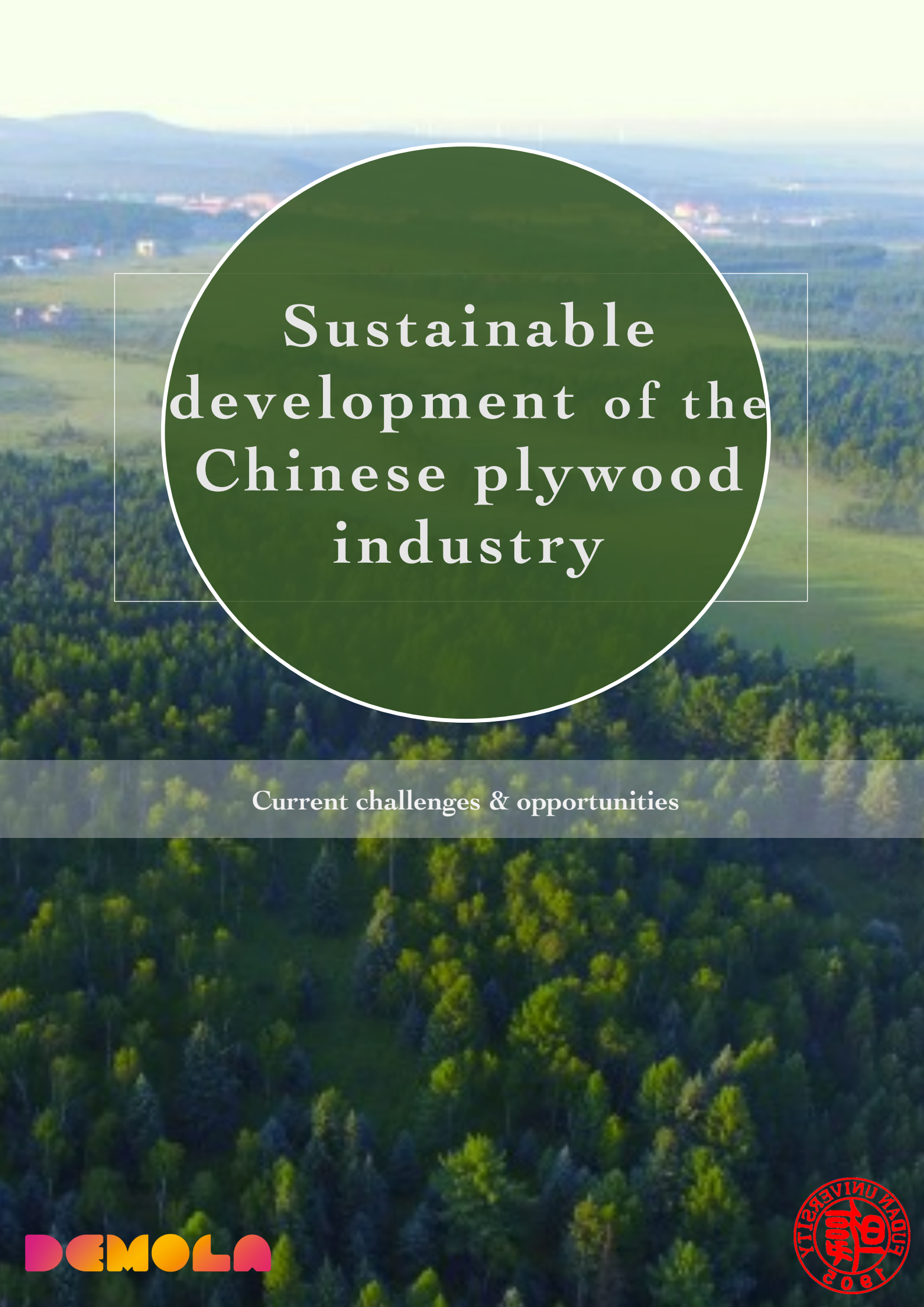


Sustainable development of the Chinese plywood industry

Current challenges & opportunities

DEMOLA

FUDAN UNIVERSITY 1905

Table of contents

1

INTRODUCTION

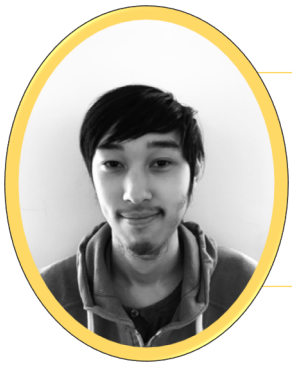
1.1 Team Members and Collaborators

1.2 Presentation

1.1 Team Members and Collaborators

M E M B E R S

Hong (Hengchi Chen) 4th year undergraduate of Ecology at Fudan University.



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All the members have worked within the DEMOLA framework but engaged at the same moment with Fudan University in Shanghai, China. The international base of the team has helped the discussion and analysis of every step accomplished and had encourage dialogue between different cultures to create a very valuable environment

C O L L A B O R A T O R S

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1.2 Presentation

This document reflects the result of two months of work of a team of students assigned to the challenge "Sustainable Forestry". The challenge was organized jointly by DEMOLA and Fudan University, and proposed by Raute, a Finnish company dedicated to the plywood and veneer technology. Together with the innovation platform DEMOLA, our team has used modern innovation methodologies to generate new ideas and potential solutions to the challenge of achieving a sustainable plywood industry in China in the next years. Raute has contacted DEMOLA to gain more insights about the trends, challenges, and opportunities of the plywood sector in China, and to explore pathways that may lead it to a sustainable state. After more than ten years in China, Raute is trying to develop a market to further introduce its plywood machinery. To do so, Raute needs to improve its understanding of all the factors that affect the whole plywood production process, the drivers behind the changes and transformations at every step of the whole chain, and the actors and practices that compose the entire forestry industry. This way, this project serves as a first step to provide a deeper understanding of the current status and future trends of sustainable forestry in China, and aims to propose a potential model that can guide further research into more specific topics related to the development of the Chinese plywood market.

2

BACKGROUND ANALYSIS

2.1 History of forestry management in China

2.2 Plywood industry development in China

2.3 Current situation

2.4 Situation of the plywood industry in other countries

2.1 History of forestry management in China

According to the Eight National Inventory on Forest Resources performed between 2009 and 2013, China has a total forest area of 207.69 million hectares, forest coverage of 21.63%, and a gross standing stock volume of 15.14 billion m^3 (Zeng, W. & Tomppo, E., 2015). Before reaching this state, China has experienced many changes in its forest land use history. In this section we make a broad review of the uses that Chinese people has made out of these forest systems.

There are two main aspects of forestry management: wood extraction technology from in-situ forest mass and forest management from different levels of administrations in terms of policies, initiatives and projects. The different contexts of forest administration have helped to create a mindset of how this administration works and the implications that its policies have had on the forest system. Understanding the history of the industry helps to understand the bureaucracy behind the plywood industry, whose inputs reside in the forests. The course between different actions and periods of change contributes to understand the capacity for change and adaptation of the Chinese government.

Our research has shown us that studies about the technology employed in the tree cutting process, transportation and other processes of the supply chain are rather scarce. There is not a well-detailed review of the methods used by the forestry farmers and the reasons behind the use of these methods, thus it is hard to know if farmers performed swidden, thinning from below or from below, hand work, selective cuts or preparatory cutting in the harvesting methods. That might be due to the highly dispersed nature and diverse degrees of enforcement of the forestry farmers involved, who use specific practices and methods based on experience.

It is also important to consider that land use in China works quite differently from other countries. The control or ownership over the forest land in China by non-governmental groups or organizations is equivalent to use rights, since all the land belongs to the government (Dai, L. & Wang, Y., 2011).

This section does not make the distinction between different regions or administrations, or by different forest types.

The following analysis of the Chinese forestry sector is conducted as a comprehensive account of the different changes in the Chinese forest land at a national level. The forest management history will be divided into three phases as Dai, L. & Wang, Y., 2011 propose:

P H A S E 1

First Changes in Forest Management (Early 1950s to Late 1970s)

After the end of the war in 1950, forests in China were put under an afforestation and protection jurisdiction. But with the cultural revolution (1966–1976), a huge change in forestry management happened. By that time harvesting and logging was carried out by small businesses formed by farmers and local workers, and owned by local governments (Dai, L. & Wang, Y., 2011). During this stage, forest management did not establish any harvesting limit, which meant that large areas of land-use forest were cut. In addition to this, many lands destined for forest uses were replaced by crops or lands used for agriculture purposes (Dai, L. & Wang, Y., 2011), which considerably reduced the ecological and environmental values and functions of forests. Furthermore, between the 1960s and 1970s, national grain policy and political ideology discouraged local users from investing in forests, and forest farms from the state often trespassed on forests of local collectives and shoveled their timber resources (Rozelle, S., Huang, J. & Benziger, V., 2006). Consisting of oil bearing trees, fruit and nut orchards, and other cash-producing, non-timber tree species, the area of commercial plantations rose by about 40 percent during the reform era (Rozelle, S., Huang, J. & Benziger, V., 2006).

