



# Study on the Application of Grass Resources in Forest Products Industry

Xiaoyu Chen<sup>1</sup>, Fengyun Chen<sup>2</sup>, Bo Zhang<sup>2</sup>, Yifu Yuan<sup>3,\*</sup>

<sup>1</sup>Tai'an Culai Mountain Wenhe Scenic Area Management Committee, Tai'an, China

<sup>2</sup>Tai'an Forestry Protection and Development Center, Tai'an, China

<sup>3</sup>College of Forestry, Shandong Agricultural University, Tai'an, China

## Email address:

18853866767@163.com (Xiaoyu Chen), yuaneco@sdau.edu.cn (Yifu Yuan)

\*Corresponding author

## To cite this article:

Xiaoyu Chen, Fengyun Chen, Bo Zhang, Yifu Yuan. Study on the Application of Grass Resources in Forest Products Industry. *Journal of Energy, Environmental & Chemical Engineering*. Vol. 7, No. 3, 2022, pp. 102-106. doi: 10.11648/j.jeece.20220703.17

**Received:** September 5, 2022; **Accepted:** September 21, 2022; **Published:** September 29, 2022

---

**Abstract:** The paper industry is an important basic raw material industry closely related to the national economy and social development and has the characteristics of sustainable development. At the same time, it has the characteristics of renewable raw materials, recyclable products and recyclable main production chemicals. It has a unique natural green color attribute. The paper industry includes pulp manufacturing industry, paper manufacturing industry (including machine-made paper and paperboard, handmade paper and processed paper), and paper product manufacturing industry. The consumption of paper is directly or indirectly affected by various fields of the whole society and is closely related to the national economic security. The consumption level of paper and paperboard is an important indicator of a country's economy and civilization. Paper import has become the third largest foreign exchange consuming industry after petrochemical and steel industries. There is a huge development space for the domestic paper industry, and the excessive reliance on fiber raw materials has become the bottleneck of industrial development. Taking the paper industry as an example, this paper introduces the current situation and problems of the domestic paper industry, and the application of grass resources in the paper industry. For a long time to come, grass resources will still play an important role in the raw materials of China's paper industry. The absolute amount of non-wood fiber pulp will continue to rise gradually. The utilization of non-wood fiber paper resources in the development of China's paper industry cannot be ignored.

**Keywords:** Grass Resources, Forest Products Industry, Raw Materials, Application

---

## 1. Introduction

China has become a big country in the world's paper consumption, production and import. According to statistics in 2021, China's paper (including paper and paperboard) production reached 121.05 million tons, an increase of 8.45 million tons over 2020, an increase of 7.5% year-on-year. The consumption reached 126.48 million tons, an increase of 8.21 million tons over 2020, a year-on-year increase of 6.94%, ranking first in the world. With the continuous expansion of the scale of China's manufacturing industry and the improvement of the innovation system, the paper industry has played an important role in serving the national strategy, meeting the needs of people's livelihood, building a manufacturing power, and promoting economic development.

As a service-oriented manufacturing industry, China's paper packaging industry is an important support for national economic and social development. At present, China has become the world's largest producer of packaging paper and paperboard [1-3]. In 2021, China's packaging paper production reached 7.15 million tons, an increase of 100000 tons over 2020, with a year-on-year increase of 1.42%. In 2021, China's packaging paper consumption reached 7.22 million tons, with a year-on-year increase of 0.56%. The development goals of China's paper industry in 2025 are: the total output of paper and paperboard in China will reach 140 million tons (the annual per capita consumption will reach 100 kg), the output of primary pulp will reach 30 million tons, and the output of paper products will reach 90 million tons. The pulp consumption, energy consumption, water

consumption and pollutant emission per unit product will maintain the international advanced level. The product structure continued to be adjusted, the product quality continued to improve, and the variety continued to enrich [4-6].

The paper industry is an important basic raw material industry closely related to the national economy and social development and has the characteristics of sustainable development. At the same time, it has the characteristics of renewable raw materials, recyclable products and recyclable main production chemicals. It has a unique natural green color attribute. The paper industry includes pulp manufacturing industry, paper manufacturing industry (including machine-made paper and paperboard, handmade paper and processed paper), and paper product manufacturing industry. The consumption of paper is directly or indirectly affected by various fields of the whole society and is closely related to the national economic security. The consumption level of paper and paperboard is an important indicator of a country's economy and civilization. Paper import has become the third largest foreign exchange consuming industry after petrochemical and steel industries. This situation shows that there is a huge development space for the domestic paper industry, and the excessive reliance on fiber raw materials has become the bottleneck of industrial development. However, as the raw materials for paper making are plant fibers that can be cultivated and recycled, and the renewable utilization of waste paper does not depend on the limited underground oil, ore and other mineral resources, the domestic paper industry has better conditions than the petrochemical and steel industries to reverse this situation [7-10].

