

Final Report on INT/15/K01 “Promoting bamboo
industrialization through value chain study in China,
Nepal and Viet Nam”

Submitted to
Perez-Guerrero Trust Fund and
China Center for International Economic Exchanges

Written by
China National Bamboo Research Center

Hangzhou, P. R. China

After Committee of Experts for the Perez-Guerrero Trust Fund approved the project of “Promoting bamboo industrialization through value chain study in China, Nepal and Viet Nam INT/15/K01)”, the project started in Oct. 2015 and completed in Oct. 2017. China, Nepal and Vietnam are the participative countries of the project. The implementers are China National Bamboo Research Center in China, Department of Forest Research and Survey in Nepal and Silvicultural Research Institute in Vietnam respectively in three countries, and initiated and guided by China National Bamboo Research Center as the leading party of the project.

I. Background

Bamboo grows widely in tropical and subtropical regions with approximately 70 genera and over 1,200 species. China is one of the most important countries for bamboo production and processing. Its bamboo resources, area, growing stock and trade volume all rank first in the world, and are reputed as “Kingdom of Bamboo”. Bamboo grows in 16 provinces nation-wide with about 10 main categories in China, including traditional bamboo products, bamboo man-made board, bamboo pulp for paper production, bamboo fabric, bamboo charcoal and vinegar, bamboo shoot products and bamboo extracts etc. About 7.55 million farmers are involved directly in bamboo production and processing. Total output from bamboo sector will reach 300 billion CNY (approx. US\$ 48 billion) in 2020, 10 million people will be involved in bamboo production and processing directly, and bamboo farmers’ income will reach 2,100 CNY, accounting for above 20% of their net income per capita by then. In this regard, China will generate even more significant portion of global bamboo exports.

A value chain study on bamboo industrial development could provide a good reference to other bamboo rich developing countries, such as Nepal

and Vietnam etc.

- To enhance the level of bamboo forest management towards a more intensive management.

- To uplift the conversion rate of bamboos to final products, and realize resource recycling

- To diversify their bamboo products and design, and increase the total value of bamboo sector

- To improve the government and non-governmental entities' role in supporting bamboo sector's development

China National Bamboo Research Center was established in 1984, and supervised by Chinese Academy of Forestry (CAF) since 1992. And China International Forestry Training Center was set up based on CBRC with the approval of State Forestry Administration in 2011. As an important platform for forestry international implementation of conventions, CBRC conducts bamboo foreign aid work which focused on bamboo technical cooperation and exchanges. Since its first implementation on foreign aid training task in 1993, CBRC has implemented 101 training courses/ seminars, including 4 ministerial seminars, for 2749 participants from 106 countries as sponsored by the Ministry of Commerce of the People's Republic of China, UNDP, UNIDO etc. Meanwhile, it provides international foreign aid technical cooperation for developing countries such as Rwanda etc. It also has bamboo technical cooperation and exchange with over 30 countries, including Mexico, India and Brazil etc. CBRC has been working actively on promotion of world bamboo development, as well as South-South Cooperation.

In this project, CBRC aimed at promoting the level of bamboo industrialization through value chain study in three participative countries. By conducting the study, CBRC offered the participative countries the technical knowhow and experience sharing of bamboo cultivation and

processing, policy supporting, roles of association, non-governmental entities, market and other actors along the chain. Besides they learnt about wide range of bamboo design and products. By the project the farmers in the participative countries also learnt cultivation technology and from the experts and know various bamboo products from the project. Through experience sharing among three countries, researchers, farmers and governmental officials who are involved in the project enhanced their awareness and skills in Nepal and Vietnam.

II. Bamboo value chain study in China, Nepal and Vietnam

Three studies on bamboo value chains were conducted in China, Nepal and Vietnam by three implementers under the guidance of China National Bamboo Research Center.

Three expert panels were organized in China Nepal and Vietnam respectively. Survey structure and report format were also discussed among the panels. Study areas were also selected by the project implementers in three countries.