It can be inferred that, from this stage of forestry development, these small companies that were engaged in extracting wood acquired some autonomy and established cutting and extraction techniques that were not clearly limited or controlled by the government. In this period, only the economic values of the forests were considered and the environmental and sustainable values that are currently being considered into policy-making were neglected at that time. During this period, the government's proposal to drive the country to

manufacture products and develop the national economy, was also transferred to the forestry sector and the wood industry.

Phase 2

Formal Legal and Jurisdictional Framework with Continued Extensive Harvesting (End of 1970s to Late 1990s)

During this stage of numerous economic and social changes and reforms, the opening of doors to international influence and the rapid development affected many sectors of the industry, including the forestry sector. It is important to note that in 1984, the first forest law was established: The Forest Law of People's Republic of China (Dai, L. & Wang, Y., 2011). The law explicitly stipulated that forestry development should be pursued under a policy of general forest protection. This law also highlighted the importance of afforestation and its link with timber harvesting as the basis of forestry management. From this moment, uncontrolled tree cutting and afforestation would no longer be allowed and the country. This started composing the basis of sustainable forestry management in China.

In addition to the forestry law, the government principle that the rate of consumption should be less than the growth rate set the basis to a stricter control over the annual rate of timber harvesting and to set up annual quotas for timber cutting. These quotas were established by state-owned forestry enterprises and institutions over farmers, factories and mines as harvesting units. The quotas also applied to collective and individually owned forests, and were applied individually. With this quota system, many local bosses acquired great importance and power, thus creating a clear social inequality. Harvesting totals would be collected and consolidated by departments of forestry in the provinces, autonomous regions and municipalities directly under the Central Government and, after examination and verification, by the local and provincial governments, submitted to the State Council for approval (Dai, L. & Wang, Y., 2011)

The forestry industry in China (specially the harvesting associations) was so segregated and there were so many local farmer companies that the collection and taxes and their monitoring by the government was very complex. Some

sources indicate that, despite the measures adopted by the government at national and local levels and the formulation of the forestry law, forestry companies exceeded their deforestation quotas to increase their profits. However, other sources of information show that, between 1980 and 1993, state forest farms and collectives have increased the afforestation area, planting 1.5 million hectares per year. Such large annual increases during the reform meant a total rise of 20 million hectares of new forest land from these afforestation efforts (Rozelle, S., Huang, J. & Benziger, V., 2006). These data and information differences reflects the low level of monitoring of forestry processes, and the low availability of accurate and reliable data. Although this is a history analysis, it is important to point out the difficulty in collecting all information on practices and decision-making in China during this period.

At the end of the 1990s, China's central government established a long-term forestry program called Classification-Based Forest Management (CFM). This program aimed to classify the country's forests into two categories: commercial forests (CoF) and ecological welfare forests (EWF), according to their distinct functions and services.

Phase 3

Addressing Sustainable Forest Management (1998 to Present)

In 1998, huge floods in the Yangtze River basin and in the northeastern parts of the country resulted in the loss of several thousand lives and hundreds of thousands of people being left homeless (Dai, L. & Wang, Y., 2011). The bad management of the forests fostered these natural catastrophes, due to the inadequate policies and enforcement measures being implemented at the time. As the forests were cut down without established, supervised and scientific-based practices (for example, based on the regeneration period of forests), the precipitation runoff increased, the soils lost absorption capability and the water caused floods in the surroundings. The Chinese government thus decided to shift direction in order to encourage ecological sustainability while balancing land uses, economic growth, and the demand for forest products (Dai, L. & Wang, Y., 2011).

This sustainable transition would be implemented by the Directive to Enhance Forestry Development, launched on 2003. This directive declared that forestry should assume a leading role in the construction of an ecological civilization and play an important part in implementing the strategy of sustainable development (Central Committee of the Communist Party of China and China State Council 2003).

In 2004, another reform was introduced in many of the provinces in China, which established a decrease in forest taxes and promoted free-market mechanisms for forest assets transfers and private support systems for forestry. These measures focused on encouraging the forestry market and attracting investment in the sector. This reflects that China wants, in addition to conserving its forests and highlighting its ecological function, encouraging the market and the trade of forestry products.

Achievements in forestry ecological construction have been made, based on the Six Key Forestry Programs. From 2001 to 2005, the total area of afforestation and reforestation was 39.33 million ha (FAO, 2009) and it is expected to increase in the future.

NFIs	Forest area (million ha)	Forest cover percent (%)	Growing stock volume (billion ha)
NFI1	121.86	12.69	8.66
NFI2	115.28	12.01	9.03
NFI3	124.65	12.98	9.14
NFI4	133.70	13.92	10.14
NFI5	158.94	16.55	11.27
NFI6	174.91	18.21	12.46
NFI7	195.45	20.36	13.72
NFI8	207.69	21.63	15.14

Figure 1: Forest area, forest cover percent and growing stock volume of the eight NFIs in China (Zeng, W. & Tomppo, E., 2015)

As it can be seen from Figure 1, the recent increases in Chinese forest area and growing stock have resulted from huge afforestation and reforestation efforts. Moreover, the new Directive to Enhance Forestry Development has played a significant role in charting the course of development for forestry and forest management in China. With these endeavors, soil and water losses in the basins of big rivers as well as the desertification of major sand areas has been

moderated, a beginning has been made at reversing the trend of overall deterioration of the China's ecological landscape, and the industrial structure of forestry has been rationalized (SFA 2008).

2.2 History of the plywood industry in China

China's plywood industry began in the 1920s, and merchants from Russia, Britain, France, Japan, Poland and other countries set up factories in Tianjin, Harbin, Shanghai, Changchun and other places (Bingyin Ding, 2013). The 30 years from the beginning of the 20th century to the founding of the People's Republic of China were the "enlightenment" stage of China's plywood industry. The annual production capacity had increased from 3,000 cubic meters to 16,000 cubic meters. China has always attached importance to the introduction of advanced equipment in the plywood industry, thus ensuring the production of plywood enterprises and playing an important role in promoting the technological progress of China's plywood industry and plywood equipment manufacturing industry.

From the founding of the People's Republic of China to the reform and opening up, plywood production had increased by 20 times, but the quality had been relatively low during this period. After the reform and opening up, the national economy had developed rapidly, and the demand for plywood in China had increased. In addition to the annual increase in domestic plywood, a large number of plywood has been imported from Indonesia and Malaysia (Shuihe Chen, 2004).

From 1990 to 1998, China's plywood industry entered a period of rapid development, producing a total of 33,180,600 cubic meters of plywood and a total of 14.428 million cubic meters of imported plywood. Due to the continuous growth of the real estate industry, large-scale high-quality plywood was required on the market. During this period, China only had a few production plants capable of producing large-scale high-quality plywood, and many of them could not meet the market demands. A large number of imported plywood products thus entered the Chinese market at a high price. Due to the high demand for high-quality large-format plywood and high profit margins, the domestic and international business community had been attracted to the development of the

Chinese plywood industry. Some companies had already begun to vigorously develop the plywood industry and introduce funds and advanced plywood production lines. Due to the high profit margin of plywood production, and in addition to the state-owned and private enterprises in China, Sino-foreign joint ventures and Taiwan-funded enterprises had also entered the plywood sector. China's plywood production had therefore entered a period of rapid development. At the same time, many small workshop-style production groups have begun to enter the field of plywood. However, the plywood they produced was generally of poor quality, and with the low price they have had a great impact on the market. A large number of smuggled plywood companies have also entered the Chinese market during this period. Since these products had not passed the national quality inspection, many foreign plywood brands had entered the plywood market in China with a variety of fake brand names (Shuihe Chen, 2004). In addition, some domestic manufacturers, in order to satisfy the needs of some buyers, have allowed these fake brand names to enter the plywood market, and many large formal plywood companies had been severely hit by this phenomenon. However, the number of imported plywood decreased in the following years.