## 2. Main Problems Existing in Paper Industry

### 2.1. Unreasonable Raw Material Structure

At present, most of China's paper-making enterprises take waste paper and wheat straw as the main raw materials, and few paper-making enterprises use wood, reed (awn), bamboo, bagasse and other fiber raw materials. In 2021, China's total pulp production reached 81.77 million tons, of which 58.14 million tons were waste pulp, accounting for 71.1% of the total pulp production. The output of wood pulp and non-wood pulp accounted for 22.12% and 6.78% respectively. The composition of this kind of pulp raw material is far from the level where the proportion of wood pulp in the world's paper industry accounts for more than 90%.

### 2.2. The Available Forest Resources Are Scarce, and the Supply of Wood Raw Materials Is in Short Supply

The basic reason for the unreasonable raw material structure of China's paper industry lies in the lack of available forest resources. China's forest resources are

characterized by large absolute amount, low coverage, small per capita occupancy, extremely unbalanced regional distribution, unreasonable forest age structure, and insufficient available resources. In the total consumption of existing forest resources in China, the consumption of industrial timber accounts for about 40%, the consumption of fuelwood accounts for about 30%, and the consumption of farmers' own timber and other materials accounts for about 30%. From the perspective of timber structure, the proportion of sawn timber and machining timber is too high, and the proportion of pulp and paper timber and wood-based panel timber is too low.

### 2.3. The Construction of Papermaking Timber Forest Lags Behind

Most of the pulp and paper enterprises in China, which use wood as raw materials, are located in areas with rich forest resources, such as the three provinces in the northeast and the south. For a long time, due to the influence of funds, taxes, systems and other factors, the paper-making forest base self-operated or directionally cultivated by paper-making enterprises has developed slowly and the existing scale is very small. The wood fiber raw materials for paper-making have to rely mainly on natural forest resources. However, the total amount and variety structure of trees in the paper-making forest base are still far from meeting the needs of the development of the paper-making industry.

### 2.4. The Number of Enterprises Is Large, the Scale Is Small, the Product Grade Is Low, and the Structure Is Unreasonable

Since 2014, the number of China's paper and paperboard production enterprises has shown a downward trend. By the end of 2021, the number of China's paper and paperboard production enterprises was about 2500, a decrease of more than 400 from 2014 and the same as that in 2020. From 2014 to 2021, the main business income of China's paper-making enterprises above Designated Size showed a fluctuating trend. Since 2018, with the continuous deepening of the elimination of backward production capacity in China's paper-making industry and the impact of raw material price fluctuations, the main business income of China's paper-making enterprises above designated size has declined. In 2021, the overall revenue of 2426 paper industry in China was 8551 yuan, with a year-on-year increase of 19.00%. There were 452 loss making enterprises, accounting for 18.63%. China's paper and paperboard products are not rich in variety, and the existing product structure cannot meet the needs of the rapid development of the paper consumption market, forming an obvious contradiction between supply and demand.

## 3. Overview of Grass Resource

Papermaking has a long history in China. The papermaking industry is not only the basic industry of the national economy, but also closely related to social and

economic development and people's life. For the sustainable development of the paper industry, the supply and effective utilization of raw materials are very important. At present, the general trend of the use of raw materials in the world's paper industry is to cultivate and use a large number of wood fibers for pulping and papermaking, and take the road of modern large-scale production of forest paper integration. This is the objective requirement of the paper industry's own technology and economic development law. However, China is a country with a shortage of forest resources and wood supply, with a forest coverage rate of only about 23%. At present, the natural forest resources protection project still being implemented restricts the logging of forests, which undoubtedly makes the wood fiber raw materials more tense. It is very difficult to increase the proportion of wood fiber raw materials on a large scale for a long period of time and bring China's paper industry into the ranks of international scale development. Therefore, it is of great practical and long-term significance to explore how to effectively utilize the abundant grass resources in China [11-13].

### ***3.1. Grass Resources Are Important Papermaking Raw Materials***

China has a long history of using grass fiber raw materials for pulping and papermaking. China is short of wood resources and rich in grass fiber raw materials. The objective reality determines that the raw materials of China's paper industry take the development path of organic combination of wood and grass resources. Looking back on the development of China's paper industry in the past half century after the founding of the people's Republic of China, it is not difficult to see that grass resources have played an important role as the main cheap fiber raw materials. Although the proportion of wood fiber raw materials is increasing. However, due to the limitation of objective conditions, grass fiber raw materials still play a major role in the production practice and occupy an important position. According to the calculation of China Paper Association, the proportion of wood pulp used at present accounts for 23% of the total raw materials, the proportion of non-wood pulp accounts for 15%, and the proportion of waste pulp accounts for 62%.