1. Value chain study in China

Experts from China National Bamboo Research Center organized the study. Through literature review, an overall data collection on bamboo sector was done, including general information such as bamboo resource abundance, distribution, output, cultivation level, utilization types, products ranges, marketing, policy and regulations, associations etc. For the case study, Anji county of Zhejiang province was selected as the study site. Field survey was conducted in Anji county. Main work including:

- 1) Identify the actors along the bamboo value chain and select the main actors for study.
- 2) Meeting with staffs from local forestry bureau and collection on general information of forestry and bamboo, such as resource area,

distribution, main bamboo industrial categories, cultivation value, industrial value, service value etc.

- 3) Visit bamboo farmers, bamboo product manufacturers, intermediaries, bamboo related association, discussion on each other's role and value along the chain.
- 4) Data arrangement and analysis, report drafting to elaborate the detailed situation about bamboo value chain development in the case of China.

2. Value chain study in Nepal

Experts from Department of Forest Research and Survey in Nepal organized the study. Through literature review, overall information on bamboo resource abundance, distribution, output, cultivation level, utilization types, and products ranges, marketing, policy and regulations, associations etc. were collected in Nepal as well. And its weakness and problems on bamboo sector's development were elaborated. For the case study, Kathmandu valley of Nepal was selected as the study site. A field survey was conducted in Kathmandu valley. Actors along the value chain were interviewed and their needs and condition were recorded. Some technical supports were also provided by the expert team on the site.

Main work including:

- 1) Identify the actors along the bamboo value chain and select the main actors for study.
- 2) Meeting with staffs from local forestry authority and collection on general information of forestry and bamboo, such as resource area, distribution, main bamboo industrial categories, cultivation value, industrial value, service value etc.
- 3) Visit bamboo farmers, bamboo product manufacturers (mainly handcrafters), intermediaries, discussion on each other's role and value along the chain.
- 4) Data arrangement and analysis, report drafting to elaborate the

detailed situation about bamboo value chain development in the case of Nepal.

3. Value chain study in Vietnam

Experts from Silvicultural Research Institute in Vietnam organized the study. Through literature review, overall information on bamboo resource abundance, distribution, output, cultivation level, utilization types, and products ranges, marketing, policy and regulations, associations etc. were collected in Vietnam as well. For the case study, Thanh Hoa province of Vietnam was selected as the study site. A field survey was conducted. Actors along the value chain were interviewed. And the costs of raw material and the benefits of processing and products were studied carefully. Technical supports were also provided by the expert team on the site. An expert team from China also visited Vietnam during the project implementation and took part in the field survey. Bamboo plantation and bamboo processing factories were visited. Discussions between Chinese and Vietnamese experts were organized to seek the differences on bamboo value chain development and opportunities for further improvement. Main work including:

- 1) Identify the actors along the bamboo value chain and select the main actors for study.
- 2) Meeting with staffs from local forestry bureau and collection on general information of forestry and bamboo, such as resource area, distribution, main bamboo industrial categories, cultivation value, industrial value, service value etc.
- 3) Visit bamboo farmers, bamboo product manufacturers, intermediaries, bamboo related association, discussion on each other's role and value along the chain.
- 4) Data arrangement and analysis, report drafting to elaborate the detailed situation about bamboo value chain development in the case of Vietnam.

III. Achievements

China National Bamboo Research Center as the project leader, aimed at providing more information and successful story on bamboo industrial development to those bamboo industrially less development countries through value chain study. Through this cooperative research work, the following achievements have been made.