From 1998 to 2003, China experienced a fast development period of its plywood industry, from 4.5 to 2012.4 million cubic meters. The provinces of Hebei, Shandong, Jiangsu, and Zhejiang in North China and East China used high-speed and high-yield forests and some imported timber to produce plywood at high speed. Due to the large-scale development of the plywood industry in the above provinces, the production of plywood in China had become the world's largest producer of plywood in 2003. The amount of imported plywood had thus been decreasing since then, and the quantity and quality of domestic plywood had been significantly improved. In 2001, the output reached 9,045,100 m3, the import was 650,900 m3, and the export was 965,400 m3. 2001 became the first year during which the export volume was greater than the import volume. However, with the development of the plywood industry, many small-scale plywood production groups and small and medium-sized plywood factories with low technical level had generally produced poor quality plywood. This kind of plywood entered the market at low prices, impacted the normal production order in the plywood sector in China and the development of the plywood industry, and also allegedly caused serious waste of forest resources and equipment.

In the past ten years, the distribution of plywood enterprises has been further concentrated in the cities where fast-growing and high-yield forest producing areas and coastal import and export are convenient. At present, the pace of structural adjustment of the plywood industry is accelerating, and the plywood industry in China is gradually recovering, moving towards rational, efficient, stable and high-quality. There are tens of thousands of plywood enterprises in China, and the concentration is extremely low (sentences contradict each other). The large-scale and enterprise groups are less than 0.3%. However, the industry is constantly improving. First, more and more enterprises use aldehyde-free glue. Second, enterprises have increased their research and development efforts to adjust the product composition. Third, the small enterprises have been gradually shut down. In 2018, China produced 155.34 million cubic meters of plywood products, which became the only variety of wood-based panel varieties, accounting for 65.3% of all wood-based panel production. In 2018, the export of plywood was 11.34 million cubic meters and the import was 163,000 cubic meters. The importing countries of China's plywood products have remained basically stable. However, in terms of export volume, the proportion of traditional export markets led by the United States and South Korea has been shrinking, and the proportion of emerging markets represented by the Philippines, Vietnam, and Israel has increased rapidly. Russia, Malaysia, Indonesia and other countries have maintained the status of China's main source of plywood products (China's Forestry Government, 2018).

2.3 Current situation of the plywood industry

In the last ten years, with the adoption of a set of key national forestry projects, an acceleration of large-scale afforestation efforts, improvements in the conservation of forest resources and a new direction for forest management policies to encourage sustainability, the forestry industry has made significant progress in enhancing the growth of country’s forest resources and bolstering the supply capacity of its forests (1). Excessive exploitation of forest resources over the past five decades has contributed to a variety of environmental problems and calamities including floods, soil erosion, sand storms and desertification, still present today (1). (Does not seem to be related to the title of this section)

The current situation of plywood industry and sustainable forestry is characterized by the low market share of large enterprises, and the high production volume of small-scale companies. Additionally, high-quality logs come mostly from other countries, and the supply of imported land has a decreasing trend (I don't understood the meaning). Therefore, high-quality plywood products rely heavily on imports, and there is an imbalance between the high-end market of imported products and the low-end market of the products exported by China.

China has formed four clusters of plywood industry centered on Xuzhou, Linyi, Langfang and Jiashan. The plywood production in Jiangsu, Shandong, Hebei and Zhejiang, where the agglomeration area is located, accounted for 22.87%, 19.68%, 18.64% and 10.57% of the total national production respectively (http://www.forestry.gov.cn). A large number of wood processing SMEs (meaning?) are gathered in these areas. China's main timber products only achieved geographical concentration, and there wasn't competition and cooperation between enterprises. This simple form of industrial agglomeration did not play a role in promoting industrial competitiveness.

Among the existing problems of the plywood sector, there is the decentralized nature of operations (workshop-like business model), that makes the production process fragmentary and difficult to manage. Moreover, capital and raw materials are largely lost in various parts of the supply-chain, and many environmental problems are also generated.
In the past, most of China's plywood enterprises used integrated production methods from logs to plywood. Some enterprises also produced various products such as plywood, particleboard, fiberboard, furniture and sawn timber, and became a comprehensive wood processing factory. In theory, this business model can use raw materials efficiently and reasonably, but the investment of enterprises is large, and the investment in fixed assets of a plywood production line with an annual output of 50,000 m3 requires about 10 million yuan, and an integrated processing plant is established. The investment is often several times its investment (meaning?).

For rural areas, especially those underdeveloped, it is still difficult to raise funds to build factories. Similarly, the construction of plywood enterprises in the Wulin area will also be limited by organization hurdles and supply of raw materials. Because the entry threshold for entering the industry is low, and the investment is generally only 100,000 to 200,000 yuan, which enables thousands of households to build a single-board processing plant. At the same time, small

plywood plants with an investment of 400,000 to 1 million yuan has also being produced. It is the severability of this production process that creates conditions for the formation of industrial clusters. (meaning? Either agglomeration or decentralization of the factories) .

The current environmental problems caused by plywood industry include harmful gases, waste water, dust, solid waste and noise, in which formaldehyde emissions from wood-based panels and organic volatiles (VOC) from wood finishing are more prominent. The timber industry discharges wastewater, gaseous emissions and solid waste into the environment during the production process, which has a negative impact on the society and local ecosystems. The timber industry does not compensate those who perceive these impacts, thus generating externalities. These emissions generated by the timber industry production process can be handled by: (1) direct discharge into the environment; and (2) waste treatment, reuse after use or discharge into the environment. The first approach is in line with the company's goal of maximizing profit. However, the direct discharge of pollutants into the environment will cause environmental pollution and cause social costs. The second way requires investment in manpower, material, and financial resources, resulting in increased corporate costs and lower profits.

2.4 Situation of the plywood industry in other countries

The distribution of plywood production around the world is heterogeneous, with China accounting for the majority of the output in 2018 (71%), followed by the US (7%), Russia (3%), Indonesia (2%) and Malaysia (2%) (FAO, 2019). The level of development of the plywood sector also varies widely among different countries.

For instance, in developing countries like China and Indonesia, the sector is composed of a huge number of rural households and also several companies which are widely distributed in the national territory. Forest management in these countries has not developed fully yet, and many challenges related to unsustainable harvesting, premature harvesting of trees, corruption, illegal logging, and the abuse of local communities still exist due to ambiguous policies and lack of enforcement (Miao & West, 2004; Xu & White, 2004). The production process usually uses a relatively high amount of labor and often uses artisanal

methods. Sometimes the manufacture stage also uses products that are harmful, particularly resins with high formaldehyde emissions. This makes processing of raw materials, although more technology-intensive, still relies on artisanal veneer, and may limit the quality of the final plywood boards. The output occupies primarily the low-quality niche of the plywood market, with low-grade products such as furniture. However, in the case of China, government's efforts are already facing some of these issues, and other underdeveloped countries in Southeast Asia may also do so in the next years. For example, Indonesia has already starting to promote certified wood in European markets, in order to promote adequate practices in the industry.

In contrast, developed countries such as Finland and the United States have a developed industry where the whole supply chain is integrated and which relies heavily on technology. High-end markets, including construction, vehicle (Finnish Forest Industries Federation, 2002). The management of forest resources has reached a mature state, where there are clear ownership and management rights for all stakeholders and there is an established system to track environmental, social and economic development. This system allows trees to grow slowly and offer an optimal raw material to produce high-quality plywood (Finnish Forest Industries Federation, 2002). The use of modern equipment and technology makes the manufacture process highly efficient in the use of inputs and minimize direct environmental impacts (Finnish Forest Industries Federation, 2002). Likewise, the integrated supply chain allows for a better control of the whole production and the use of quality and environmental certificates that are often required by developed countries. Plywood from these countries aim for the high-end market, where products are commonly used in floors, roofs, concrete formwork and vehicle parts (Finnish Forest Industries Federation, 2002).

3

Problem Statement

The objective of this project is to improve the understanding of the actors, processes and interactions in the plywood production chain. After conducting a comprehensive review of the forestry management and plywood industry in China, the team conducted a stakeholder analysis to identify the needs, approaches, and interests of the different actors that compose the industry. By merging these two components, this report constitutes a holistic and interconnected view of the different actors, factors, processes and relationships that constitute the Chinese forestry industry. This will facilitate future analyses of the current trends, challenges and opportunities of the plywood industry, and also serve as a basis to propose ideas that might serve to guide the transition of the current plywood industry towards sustainable development.

4

STAKEHOLDER ANALYSIS

4.1 Farmers

4.2 Industry

4.3 Government

4.4 Academia

4.1 Farmers

This section describes the work pattern of the farmers and their problems, including their adaptation to a new lifestyle together with policy changes, and their dilemma between work and life. One case study in a Sichuan village help to explain in detail the difficulties met by those who have spent their whole lives in these areas. Their point of view might seem to contradict the government vision, but it will serve as a complement that may offer valuable insights for the whole solution.

