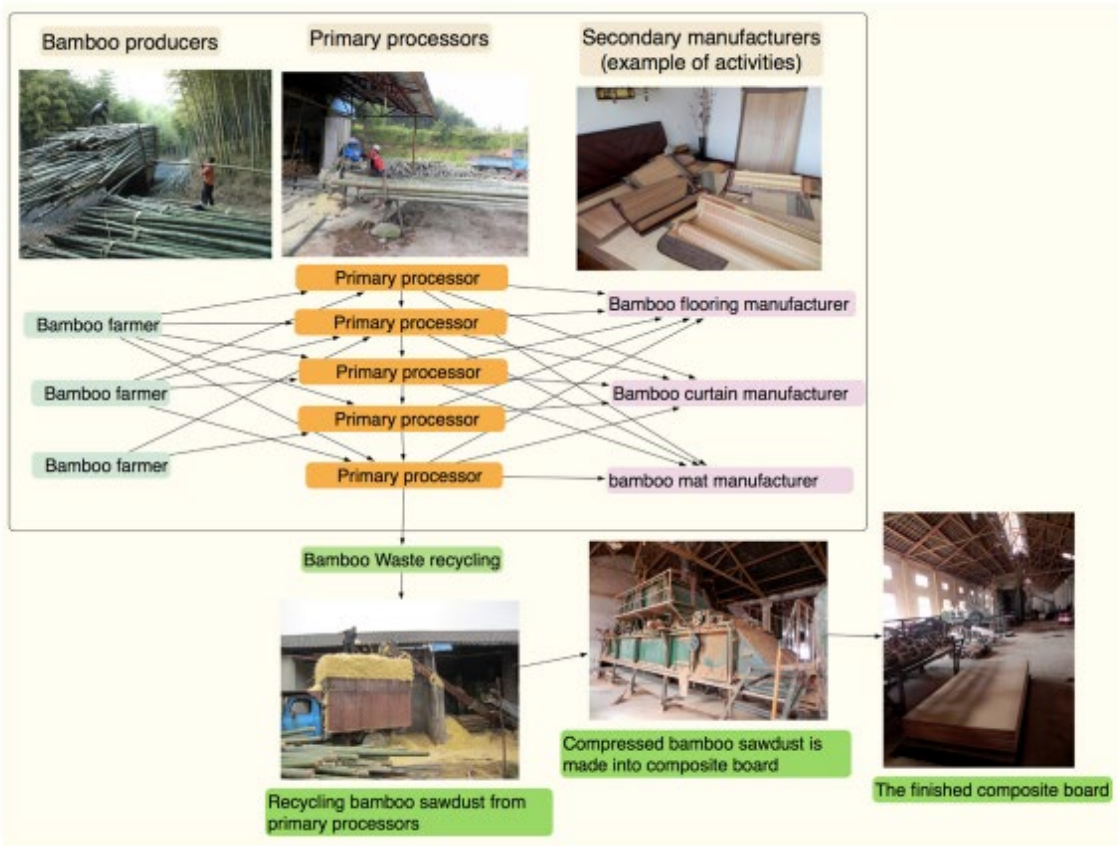
The web concept is categorized into three: farm, industrial, and local, national, and international consumers. Farmers are involved in the production of bamboo, and the materials produced are processed, traded, and transported by industries. Finally, processed items are traded in the international and domestic markets for consumption (Virchow, et al., 2014).

Model of Vietnam



Bamboo growers harvest Lu<sup>2</sup>ng (bamboo species used in bamboo industry of Vietnam) from bamboo gardens, then sell it to local bamboo traders in the village. Bamboo processors do not buy the bamboo material directly from the growers but from traders because traders have good relationships with the growers and they also have special transport vehicles for the hilly terrain, to collect Lu<sup>2</sup>ng bamboo from the gardens (Baulch et al., 2009). Hence, the enterprises are dependent on the traders for purchasing the bamboo materials. Most of Lu<sup>2</sup>ng bamboo is used for construction and agriculture with low value, and only one-third of the quantity of Lu<sup>2</sup>ng is employed for producing semi-industrial products (Renard and GRET, 2009). Bamboo companies are not able to produce the final products due to a lack of advanced technology and machines, and they highly depend on commercial companies distributing their products to retailers (Hiep, 2021 ).

## Model of China



Anji has long been famous as a home of bamboo and continues to enhance that reputation today. The place and the material become synonymous, and can reinforce ideas of sustainability. Bamboo is continually promoted within Anji and beyond as a sustainable material (Zhu, et al., 2012).