1. Identifying the SWOT of three participating countries. In this study, the strength, weakness, opportunities and threats of each country were identified, particularly the weakness and threat of bamboo industry development in Vietnam and Nepal. By looking at the story of bamboo industry development in China, both Nepal and Vietnam have big opportunities to improvement their bamboo sector's development through optimizing the value chain.
2. Establishment of a more firm network among three countries. A joint study provided more opportunities for different countries to share each other's information a current situation. Through communication and experiencing sharing, firm network is setup and further cooperation shall be developed in the future.
3. Consultative network. Under the current situation, China has accumulated rich experiences on bamboo sector's development, and it is also very willing to sharing the experiences and lessons to other developing countries. Through various types of studies and cooperation, China is able to provide more consultations to its partners and therefore, contribute to bamboo sector's development in a bigger scale.
4. Three detailed reports on each other's bamboo value chain development in China, Nepal and Vietnam are provided through the study. And a SWOT analysis on bamboo industrial development in China Nepal and Vietnam is also provided after the study.

A comparison of bamboo value chains in China, Nepal and Vietnam

1. General information

Bamboo is a tree-like grass belonging to Gramineae family. It is divided into three categories based on its morphologies: monopodial bamboo, sympodial bamboo and amphipodial bamboo. It is one of the fastest growing species in the world and takes a much shorter time period from plantation to processing, which is only 3 to 5 years. Comparing to 30 to 50 years of most tree species in the tropics and subtropics, bamboo is 10 times fast than trees. Therefore, it is perceived as one of the most important NWFP in the world and an excellent wood substitute.

Bamboo grows naturally in tropical, subtropical and temperate zones as a component of natural forests. It is estimated to have 31.5 million ha of bamboo forest and over 1,200 species in the world by 2010, among which 5.71 million ha is found in China, 5.47 million ha in India and 9.3 million ha in Brazil (FRA 2010). Asia-pacific regions, Latin America and Africa are world's three centers for bamboo distribution. Asia-pacific regions have the most abundant bamboo resources, where 45% of the world's bamboo forests and 80% of bamboo species are found here. And China is the center of center. 39 genera and over 500 bamboo species are reported in China with a total area reaching 6.03 million ha. Bamboo is substituting wood in almost all industries in China, ranging from housing, crafts, pulp, paper, panels, boards, veneer, flooring, roofing, fabrics, charcoal to food (the bamboo shoot is regarded as a healthy vegetable) etc. Bamboo industries are so thriving in China that it is always placed in a separate category in various statistics to highlight its importance. Except the expansion of natural bamboo forests, bamboo plantation areas keep increasing. It was roughly 2 million ha bamboo forests in 1950s and has been expanded to over 6 million ha today, which most of them are plantations.

Nepal and Vietnam also boost with rich bamboo resources. It is estimated that there are 81 bamboo species in Nepal. Bamboos are used for daily activities in both rural and urban areas. Bamboo-based

economy is an intrinsic part of rural and urban socioeconomic life. Marketing of bamboo products is an important source of income for household. For many people who are socially and economically under-privileged, the income from the sale of the bamboo crafts that they make has remained as the main source of income for their livelihood. The most common bamboo products found are mats, baskets, household accessories etc.

There are about 194 bamboo species and 1.5 million ha bamboo forest (including bamboo and other trees mixed forests) in Vietnam, which account for 11.3% of total forest area. Bamboo processing provides important livelihoods for 24 million farmers nearby and 1 million local people depend completely on bamboo processing. Currently, there are 723 villages engaged in production and trade of bamboo handicrafts. The Vietnamese government has set its target to increase its bamboo (and rattan) products' international market share from 3% to 12% within 5 years.

2. Findings of bamboo value chain research in China, Nepal and Vietnam

In order to improve the output and value of bamboo sectors in its cultivation, processing and marketing etc. phases, we took a close look at the value chain of bamboos in China, Nepal and Vietnam through the study entitled "Promoting bamboo industrialization through value chain study", which is funded by UNDP-PGTF.