4.1.1 Definition

The farmers are all those who are involved in logging and processing wood into veneers. For some of the farmers, the manufacture of veneer from raw wood is an important way to add value to their production. In this chapter we will be focusing on two types of farmers: those who only focus on logging (hereinafter called “loggers”) and those who are also workers (hereinafter called “employees”) in local veneer factories.

4.1.2 Work pattern from the perspective in plywood production chain

Farmers constitute the very beginning of this plywood production chain. The farmers chop trees down, which is called “timber”, then make them into veneer and send them to plywood companies for further processing. While manufacturing veneer, they usually cut timber into small pieces and dry them under sun. Some farmers also rely on sidelines such as crops. All these farmers strive for their livelihood of their households. Usually for them, a stable job with enough salary is their primary goal.

4.1.3 Interaction with Industry

In the past, it was common for farmers to take on jobs other than farming to feed their family. This phenomenon is not only seen in forestry but also in other agriculture activities because one important factor in agricultural

production is time. There's not much things for farmers to do while waiting for the trees to grow up. Therefore, instead of waiting, many farmers decide to take other jobs, thus creating in this way a "village industry". Usually with a large population, local agriculture production can barely satisfy the village needs for food. Usually villagers can't leave here because they can't leave the trees to die while doing another full-time job, nor can they abandon their families, therefore their labor force is often wasted during this period of time. They have had many solutions in the past by doing hand-knitting and making "paper". With the increasing demand of wood in the forestry market, one common solution adopted by many farmers is employing a cutting machine or setting up small veneer factories to add value to their raw product.

4.1.4 Current problems

I. Logger's perspective

A) Restriction on logging

For many loggers, the latest Natural Forest Protection Project (NFPP) is a problem for them, because it strictly prohibits most logging activities on natural forests. Many loggers have been dependent on natural forest nearby their village for generations, some of them even had loans to expand their logging scale. This project sets up the most stringent cutting limits ever implemented in China, and goes beyond most loggers' expectations. At the same time, this project does not provide any kind of compensation to these loggers. Some of them have had to switch to alternative economic activities which generate less profits than logging. Others face an even more serious problem, because they cannot pay the debts they incurred in when their expectations on their investments were higher.

B) Division of forestry area

The Forest Tenure Reform is also giving trouble to farmers because it's sometimes hard to apply in a real situation, where forests are not objects but areas with on-going activities. One goal of this reform is to give a clear division of forest for each family, but this reform often creates conflicts and contradictions. For example, if a farmer has claims on land where another farmer has been growing trees for some years, the farmer with the land claim can neither cut down the trees immediately nor give them back to the farmer who set the

trees. Waiting is not an option either because if the second farmer doesn't do anything, this part of forest will soon become uncultivated and difficult to seed again.

C) High taxation

In sharp contrast to other agriculture activities, where government exempts agriculture taxation and provide subsidies, the taxation on forestry is high (see attachments for an example). In some regions, this tax could even go up to 40%, which significantly lower the farmer's income.

II. Employee's perspective

A) Lower income

The environmental protection policy is giving local factories a hard time. Employees are also being paid less, or factories just go bankrupt. Together with the limitations farmers have to exploit local forest resources, their economic status deteriorates even more. For some villages that are covered by government policies, villagers get some kind of help, but many others do not have any kind of assistance from the government.

B) Unemployment

The situation gets even worse when factories are being shutting down and employees lose their jobs with no compensation. This more often happens to people around mid 40-50's who has been doing manufacture work for years and is unable to find other jobs for lacking skills and knowledge. These employees usually learned their skills when they're young and expects this jobs will last til they retire. Some of them have children at school and wife and parents to feed, while this sudden hit gives these families serious crisis. Some factories got moved into downtown instead of being shut down, which might be better for the owners but would't change the fate of these employees —Leaving their land and family simply isn't possible.

III. Government perspective

A) Illegal logging

Some self-employed households do not carry out log harvesting in accordance with relevant government regulations. Individual households do not necessarily have a stable source of wood or forest supplies, so their unregulated activities are more likely to create issues such as environmental problems.

4.1.5 Case of Yangxi village in Guizhou: How local villagers were affected by reforms.

Yangxi village is located in Maoping Town, Jinping County, Guizhou Province. With 756 people living here, this village has an 89% forest coverage and depends highly on the forestry industry (it generates more than 40% income of the whole village). The reform and NFPP is making many changes to this village, and also is arousing many problems as well.

First, the local loggers are indifferent and even reluctant to the Forest tenure reform. Younger generations usually work far away from hometown, and those who stay in the village to develop the local forestry production do not want to change current boundaries and deal with other related issues. Also, it's difficult for every stakeholder to be present because these policies have to be designed when many youngsters are away from the village.
Second, the policy is making the logging permits more complex. Even within the cutting limit, it's difficult to acquire a cutting permit. For Zhang, he needs to go through 8 steps involving 5 government departments to finish the process. He considers that the forest has been used by him for decades, and it is thus not reasonable to go through all these troubles and spend time and effort just to cut a relatively little amount of timber.

The compensation also has become a huge problem. A large portion of forest are now being categorized as non-commercial forest, meaning that local farmers cannot harvest wood from these areas anymore. They said that government didn't notify them about non-commercial forest regulations beforehand, so they didn't know how this plan came to be nor have any time to prepare for it. Some government documents stated that the government would offer compensation for non-commercial forest, but the local official said that it

only applies to non-NFPP areas, and under NFPP farmers will not get any compensation.

Conclusion and expectation

For farmers, the environment policy is increasing pressure on two of their major income sources. Some farmers could expect an adequate compensation and a job promise, but others may hve many difficulties due to the new reforms. Still, it's reasonable to expect more young people will leave those areas and strive for more profitable job in nearby cities. Therefore, a decrease in the local population of farmers is foreseeable. As the ageing of the population increases, new problems such as lacking work force might occur in the next years.

4.2 Industry

This chapter describes the three main parts of the plywood industry — local veneer factories, plywood manufacturing companies and other big companies involved, each providing their strategy and problems facing environment policy along with cases in detail. Insights from these may shed light on the whole plywood industry's development in the near future.

4.1 Local Veneer factories

I. Introduction and work pattern

As stated above, it's common for farmers to produce veneer and add value to their production. To do so, some of them set up small factories. The size of these factories range considerably, depending on the capital availability of local farmers. Many small factories are built by some of richest villagers who decide to invest part of their money to take advantage of their resources. These factories are relatively small, with only cutting machines as equipment, while protection measures are often inexistent. Some factories put the veneer outside to dry, while others open the roof to allow sunlight coming in, but the veneer needs to be moved by manpower. Afterwards, they sell the dried veneer to plywood manufacturing companies.

II. Company's goal

Profit is their main concern of the companies. But unlike big companies, these factories usually don't have a formal company structure or management plan. The owner is familiar with the workers who mostly live in the same village, so the relationship between employer and employees might be different than normal companies. As such, factories like this may not look for as much profit as possible, but rather focus on maintaining a reasonable profit to keep this business running while keeping a stable relationship among company members. The owner would expect to profit by lowering costs (buy cheaper machinery) and selling at the highest price possible, given its financial ability to conduct the business.

III. Current problems

a) OWNER'S PERSPECTIVE

1) High pressure from environment policy

The impacts of environment policy on the operations of factories has increased together with the last reforms. With "the strictest environment policy ever", many factories will be temporarily or permanently shut down. Even for those who meet the standard, they may still need to suspend their normal operations temporarily for certain events. Unlike big companies who have financial capital to withstand these situations, many local factories cannot overcome these problems. The environmental problem for these factories is often dust or noise pollution, which is caused by waste stored inside and by the sounds of machinery. They might also be inspected in other aspects like fire precaution, which is also an important aspect for local environment bureaus. Local owners will have no choice but to close down if they cannot manage to meet the new standards, while those who come from other provinces might choose to relocate to areas with a less strict law enforcement.

2) Legal issues

For small factories, they might have another risk: legal problems. For example, the old Company Law requires paid-in capital, which means that a large amount of money is required when you register a company, and you cannot

use it for any other purpose. Small companies often have difficulties with this regulation, because they had to take out the money to buy necessary items to operate, like equipment. This situation makes it easy for the local government to fine and close down small companies, especially when the central government decides to regulate small companies for some reasons, such as the implementation of new environmental regulations. Even if everything is fine with the company but it is still closed down, and the owner wants to file a suit for wrongful acts, he might still find it difficult to go through all the process since most of the owners don't know enough about law.

b) PLYWOOD INDUSTRY PERSPECTIVE

1) Low efficiency

The distribution of small factories and the natural drying process leads to a low efficiency. Large number of small factories located in all over the map makes transportation costs may go up. Natural drying on the other hand, limits the size of veneer (need to be small enough for a man to hold) and its use on an automated production line. This may lower the cost of factories itself, but it may also increase the whole cost of the plywood industry as a whole. Natural drying is also limited by the weather, therefore, wood supply may drop significantly during rainy seasons.