## References

- Adhikari, N., 2008. Economic potential of bamboo in Nepal for the traditional bamboo users in the modern economy. [Online] Available at: <http://abari.org/economic-potential-of-bamboo-in-nepal>
- Das, A. N. 1999. Socioeconomics of Bamboos in Eastern Nepal. Ph D Thesis. University of Aberdeen, UK.
- Das, A. N. 2007. Status of bamboo research and development in Nepal. A paper presented in the International Workshop on Bamboo held in Kathmandu, 10-12 April, 2007.
- Das, A., 2002. Bamboo growing and its market development potential for sustaining rural livelihood and poverty reduction in Eastern Nepal, s.l.: Banko Janakari.
- DFRS. 2010. Market Opportunities and Constraints for Bamboo and Rattan Products in Nepal. Department of Forest Research and Survey, Kathmandu.
- FAO. 2020. Global Forest Resource Assessment 2020. Main Report. Food and Agriculture Organizations, Rome.
- GTZ. 2008. Bamboo in Nepal. A Value Chain Upgrading Approach, Strategies and Interventions. GTZ, Kathmandu.
- Hiep, T. V., 2021 . Key factors affecting small bamboo enterprises upgrading in North Vietnam: Case studies from Chuong My, Hanoi and Thanh Hoa province , s.l.: s.n.
- INBAR, 2019. Trade Overview 2017: Bamboo and Rattan Commodities in the International Market. International Bamboo and Rattan Organization, Beijing.
- INBAR. 2015. Five Ways Bamboo can Fight Climate Change. International Bamboo and Rattan Organization, Beijing, China (<https://www.inbar.int/five-ways-bamboo-can-fight-climate-change/>). Accessed on 18 July 2020.
- Ingram, V. et al., 2010. Bamboo production to consumption system, Cameroon, Bogor, Indonesia: CIFOR.
- Isagi, Y. 1994. Carbon stock and cycling in a bamboo *Phyllostachys bambusoides* stand. *Ecol. Res.* 9: 47-55.
- Karki, M. B. and Karki J. B. S. 1995. National bamboo and rattan information database, Nepal, Tribhuvan University, Institute of Forestry, Pokhara.
- Lou, Y.; Li, Y.; Kathler, B.; Giles, H. and Zhou, G. 2010. Bamboo and climate change mitigation: Comparative analysis of carbon sequestration. INBAR Technical Report No. 32. 1-20 pp.
- MDBRPP/DFRS, 2011. Review of Traditional Designs and Technologies of Bamboo and Rattan Products in Nepal, Kathmandu, Nepal: Market Development of Bamboo and Rattan Products with Potential (MDBRPP) Project, Department of Forest Research and Survey.
- MDBRPP/DFRSa, 2010. Market Opportunities and Constraints for Bamboo and Rattan Products in Nepal, Kathmandu, Nepal: Market Development of Bamboo and Rattan Products with Potential Project, Department of Forest Research and Survey.
- MDBRPP/DFRSb, 2010. Review of Developed Western Markets for Bamboo and Rattan Commodities of Nepal, Kathmandu, Nepal: Market Development of Bamboo and Rattan Products with Potential (MDBRPP) Project, Department of Forest Research and Survey.
- Nath, A. J.; Lai, R. and Das, A. K. 2009. Above ground standing biomass for carbon storage in village bamboos in northeast India. *Bio. Bioeng.* 33: 1188-1196.

- Stapleton, C., 1994. Bamboos of Nepal: An Illustrated Guide, Kew, London, UK: Royal Botanic Garden.
- Thapa, H. B. and Aryal, R. R. 2012. Growth Performance and Culms Production of Some Bamboo Species in the Mid-and-Far-western Terai of Nepal. Department of Forest Research and Survey, Kathmandu.
- TEPC, 2020. Nepal Foreign Trade Statistics, Fiscal Year 2019/20 (2076/77), Tripureshwor, Kathmandu: Ministry of Finance, Department of Customs.
- Thokchom, A. and Yadava, P. S. 2015. Bamboo and its role in climate change. *Current Science* 108 (5): 762-763.
- TIS, 2004. Manual of Bamboos in Nepal. Tree Improvement and Silviculture, Department of Forests, Kathmandu.
- Virchow, D. et al., 2014. The Value Web Approach—So That the South Can Also Benefit from the Bioeconomy. *Rural* 21, p. 16–18.
- Yuen, J. Q., Fung, T. and Ziegler, A. D. 2017. Carbon stocks in bamboo ecosystems worldwide: estimates and uncertainties. *Forest Ecology and Management*. 393: 113-138.
- Zhu, Z. et al., 2012. Supply Chain of the Bamboo Industry: Increasing Rate of Bamboo Utilization and Value Addition, s.l.: INBAR.



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