2.1 The case in China

Three reports describing the detailed bamboo value chains in three countries are provided. Typical bamboo growing regions and bamboo utilization types are selected as study cases in three countries. In the reports, we can find that three countries have very different level of bamboo resource management and products production. China is in a much advanced stage in terms of bamboo cultivation and utilization. Bamboo resources are intensively managed and very fine products are produced. The government also attaches great importance to the bamboo sector's development. It provides numerous supports from finance, R. & D., policies and regulations, etc. The farmers who are at the low phase of the value chain are also well considered and receive lots of

technical and financial support from the downstream of the value chain. The bamboo value chain the most developed in China. The bamboo value chain is much longer in China than in Nepal and Vietnam. All actors along the chain are benefiting from the bamboo industrialization use. As a major Non-wood Forest Product (NWFP) and an excellent wood substitute, bamboo is thriving in China. The Chinese people have been utilizing bamboo in their traditional ways for centuries and modern technologies have further developed bamboo, a tiny grass, into a huge industry with over US\$ 27 billion annual output and millions of Chinese farmers make their living out of bamboo.

2.2 The case in Nepal

However, by looking at Nepal and Vietnam, most bamboo resources remain wild and extensive management. In the case of Nepal, bamboo resources are important for local farmers. The government also has made some efforts to use bamboos in a big scale. Some academic researches are conducted by both governmental and non-governmental entities in order to promote bamboo sector's resource management and product production. The main product in Nepal that we found from the research is bamboo handicrafts. Bamboo handicrafts bring cashes for the local households. Large scale bamboo product production such as paper making, bamboo floor and bamboo woven products etc. are very rare. Most of bamboo resources are traditionally used for subsistence. And most of the products such as bamboo handicrafts are locally consumed. The export value of bamboo products is very low. Some efforts are made by public and private sectors to develop high value added bamboo products production including bamboo floor, but both the number of factories and the scale of the factories remain small. The bamboo value chain in Nepal is much shorter than China and it's evidently that the input and output of the bamboo value chain in Nepal is much lower than the case in China.

2.3 The case in Vietnam

In the case of Vietnam, it has very favorable climate and topography conditions for bamboo growth. Bamboo resources are rich in terms of species diverse and bamboo forest area in Vietnam, but bamboo resources are decreasing together with its total forest resource reduction in recent decades. Most of the bamboos grow together with

other tree species and therefore, bamboo forest management level is quite low, most remain extensive management and wild. For instance, bamboo planting in Thanh Hoa is extensive farming, without fertilizing activities, no-using method to improving bamboo quality. Nowadays, some farmers would consider easy access of transportation when planting bamboos. The quality of bamboo forest in Thanh Hoa is degrading with large-scale of No. trees. The quality of bamboos is also low in the criterion of classification which the traders and local people use to buy and sell bamboo. In our field survey, we found that almost no farmers do fertilization in their bamboo forests (98%) and very few farmers conduct management activities such as weeding (12%). And the local people usually collect and burn the branches at bamboo forest after exploiting. The unit output of bamboo forest is much lower than China.

In terms of bamboo utilization, besides the traditional products and material for building, bamboo is also used to produce new products with the higher value. Bamboo's industrial utilization is focused on bamboo panel, bamboo flooring, bamboo poles for construction, bamboo paper pulp and other bamboo small and low value bamboo products such as toothpick, skewer, chopsticks etc. Its products types are richer than Nepal but poorer than China. Bamboo products are not only sold in domestic market, but also exported together with rattan products to over 120 countries around the world.

3. SWOT analysis of bamboo sectors in China, Nepal and Vietnam

SWOT analysis (or SWOT matrix) is an acronym for strengths, weaknesses, opportunities, and threats and is a structured planning method that evaluates those four elements of an organization, project or business venture. A SWOT analysis can be carried out for a project, company, product, place, industry, or person. It involves specifying the objectives of the business venture or project and identifying the internal and external factors that are favorable and unfavorable to achieve that objective.

In our case, a bamboo value chain study is conducted in three countries. We tried to identify its achievements and problems under the current

conditions. And by looking at each actor's performance along the value chain, we compare the differences in three countries and identify the advantages and shortages. Through this kind of research, we hope that three countries can learn from each other and improve the value chain so that bamboo industry could develop towards a better direction in the future.