2) Low quality

The natural drying lowers the quality veneer. For plywood companies, they would need to conduct a second drying stage if they want to improve plywood quality, which adds up some cost as well.

c) GOVERNMENT PERSPECTIVE

1) Dust and noise

For some factories built near neighborhoods, many residents might face dust and noise problems. Waste in factories can pile up and be dispersed by wind. These problems may affect the life quality of citizens nearby.

2) Energy concerns

The first part of the plywood production chain, for the reasons stated above, is underdeveloped. Factories with this scale and distribution is expected to waste energy and raw materials. This may be related with the "structural reform of the supply front", which aims to eliminate excessive production capacity and optimize industrial structure. Small factories in villages are precisely the ones deemed unfit to keep operating in their current state.

IV. Interview of an anonymous company J in Sichuan: How local workers are being affected by policy.

Company J has a factory with 10 veneer cutting machines and 32 employees in Sichuan. The owner said that government can easily find loopholes in their management because "no factory here can meet such high standards without losing money". Government officials from the Environment Department pointed out their company are producing too much dust, noise and has fire risk. The thing is from what they knew, there were other factories who has dust-control techniques were also getting "dealt with". He thinks it's very easy for government to find a cause to shut you down. What happened then is the worker got unemployed — they could not find jobs elsewhere because similar manufacture factories were temporarily or permanently shut down as well — so they decided to post up slogans that asks government to give their jobs back. At first government refused any form of compensation, but after several rounds of negotiation they accepted an "award and compensate agreement" with a total amount of about 40% of the company's estimated market price. The owner quits wood industry and turns to other area instead.

V. Case of Zhenqi wood manufacturing factory: How legal issues prevail

Zhenqi wood manufacturing factory (owned by Zhenqi Wang) is located in Shaoyang county, Hunan province. It has fixed assets over 12 million yuan and more than 200 local workers. In 2013, Shaoyang government closed down Zhenqi factory because of "The spirit of Shaoyang [2013] No.7 official document". Zhenqi factory had legal qualification and didn't act against the law, so the owner Mr. Zhang appealed to local government. But local government could not afford a monetary compensation, so they told him to be patient and wait for

higher authorities' decision. He appealed to the government along with other owners whose factories got shut down as well again in 2016. Finally, in 2017, local government decided a compensation ranging from 10,000 to 30,000 yuan, which is nowhere near the value of Zhenqi factory. He finally decided to bring a lawsuit against the government, but got dismissed because he did not filed a lawsuit on time, and "negotiating and appealing to government is not considered an exception under law". Mr. Zhang didn't know anything about this, but he had to accept the consequence of not filing a lawsuit earlier. Now Mr. Zhang has to sell all his assets to pay back a loan of 540 million yuan to the bank. His wife passed away in 2015 because of the life pressure after their only income source was shut down.

4.2.Plywoodmanufacturing companies

I. Introduction

There are plenty plywood manufacturing companies in China, whose scale and work patterns vary from case to case. Generally, they use several processes to make veneer into plywood. Some companies get wood supply within China, while others also import from other countries. Some companies also do veneer cutting when they import raw timber instead of veneer. Demand for plywood also depends on their targeting customer, therefore diversity can be seen in the Chinese plywood industry.

II. Current problems

a) Environment policy

Unlike veneer factories which usually affect residents, plywood companies have more problems to cope with — dust pollution, air pollution, and water pollution. Big companies manage to make it through the regulatory system, small companies that can't afford the cost to do this either relocate or close down.

b) Plywood quality

Small veneer factories work have an effect on plywood quality. Usually these veneers are cut by low-tech machine, dried under sun and carried around by

workers, making difficult to ensure the quality of veneer. For example, veneer with natural drying not only have high water content, but also may experience wrinkles or warps. These problems limits the quality of the final product.

c) Production mode

Veneer carried by manpower is small in size, and does not have an appropriate size to be used in an automated production line. Therefore, plywood companies are often labor-intensive.

d) Increasing cost

Although problems above are common, Chinese plywood companies still have a big advantage in the global market. The main reason is that this whole production chain is low-cost and focus on reaching the low to mid-end plywood markets. However, this advantage is starting to disappear with the rising cost of manpower and raw timber.

III. Company's attempts

Many companies have used different approaches to solve these problems. Some companies have added a second drying stage to ensure the quality of veneer. To reduce costs, two options prevail. One is to expand their business to forestry land, which means to have it on their own. In this way companies can both lower costs and ensure veneer quality. The other option involves moving closer to veneer suppliers to lower transporting costs.

IV. Opinion from company executives

a) Fenglin Wood Industry Group

Fenglin Wood Industry Group is one of the plywood manufacturing companies that owns commercial forest lands. For deputy manager Mr. Wei, this is a strategy they expect to continue in the next five years. They're now changing their focus to fiberboard, but they have some insights on plywood industry.
Fenglin has this strategy called "Integration of forest and wood panel" that they had in mind more than ten years ago. They also faced a lot competition from small plywood factories we mentioned above, but they compared to western

market and stacked to their long-term strategy that the market will eventually centralized to big companies in which Fenglin would have big advantages by then. He further explained where their advantages come from —techniques and natural resources. Especially for resources, forest is everywhere in the past and can be easily obtained by plywood manufacturers who kept competitive in this context. But now, with the new government policy, they cannot do it anymore. Fenglin owns now more than 10,000 acres of timber land, and this helped them to profit substantially since 2017. Having timber land of their own not only means resources, but also means lower cost. He said that in this way the overall cost for raw timber or veneer is 10% cheaper than buying them in the market, and he expects these benefits to keep growing.

All these advantages can be seen in their annual report — a gross profit over 20%, significantly higher than most of plywood manufacturing companies. He believes that the plywood industry is moving quickly toward the western model, not in the exact same way because transportation network and regional market is different, but a similar model of an integrated supply chain will be replacing the current model, where plywood manufacturing companies will be more inclined to own forest land instead of buying veneer. He also mentioned that although there are three major forestry areas, the southern area is the only one with large area of commercial forests, so he believes those forest in Guangxi province will provide a bigger advantage to the industry.

b) Investment report

From investment report, it is expected that plywood companies will develop in 3 directions: targeting high-end market, extending to furniture business or having self-owned forestry land. It’s mentioned that forestry company has relatively low percentage of net profit because of management fee, long waiting period and capital shortage problems. But these problems does not affecting this much for large plywood company, therefore might become an attractive solution. It expects that with higher environmental cost, those thrive in future market is likely to be those big plywood companies with extended business.

V. Comments from professor Li

Professor Li thinks that, at present, China's plywood enterprises will certainly adjust, because there are more and more plywood factories now, and it is often difficult to unify standards and control them. In the vicinity of big cities,

it is not realistic at present to be able to have all production lines concentrated in the same area. The current Chinese plywood business model is relatively low in cost, while the cost of foreign plywood factories is much higher than that of China. Therefore, in the middle and low-end plywood market, foreign countries can't compete with Chinese producers. He expects that small and medium-sized enterprises will tend to form industrial clusters and eventually constitute a more integrated production chain.

VI. Other big companies

a) Particleboard manufacturing companies

Particleboard is acquiring a bigger market share because the production process meets higher environmental standard and the resources are easy to obtain. Many plywood companies have started to shift their focus towards particleboard. Unlike plywood, production of particleboard is usually more centralized and automated. Therefore, it might become a strong competitor against plywood manufacturing companies.

b) Wood technology companies

For wood technology companies, developing equipment or production lines for China is a challenge. The recent change in the regulations concerning the plywood industry may strongly affect their business plans. Companies that provide services for the whole production line may have a bigger opportunity to conduct their business in this country, given that they adjust their products in accordance with the local context.

4.3 Government

Under the background of rapid global change, the Chinese government has highlighted the efforts of forestry development to respond to climate change and has also actively advanced the CDM (Clean Development Mechanism) project on carbon sequestration by afforestation and reforestation under the Kyoto Protocol. In July of 2007, the China Green Carbon Fund was founded (Dai, L. & Wang, Y, 2011). To promote the sustainable utilization and conservation of China’s forestry resources, the Chinese government has set a series of

regulations and laws on those manufacturing industries which use logs as raw materials, including the plywood sector. This sector, which includes veneer and plywood factories, could get involved with problems such as resource waste and environmental insecurity. Biological invasion is also an important part of global environmental changes (Ricciardi 2007). Since wood constitutes a carrier of alien organisms, the government have set strict rules for the transportation of wood.

For example, every truck needs one independent certificate to enter another city each time. The reasons behind these policies might be the impact of news reporting the disasters brought by alien species these years. The biological invasion of alien species can cause huge economic loss and destruction to local and regional ecosystems (Perrings et al. 2002). On this point, the government and plywood industry both stand at the same side. However, regarding the environmental policy about forestry resources, conflicts have appeared between the central government and the plywood industry.

Currently, the government aims to reduce pollution and improve the efficiency in resource usage. Therefore, the government has issued related policy to guide the whole national industry. For those unqualified factories, the government is ordering them to shut down or relocate. However, the government do not further intervene and the company itself is the one in control of all related relocation activities. However, because the government cares about result, it often pushes company to transform until the settlement work is done. If the company cannot fix its problems on time, it will be forced to shut down and this might lead to social problems like unemployment and protests. Although the government would not offer compensation to these affected employees, these affected employees are protected by labor contract and insurance according to labor laws, which means they could get compensation from their companies as long as the contract is legal. However, for small veneer factories, the owners and the employees often do not have a formal labor contract. Another problem is that the same small veneer factories are unable to bear the restructuring cost that is required to comply with all regulations. Although environmental protection is an important goal to be achieved, it is crucial for the government to also find solutions that are more appropriate to local conditions.

“Timber legality verification in China” (2017) shows the interests of the Chinese government towards the forestry industry. According to it, the regulation of the Chinese government regarding timber can be divided into four parts.

I. Forest management unit

Forest management units must be registered with the relevant agencies prescribed by the state and have business licenses issued by the relevant agencies of the state. The units must pay the relevant taxes and fees stipulated by the state or the region for cutting trees on time in accordance with the law. The units shall abide by national laws and departmental regulations, establishing a management system and rules according to the requirements of the state and local government, so as to ensure the legality of management. The units must protect the human rights of employees and residents of surrounding communities from infringement, strictly abide by the conventions of the international labor organization, the labor law and the law on work safety issued by China, to ensure the health and safety of employees and protect the legitimate rights and interests of employees in the form of workers' congresses or trade unions.

2. Forest ownership

Forest management units shall have a forest right certificate issued by the people's government at or above the county level or the competent forestry department of the State Council to confirm the ownership, managerial authority and usufruct of the forest land and trees. The contractor or tenant shall have relevant legal certificates, such as signing a legal contract and lease contract, etc., to confirm the right to manage and use the forest land and trees. The units shall have clear boundaries and mark them on the map. When timber is needed to be transported out of forest areas, a transport certificate issued by the competent forestry department must be held. At the same time, the supervision system should have an effective approach to prevent corruption. The units should not use the chemical pesticides which are prohibited by national laws and international conventions. The relevant records of the enterprises (especially the purchase of raw materials and product sales records) shall be kept for at least 5 years.

3. Production and management activities of forest management units

State owned or private large and medium-sized forestry enterprises and institutions shall formulate timely, effective and scientific forest management plans, which shall be implemented after being approved by the higher authorities. Units or individuals that cut trees must hold the cutting license issued by the competent forestry department, complete the cutting and renewal tasks according to the area, number of trees, tree species and time limit specified in the cutting license.

4. Timber raw material purchase

To confirm the source legitimacy of domestic timber raw materials, "three licenses" shall be provided, i.e. cutting license, transportation license and production and processing license. For the timber produced by farmers and forestry households (less than 2 acres), it can be recognized as the timber with legal source.

To confirm the source legitimacy of imported timber raw materials, 1) for enterprises that import raw materials directly from abroad, the original or photocopy of the certificate of origin and customs clearance procedures (export customs of the country of export, entry customs of the country of import) shall be provided, 2) for the tree species listed in the appendix of CITES convention, relevant certificates for the performance requirements of the convention shall be provided, 3) for legal timber confirmed by intergovernmental agreement, relevant certificates required by the agreement shall be provided.

When an enterprise purchases timber raw material from suppliers, it shall obtain sufficient information from the suppliers about the products included in the evaluation of timber legitimacy, so as to effectively determine, evaluate and avoid the risk of receiving materials from illegal sources. The information shall at least include the common name and Latin name of the wood species, material procurement and sales volume, country or region of origin, supplier name and address, etc. At the same time, the enterprise shall ensure that its suppliers inform the enterprise when planning to change the supply chain. The enterprise shall formulate and implement effective and reasonable measures to avoid the identified risks. If the supplier seriously violates or continuously violates the requirements of standard, the enterprise shall interrupt the supply relationship with the supplier. The effectiveness of all avoidance measures and their implementation shall be recorded. The enterprise shall timely count and record the quantity of raw materials purchased, produced, stored, products finally sold

and the conversion rate of products. The enterprise shall mark the products with the identification of the products for which the legitimacy of timber is recognized. When confirming the legitimacy of raw materials, it is necessary to accurately identify and clearly distinguish them, and take effective measures to avoid the risk of mixing materials of illegal origin.

4.4 Academia

Academy is an important stakeholder to consider in most comprehensive analysis. Despite not having a direct influence on the production chain or the different factors that affect our focus of study, the academy always provides state-of-art solutions and different perspectives, both qualitative and quantitative that help to understand the situation of the industry. Consulting with this stakeholder can facilitate the process of analyzing the plywood sector from a different point of view.

5

Future trends

Based on the literature review and the interviews with stakeholders, we got some insights about the future trends of the plywood industry.

Trends in the structure of plywood industry and plywood production

1. The natural way of drying veneers would still be used in the next years.

From the perspective of researchers, it is recommended that the plywood industry should take advantage of solar drying. This can contribute to save a large amount of energy, prevent emissions from this process to the environment, and also have low requirements of cost and labor. The natural way of drying veneers is one essential part of these advantages, and many owners of those veneer factories would be unable or unwilling to bear the cost of using drying machines.

2. Plywood production capacity would gradually concentrate and form industrial clusters in the next 20 years

Since there are more and more plywood factories, it is often difficult to unify standards and control all of them. However, the increasing demand from the market will promote efficiency and the integration of the smallest factories into larger associations and conglomerates.

Trends in the employment of farmers and supervision of plywood industry

1.The government would encourage farmers to get involved with plywood industry

For China, the wood processing sector is a traditional industry that belongs to labor-intensive enterprises. In large cities with stringent regulations, it is impossible for an industry with a low-profit margin to survive due to the high cost of employment and land. It is an inevitable trend for plywood industry to transfer to the second and third tier cities and suburbs. When it comes to the issue of pollution, taking the holy elephant and Daya (two renowned brand) for example, the emissions of these large enterprises have fully met the emission standards. The wood industry is not strictly considered as the "Three highs One

low" enterprises, while the "low" is indeed low, but the "three high" is far from the coal and steel enterprises. Sometimes, China has done a bit too far. In the second and third tier cities, it is unreasonable to cut down / shut down some wood processing enterprises just because they are inefficient. First, China does have such a large market demand. Second, the “three rural issues” are also major issues. To solve the employment problem of farmers, it is impossible for the government to let farmers engage in the construction industry. Farmers only have opportunities to carry out some work in some traditional industries. If these traditional industries are shut down, farmers can't find jobs. How can the countryside revitalize? So in the second and third tier cities, under the condition of meeting environmental protection policy, the state could actually encourage and guide these types of work, which is a great contribution to the local employment and tax revenue, given the truth that at present the annual output value of some private enterprises like Sofia also reaches several billion levels!

2.The government would control the big direction while leave the small direction to be negotiated within enterprises

Not everything needs to be enforced by the government. There are many standards such as mandatory standards, recommended standards, national standards, and industry standards. For products which are not directly related to the safety of citizens' lives, generally recommended standards are used. Recommended standards are not mandatory, which means enterprises could refer to them or not, but they are useful in lawsuits. There is only one mandatory standard in the wood-based panel industry of China, that is, formaldehyde emission, because it involves the life and health of citizens. In fact, the national standard design is reasonable. It controls the major direction, leaves the minor direction to be negotiated within enterprises, which is regulated by the industry itself. It can't be said that in order to guide the quality improvement, the government set all the standards as mandatory standards, which is not realistic, but many electrical industry in China is mandatory standards, since it is directly related to life safety, and wood based panel industry has its particularity. The government would control the big direction while leave the small direction to be negotiated within enterprises continuously.