3.1 SWOT analysis of bamboo sector in China

3.1.1 Strengths

- Availability of bamboo resource: bamboo is found around the country and bamboo is also one of the key supporting species for development in China, therefore, resource is guaranteed. Particularly for Moso bamboo, over 70% of bamboos are Moso, which is of the highest economic value among all bamboos in China and most widely industrial used in China.
- Natural merits: fast growing and short cycle
- Multi-purpose species: Bamboo is very useful, multi-purpose plant species that can be used for ecological economic and social purposes, which covers almost all aspects of daily life.
- Price competitiveness: China has the most and the best bamboo products in the world, which prices are low and competitive in the global market.
- Advanced R. & D.: governmental has put much efforts on bamboo related R. & D., research academies have made big achievements on bamboo related technologies such as high yield plantations, new products development, new technologies for processing etc. Technical know-how on bamboo is quite developed in China through half century's accumulation.
- Policy supports: favorable policies and regulations are made by central and local governments to support bamboo sector's development, not only support to farmers in bamboo cultivation, but also for bamboo processing sectors, bamboo products marketing and bamboo related research funds.
- Low investments: The investment for bamboo industry development requires low investment as compared to other sectors.

- Low management cost: Bamboo plantation can be managed with low cost for long time.
- Many people have received skill-oriented training on making bamboo products from governmental and non- governmental organizations.
- Market potential: bamboo is regarded as a sustainable plant and its products are regarded as green and eco-friendly products, therefore, there is high market potential of bamboo products at the local and international markets.
- Well-developed bamboo value chain: China's bamboo value chain is well developed and covers almost all aspects of the chain, and all stakeholders on the chain are considered highly.

3.1.2 Weaknesses

- Lack of data: although many researches are conducted on bamboo, there are still lots of basic statistic data and dynamic observation records missing or scanty. Further detailed basic survey is required.
- Lack of awareness, knowledge and know-how for ecological oriented bamboo development: the government is guiding a trend of bamboo development towards a more environmental friendly direction, and tries to explore more on its ecological function. However, bamboo's roles on carbon sequestration etc. are still under researching and have not yet turned into economic value.
- Lack of high quality man-power: although there are thousands of bamboo products found in the market, but human resources on advanced designed products making and marketing of bamboo are still lacking.
- The role of various bamboo associations needs to be strengthened.
- Lack of action plan: there is a <National Bamboo Development Plan (2013-2020)> in China, it sets up the target of bamboo development in China till 2020. It summarizes the general bamboo sector including forest area, regional development outline, each bamboo products' industrial output and value etc. But all the information is general information. The action plan

and follow-ups to achieve the targets are very broad and needs to be specified.

- Lack of availability of extremely good designs and high quality and high valued bamboo products in the market.

3.1.3 Opportunities

- Sources of income, employment and livelihood opportunity: bamboo is identified as a good species to solve rural and economically less developed regions' economic development in China due to its properties of easy access and labor intensive etc.
- Good market demand: bamboo products are recognized as green and sustainable and eco-friendly products both in China and in the international market, therefore it has a very good market demand currently and is a good source of earning foreign currency.
- Landscape restoration: There is a huge potential that the bamboo can be planted for degraded land restoration.
- Climate change mitigation: Bamboo has a high potential to mitigate and adapt for climate change.
- Suitable climate and topography for bamboo cultivation in China.
- The benchmark for entering into bamboo related business is comparatively low and therefore, small investment can start a good business.

3.1.4 Threats

- Bamboo industry development of neighboring countries: bamboo resources are rich in many Asian countries and their bamboo industries are growing very fast in recent years. Many new and fine designed bamboo products enter into the international market, which provide more competition to Chinese products.
- Scarcity of man power: At present, labor migration from rural area to cities are very common in China. And many bamboo processing factories are located in rural areas, and many of them faces problems of labor shortage. Meanwhile, some tradition skill such as weaving and carving could not find successors from the young generation, which turns out to be a big issue in China.