Trends in China’s wood cutting and import

1.The government would encourage moderate felling of forest

Tree is a life cyclical body, which means it must be cut moderately especially in the south forest since the growth rate of which is relatively high. In the south, if trees are not cut: first, the planters would lose benefits, which would harm the enthusiasm of tree planting; second, trees have aging problems which means the trees would die after a certain age. Even if they are not cut, the trees in the forest would rot sooner or later. Taking bamboo for example, if bamboo is not cut down for four or five years, it would blossom, apoptosis and degeneration, which means bamboo would better to be cut down every year.

Therefore, it is wrong to say that we should never cut down forests, but we should have reasonable and scientific guidance, such as classified management like ecological forest, industrial forest, water and soil conservation forest, etc., so that we can provide a continuous supply and consumption of wood on the premise of protecting the ecological environment. In fact, this is not a contradiction. Taking Shandong as an example, the forest coverage rate of Shandong Province was very low before, but with the rapid development of plywood industry in Shandong Province in recent years, the forest coverage rate of Shandong Province is growing exponentially, which is largely benefited from the development of plywood industry.

2. The government would strengthen the management of domestic forests and expand the import of timber

Now we all know that as long as there is scientific and reasonable control, cutting is allowed. However, the growth of domestic trees is not enough to support China's plywood industry system. Thus, China has imported a large body of wood, and the truth is that two trees in every three trees in international trade are transported into China. To strengthen the management of domestic forests, the government is giving farmers more and more subsidies to encourage them to scientifically tend and cut forest. Take bamboo as an example, in Hunan, the biggest problem is that no one is tending and cutting down bamboo now, because local farmers think it's too hard and costly. If no one is tending and cutting down these bamboos, they would degenerate and greatly affect the stability of local even regional ecosystem. The trend is that China would continually expand the import of timber and strengthen the cultivation and control of domestic forests.

Trends of the environmental protection

Internalization of private costs

Generally speaking, the social cost caused by environmental pollution is much greater than the private cost. Since the production causes environmental pollution, enterprises should bear the social private cost. In order to solve this problem, private costs must be internalized or internal external economics must be internalized. It is possible to reduce or even eliminate social costs through means such as sewage charges and emissions trading, thereby saving the cost of pollution from social inputs and achieving coordinated economic and environmental development.

Also, there are things being done and will probably take a lot of years, which are also trends.

Trends in the government

1. Technology support for the villages: Sending expert in relevant areas to the villages to teach the farmers how to better manage the forest and help the village development. There are certain number of years of appoint for the expert.
2. High quality and well-knownPromoting the large-scale operation of regional forestry production.
3. Implementing the labor law to guarantee the basic rights and interests of farmers.

Trend in forest management

The forest rights transfer system will be completed to promote the large-scale operation of regional forestry production. Local governments encourage small-scale farmers to transfer forest land through forestry subcontracting, shareholding, transfer and other forms, increase the proportion of medium-sized farmers, and concentrate forest management rights to forestry technology experts or other businesses units.

6

SOLUTION

6.1 Solution proposition

6.2 Solution validation

6.1 Solution proposition

Based on all our findings, here we present some measures that could help to develop the Chinese plywood industry in a sustainable way. These measures should be taken as an initial step to find a more detailed solution.

First, we believe that the development of the industry can be enhanced by promoting investment from big companies who are interested in entering the plywood sector or modernize their operations. This investment could be promoted by the government through a number of mechanisms, such as tax exemptions, loans, etc., and it should aim to provide high-technology machinery to the plywood manufacturing sector. This measure would let farmers keep using solar energy to dry the veneer. This way, farmers can still rely on natural processes for veneer drying, keep a low energy consumption, and be allowed to keep operating in this fashion without being shut down for alleged "inefficiencies". Additionally, a second drying stage can then be used by plywood manufacturers to improve the quality and add value to the final product. Plywood producers would also be able to reduce the risk of investment in machinery by using this scheme. At the same time, the government would be able to modernize the plywood sector in the country and raise it to the levels of similar industries like the pulp and paper sector by using environmentally-friendly practices in the sector (use of renewable energy and high technology).

A machine specifically designed to work with lower volumes might be needed for this solution to work. Therefore, this would require more R&D investment for machine suppliers to adapt the big machines used in other countries to the smaller veneer size in the Chinese market and to perform only a second drying stage. Big machinery is usually suited for more integrated industries operating in developed countries, and is not designed for the local conditions of the Chinese market. If machinery is created here in China the situation would be even better, because that makes easy for companies to contact the machine manufacturer and troubleshoot if the need arises.

Second, the government could provide special loans to the farmers which are in charge of forest management. This would be an improvement over the current solution, where the government only provides some financial help to those families who lost their jobs as a result of a shutoff. The current solution offered by the government is only short-term and do not constitute a sustainable

solution, because it puts pressure on the most vulnerable social sector. This measure would help the farmers have more financial security, thus encouraging tree growth and preventing premature harvesting by the farmers. At the same time, it would also improve the quality of the wood harvested due to a bigger tree size. This measure would also give more incentives for farmers to legalize their operations. This way, all farmers would have legal responsibilities (taxation duties) and rights (labor rights). Similarly, the government would be able to include all those farmers which operate outside the formal market and avoid current issues like tax evasion and workers without labor rights, thus avoiding illegal operations and all its undesirable consequences to socioeconomic development and environmental protection.

A drawback of this solution is that the final products of the plywood production are limited by the small-sized veneer that is commonly used by the farmers. This business model would not be able to provide high-value products that require bigger sizes of plywood. In this case, another separate business model might be necessary for the Chinese market. For example, a separate industry niche can be developed from imported timber (which meets the requirements of quality and size for the production of high-quality products) to produce exclusively high-value plywood and its products.

6.2 Validation

Due to the high number of stakeholders and the limited time of this particular project, we were not able to properly validate the solution described above. Nevertheless, we consider the solution to be a valuable first step to conduct further research about the sustainable development of the plywood industry in China.