- Fine and well designed and produced wood products pose a severe competition to bamboo products.
- High global market competition: There is high market competition of bamboo products from neighboring countries such as India.

3.2 SWOT Analysis of Bamboo Sector in Nepal

The strengths, weaknesses, opportunities and threats of bamboo sector in Nepal are as follows:

3.2.1 Strengths

- Availability of resource-base: The resource base of bamboo is available throughout the country.
- Multi-purpose species: Bamboo is very useful, multi-purpose plant species that can be used for soil conservation, house construction, food and also for carbon sequestration
- Geo-physical situation and climatic conditions of the country are suitable for bamboo cultivation.
- Light and cheap product: Bamboo product is cheaper and lighter than any other products.
- Fast growing species: Bamboo is a fast growing species.
- Low investment: The investment for development of market of bamboo products inside and outside the country requires low investment as compared to other sectors.
- Low management cost: Bamboo clumps can be managed with low cost for long time.
- Many people have received skill-oriented training on making bamboo products from governmental and non- governmental organizations.
- Market potential: There is high market potential of bamboo products at the local and international markets.
- Availability of quality raw materials: High valued native bamboos are grown in different parts of the country, from which quality raw materials can be obtained.
- Bamboo products are environmental friendly.

3.2.2 Weaknesses

- Lack of data: The data on bamboo resources and products are scanty and scattered.
- Lack of awareness, knowledge and know-how: There is lack of awareness, knowledge and know-how on cultivation, management aspects, preservation and treatment technology used for bamboo.
- Lack trained man-power: At present, there is a lack of trained human resources in cultivation, designing, products making and marketing of bamboo.
- Lack of coordination and networking among bamboo growers, craft-makers, middleman, retailers and entrepreneurs.
- Lack of a strategic plan: There is a lack of a bamboo sector strategic plan for Nepal.
- Negative social perception and value of bamboo in the society.
- Lack of promotional support: There are not encouraging promotional supports from the Governmental and non-governmental organizations.
- Limited product ranges, designs and variety.
- Less focus on marketing and promotion.
- Retailers are not getting sufficient numbers of bamboo products as per their demand. As a result, they are not able to meet the consumers' demand.
- Lack of availability of different attractive, new designs and quality bamboo products in the market.
- Lack of demand for bamboo products due to the availability of cheaper plastic products in the market.
- Lack of government initiative and support for the development of bamboo-based industries in the country.
- Lack of selling centres/shops of bamboo products.
- Problem in competing in terms of price and quality with imported products from China and India.
- Use of less cost effective tools, techniques and equipment.
- Lack of bamboo processing facilities to make modern bamboo products.

3.2.3 Opportunities

- Sources of income, employment and livelihood opportunity: Bamboo is a source of income for many rural people and communities. Bamboo can be an important sector that provides employment opportunities for many people and a source of livelihood.
- International market and good demand: Bamboo products have high potentiality to export to international market. There is also an opportunity for establishing national and international market for bamboo products. Besides, it can be a source of earning foreign currency for Nepal. The bamboo products are in increasing demand both in the national and international market.
- Landscape restoration: There is a huge potential that the bamboo can be planted for degraded land restoration. Bamboo can be planted on community forests.
- Climate change mitigation: Bamboo has a high potential to mitigate and adapt for climate change.
- Conducive forest policy 2015: The new forest policy 2015 urges for the involvement of private sector for the overall development of the forestry sector in the nation.
- Suitable climate and topography for bamboo cultivation in Nepal.
- Majority of bamboo-based enterprises are of small scale and they can be started with smaller investment as compared to other businesses. The products manufactured by these enterprises are traditional and easily marketable in the local and national markets.
- People, who have traditional and indigenous skill, can produce unique and attractive bamboo handicrafts that can be easily exported to foreign countries.
- A number of large and small native bamboo species are available in the country for making woven products, handicrafts and furniture.
- Exhibitions and trade fair are occasionally organized in different parts of the country for the sales promotion of the bamboo products produced by the factories and individuals in different.

3.2.4 Threats

- Depletion of bamboo resources: The bamboo resources are depleted as well as deteriorated gradually, affecting the sustainable production of bamboo for various uses.
- Scarcity of man power: At present, there are very few people in bamboo processing and crafting. The migration of youth people as labour force is a big problem in Nepal as it has also led to the scarcity of labourers in this sector.
- Consumers' interest: Consumers' interest is decreasing in bamboo products due to low quality products.
- People who used bamboo once are now habituated to use plastic products. It is quite difficult to bring them back to previous stage of using bamboo products.
- High market competition: There is high market competition of bamboo products with India and China

3.3 SWOT Analysis of Bamboo Sector in Vietnam

The strengths, weaknesses, opportunities and threats of bamboo sector in Vietnam are as follows:

3.3.1 Strengths

- Availability of rich bamboo resources: There are abundant natural bamboo resources throughout the country.
- Diversified bamboo species: Bamboos are found to be very diversified in Vietnam, and there are several species of high economic and ecological values.
- Favorable geographic and climatic conditions: the geographic and climatic conditions of the country are suitable for bamboo cultivation.
- Cheap costs: Raw materials of bamboo and labor costs are cheap and light in Vietnam.
- Fast growing species: Bamboo is a fast growing species.
- Low investment: The investment for development of market of bamboo products inside and outside the country requires low investment as compared to other sectors.
- Low management cost: Bamboo clumps can be managed with low cost for long time.

- Many people have received skill-oriented training on making bamboo products from governmental and non- governmental organizations.
- Diversified products: although the general bamboo production level is not very high, but there are many mass production on bamboo products such as panel, floor etc.
- Market potential: There is high market potential of bamboo products at the local and international markets.
- Availability of quality raw materials: High valued native bamboos are grown in different parts of the country, from which quality raw materials can be obtained.
- Bamboo products are environmental friendly.

3.3.2 Weaknesses

- Lack of data: Baseline surveys on bamboo resources and products are scanty and scattered.
- Lack of awareness, knowledge and know-how: There is lack of awareness, knowledge and know-how on the aspects of bamboo cultivation, management, preservation and treatment technology used for bamboo.
- Lack trained man-power: At present, there is a lack of trained human resources in cultivation, designing, products making and marketing of bamboo.
- Lack of coordination and networking along the bamboo value chain from growers, traders, bamboo products manufacturers to marketing actors etc.
- Lack of a strategic plan: There are some regulations on bamboo development, but bamboo sector strategic plan for Vietnam is not found.
- Limited product ranges, designs and variety: Bamboos products are not fully explored and product types are not very diversified as in China.
- Less focus on marketing and promotion.
- Lack of availability of different attractive, new designs and quality bamboo products in the market.
- Lack of government initiative and support for the development of bamboo-based industries in the country.

- Problem in competing in terms of price and quality with imported products from China and India.
- Use of less cost effective tools, techniques and equipment.
- Lack of bamboo processing facilities to make modern bamboo products.

3.3.3 Opportunities

- Sources of income, employment and livelihood opportunity: Bamboo is a source of income for many rural people and communities. Bamboo can be an important sector that provides employment opportunities for many people and a source of livelihood.
- International market and good demand: Bamboo products have high potentiality to export to international market. There is also an opportunity for establishing national and international market for bamboo products. The bamboo products are in increasing demand both in the national and international market.
- Landscape restoration: Bamboos are regarded as good species for ecological function such as degraded land restoration, carbon sequestration and water conservation etc.
- Climate change mitigation: Bamboo has a high potential to mitigate and adapt for climate change.
- Suitable climate and topography for bamboo growing in Vietnam.
- Majority of bamboo-based enterprises are of small scale and they can be started with smaller investment as compared to other business.
- A number of large and small native bamboo species are available in the country for making various bamboo products.
- Exhibitions and trade fair are occasionally organized in different parts of the country for the sales promotion of the bamboo products produced by the factories and individuals.