7. Collection of ideas and demos

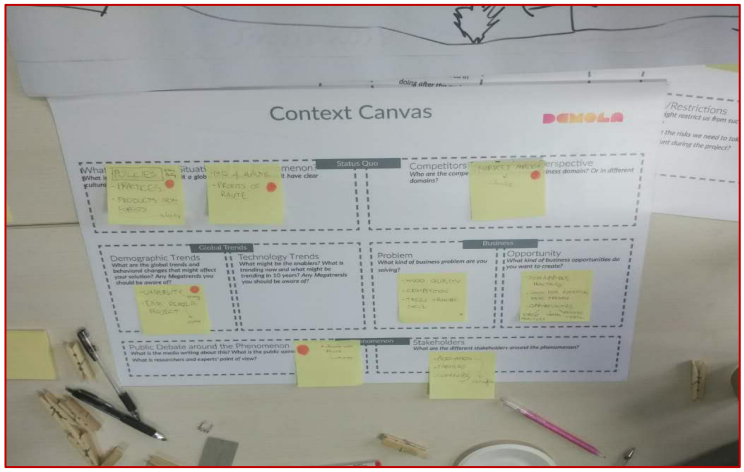


Figure 1: Framework to establish the framework context

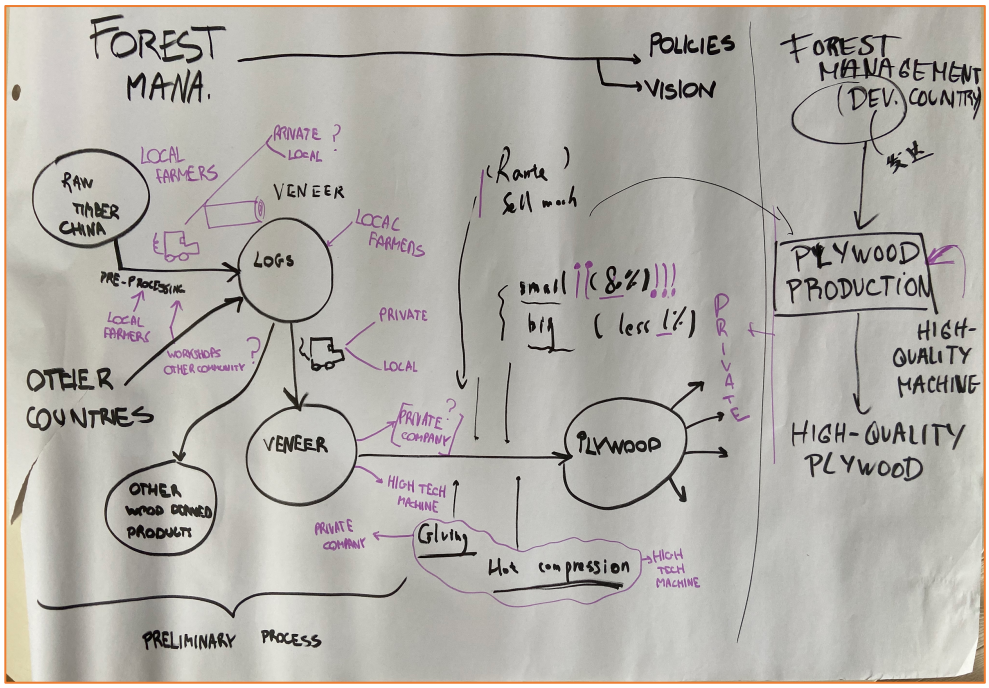


Figure 2: Diagrams to understand the current situation and stakeholders involved

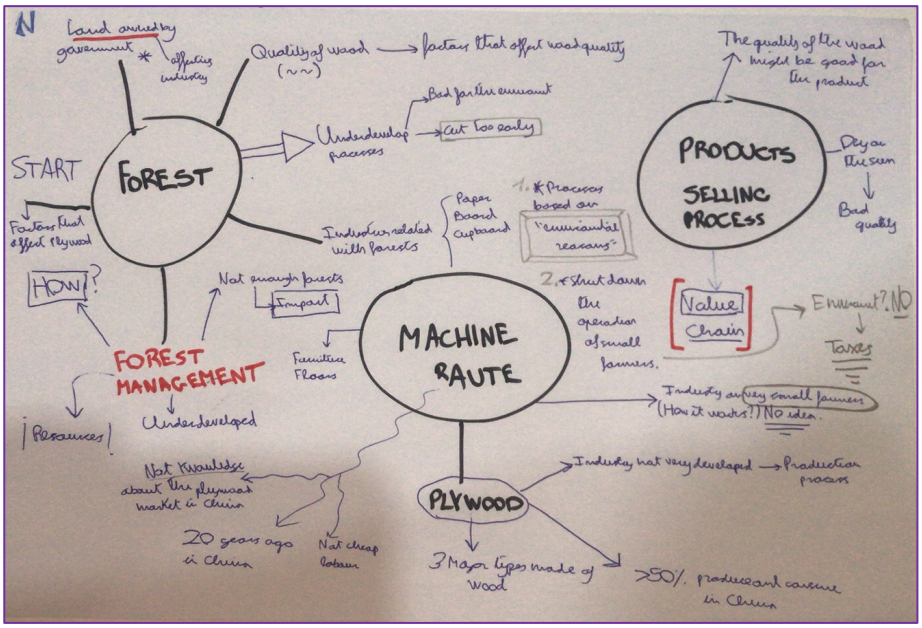
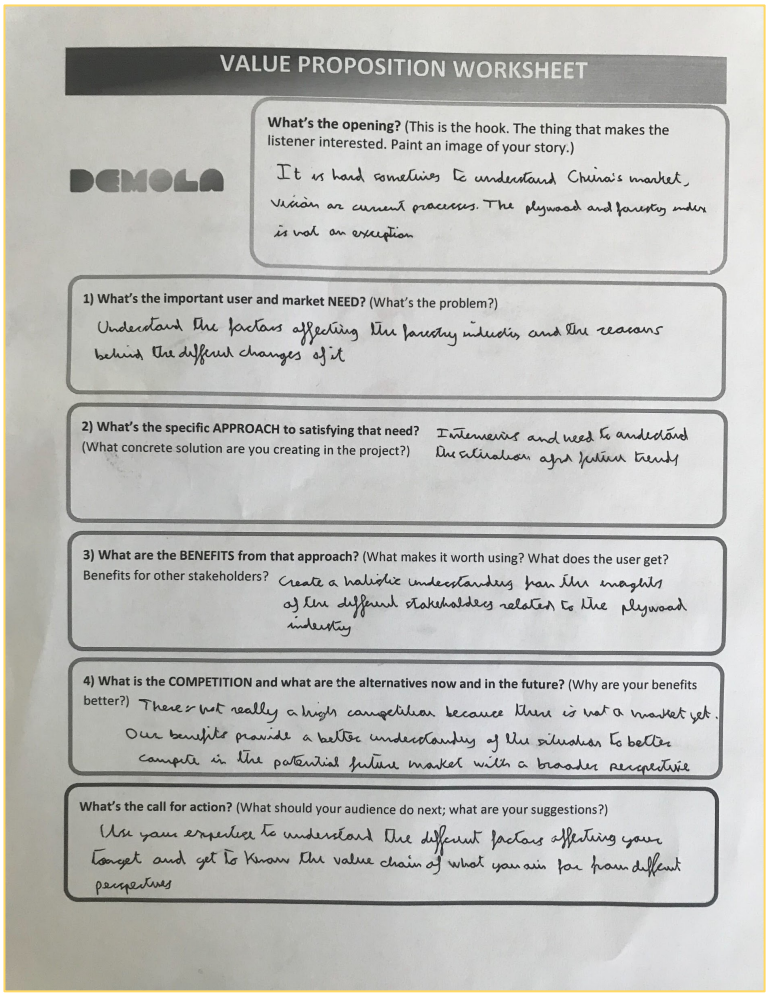


Figure 3: Understanding RAUTE's position in the model



VALUE PROPOSITION WORKSHEET

DEMOLA

What's the opening? (This is the hook. The thing that makes the listener interested. Paint an image of your story.)

It is hard sometimes to understand China's market, vision or current processes. The plywood and forestry index is not an exception

1) What's the important user and market NEED? (What's the problem?)

Understand the factors affecting the forestry industry and the reasons behind the different changes of it

2) What's the specific APPROACH to satisfying that need? (What concrete solution are you creating in the project?)

Interviews and need to understand the situation and future trends

3) What are the BENEFITS from that approach? (What makes it worth using? What does the user get? Benefits for other stakeholders?

Create a holistic understanding from the insights of the different stakeholders related to the plywood industry

4) What is the COMPETITION and what are the alternatives now and in the future? (Why are your benefits better?)

There's not really a high competition because there is not a market yet. Our benefits provide a better understanding of the situation to better compete in the potential future market with a broader perspective

What's the call for action? (What should your audience do next; what are your suggestions?)

Use your expertise to understand the different factors affecting your target and get to know the value chain of what you aim for from different perspectives

Figure 4: Value proposition model of the project

9. Attachments

NFIs	Period	Key characteristics
NFI1	1973–1976	Based on county-level inventory, in most regions the inventory was not unified for the whole country
NFI2	1977–1981	The continuous forest inventory (CFI) method was applied, establishing an effective foundation for national monitoring
NFI3	1984–1988	The 1st re-inventory based on the CFI system, providing the changes on both quantity and quality of forest resources
NFI4	1989–1993	4 national forest monitoring centers were set up, which were responsible for quality check, statistical compilation, and output reporting for different regions
NFI5	1994–1998	The UNDP CPR 91/151 project was executed, and new technologies such as "3S" (RS-remote sensing, GPS-global positioning system, GIS-geographic information system) were started
NFI6	1999–2003	Remote sensing was widely applied, and full-coverage inventory for the mainland of China was achieved
NFI7	2004–2008	Several ecological variables were added, and forest ecological services in the whole country were evaluated
NFI8	2009–2013	Modeling of tree biomass equations for main tree species in China has been actively pursued

Table 1: Key characteristic of the eight NFIs in China (Zeng, W. & Tomppo, E., 2015)

Class name		Description
Forest land	Arboreal forest	Forest land with a minimum area of 667 m^2, a minimum width of 10 m, and a minimum crown cover of tree species of 20 %
	Bamboo forest	Forest land composed of bamboos with a minimum dbh of 2 cm
	Open forest land	Forest land with a crown cover of tree species of 10–19 %
	Shrub land	Forest land with a minimum crown cover of shrub species of 30 %, including two sub-classes: special shrubs and general shrubs
	Other forest land	Unclosed afforestation land, nursery land, clear-cut land, burned forest land, and planned forest land
Non-forest land	Cropland	Cultivated land, farmland
	Grazing land	Pasture, rangeland, grassland
	Inland water	Lakes, rivers, and other water bodies
	Built-up land	Industry and commerce, mining, traffic and transport, tourist facilities, dwellings and parking sites, gardens and parks
	Other land	Unused and unproductive non-forest land

Table 2: Land classification system (Zeng, W. & Tomppo, E., 2015)

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