3.3.4 Threats

- Depletion of bamboo resources: The bamboo resources are depleted as well as deteriorated gradually, affecting the sustainable production of bamboo for various uses.

- Shortage of labors: it is a general trend that young people migrate to cities in many Asian countries, which causes scarcity of labors in rural villages. Bamboo industry is labor intensive industry, and scarcity of labors will bring difficulties during processing.
- High market competition: There is high market competition of bamboo products with India and China

3.4 SWOT Matrix of bamboo development

	Strengths	Weaknesses
	<ol style="list-style-type: none"> 1. Resource abundance 2. Species diversity 3. Favorable geographic and climatic condition 4. Policy support 5. Production capacity 6. Technical know how 7. Marketing capacity 8. Networking and association 9. Costs advantage and low investment 10. Manpower 11. Eco-friendly property 	<ol style="list-style-type: none"> 1. Lack of basic data 2. Lack of awareness 3. Unfavorable policy support 4. Lack of technical know how 5. Lack of manpower 6. Lack of marketing and promotional network 7. Lack of coordination and associations among value chain actors 8. Limited design and product variety 9. Lack of market demand 10. Lack of processing facilities
Opportunities	<p>Opportunity - Strength strategy</p> <p>Use strengths to take advantage of opportunities</p> <ol style="list-style-type: none"> 1. Domestic and international market demand 2. Job opportunity and income generating 3. Role in landscape restoration 4. Low benchmark for business starters 5. Government encouragement 	<p>Opportunity -Weakness strategy</p> <p>Overcome weaknesses by taking advantage of opportunities</p>
Threats	<p>Threat - Strength strategy</p> <p>Use strengths to avoid threats</p> <ol style="list-style-type: none"> 1. Resource depletion 2. High market competition 3. Scarcity of manpower 4. Costs increase 	<p>Threat - Weakness strategy</p> <p>Minimize weaknesses and avoid threats</p>

4. Recommendation and way forward

Bamboo is a very important non-timber forest product in the world. It plays a more and more important role in the economic, social and ecological development in the society, particularly in many developing countries and in rural areas. China, Nepal and Vietnam are in different stages of civil economic development, and so to their bamboo industry development. It's very evident that China is much advanced in bamboo resource management and product design and production. Vietnam is also developing fast, but its resource management is more extensive, product varieties, processing equipments, product quality and market share etc. are less competitive than China. Nepal is much lower than both China and Vietnam in terms of overall bamboo sector's development level. Therefore, following recommendations are provided through the value chain study.

- 1) A thorough bamboo resource assessment is needed both in Nepal and Vietnam.
- 2) Bamboo development master plan should be outlined and operation plan is also needed to guide the overall bamboo sub-sector's development with an ultimate goal of contributing to environmental conservation and to economic development.
- 3) High attention from the government is needed to support bamboo sector's development, including more financial and technical supports.
- 4) Demo-sites for bamboo cultivation and products exhibitions should be established either by governmental entities or non-governmental organization.
- 5) Government should strengthen its role in providing more information on marketing and new product design. Many of the bamboo products remain in traditional use and normal design. It is very necessary to explore new patterns of bamboo products.
- 6) Further research and studies, both at micro and macro level, are necessary to identify existing gaps and issues, explore constraints and opportunities, and to address the issues and the barriers for the development of the bamboo sub-sector.
- 7) More efforts should be done to improve bamboo forest management level towards sustainable development.
- 8) The capacity of each actor along the value chain needs to be

strengthened.

- 9) Technical extension and R. & D. supports still need to be strengthened to enhance the capacities of the actors along the value chain.
- 10) Linkages along the value chain actors should be strengthened and the roles of various associations need to be fully explored.
- 11) Communications among China Nepal and Vietnam, either from government aspects or from non-governmental side should be enhanced to share the good experience from each other, especially that China's development path could provide good lessons to Nepal and Vietnam