### ***3.2. The Utilization of Grass Fiber Raw Materials Conforms to the Current Situation in China***

The raw materials for papermaking mainly include wood, reed, bamboo, bagasse, awn pole, kenaf, wheat straw and straw. More than 90% of the papermaking raw materials in the developed countries in the world are wood. No matter in terms of production technology, technical maturity, paper variety and quality, or in terms of economic scale and benefits of papermaking, other raw materials cannot be compared. China's forest coverage rate is only about 23%, and the per capita forest resource share is only one-fifth of the world average level. China is rich in grass resources. It is not only rich in natural wild plants such as reed, silver grass, awn, and *Gracilaria*, but also rich in agricultural crops such

as rice, wheat and sorghum. Before wheat straw is used as raw material for paper making, the main treatment method is fuel burning, which not only wastes resources but also pollutes the environment. It can be said that the utilization of wheat straw for pulping and papermaking is the embodiment of comprehensive utilization and has high economic benefits, which conforms to the national conditions of China. This situation makes it impossible for China to use a large amount of wood to make paper for a considerable period of time, and we must make full use of non-wood fiber raw materials.

### ***3.3. It Is Technically Feasible to Make Pulp and Paper with Grass Fiber Raw Materials***

The characteristics of grass fiber raw materials determine that it is only suitable for producing ordinary paper with high tensile strength and bursting strength but low tear strength. However, with the joint efforts of the majority of papermaking workers, the problem of improving the quality of straw pulp papermaking has been successfully solved by adopting new processes, new technologies and new equipment. The environmental pollution caused by straw fiber pulping and papermaking has always been a difficult problem in production, and alkali recovery is particularly important. Now many enterprises have successfully solved this problem.

## **4. Problems to Be Solved**

### ***4.1. Collection, Storage and Transportation of Grass Fiber Raw Materials***

The straw of grass raw materials has the most fiber content and the best quality. The good harvest directly affects the supply quality of raw materials. Paper making enterprises should work with farmers to solve the processing and packaging problems on the spot, facilitate the storage and transportation of raw materials, and provide the best raw materials for enterprises.

### ***4.2. Production Scale and Structure***

The paper industry is an industry of scale benefit and intensive management. The scale and structure of enterprises are closely related to production efficiency, production efficiency and environmental pollution control. However, most of the paper-making enterprises in China have the phenomenon of small scale and unreasonable structure. In view of this situation, we should focus on the overall situation of the whole country, reduce the total number of enterprises, adopt the methods of centralized pulping and decentralized papermaking through rational distribution, and make China's paper industry modernized and large-scale as soon as possible.

### ***4.3. Scientific Research Intensity and Equipment Level***

The paper industry is capital intensive, technology intensive, resource intensive and talent intensive. The size of

scientific and technological investment and the level of mechanical equipment have always been the key factors restricting the development of the paper industry. This requires us to strengthen scientific research and manufacturing forces, actively digest and absorb foreign advanced scientific research achievements, and transform them into productive forces to enrich the first line of production practice. In this regard, the development of paper industry in Japan and South Korea is worth learning from. In short, we should not only see the prospect of the development and utilization of grass resources, but also pay attention to solving the problems existing in the sustainable development of the paper industry, and act according to the essence, characteristics and development laws of the paper industry. China's national conditions and the current situation of China's paper industry determine that grass resources will still play a role as the main raw materials for pulp and paper production in the next 10, 20 or more years. This requires us to continuously increase investment in science and technology and improve the equipment level and process research level of machinery. As long as the grass resources can realize the economic principle and solve the environmental pollution problem in the production, there will be broad development prospects [14].

Although China is still the largest producer of non-wood fiber pulp, its proportion in the domestic pulp consumption is decreasing, which is an inevitable result of the adjustment of the paper material structure. How to consider the rational use of non-wood fiber is a problem worthy of serious study. It is generally believed that from the perspective of bamboo and reed, which have more development prospects, it is necessary to invest cultivation funds and strengthen management in order to achieve higher growth; On the other hand, many areas in China can consider cultivating trees, which will depend on the management efficiency of land use, and the non-paper industry can be controlled. From the experience at home and abroad, the existing resources can be used for emergency in the short term, but in the long term, it is not a promising choice. Wheat straw is a by-product of grain crops, and the output is relatively stable, so only the purchase cost is needed. The production and application of wheat straw pulp and the pollution control technology have been relatively mature, and it is still a non-wood fiber resource worthy of greater attention at present. As for plant fibers such as cotton, hemp, and *Gracilaria*, although they are of good quality, they can only be adapted to local conditions and used to produce appropriate varieties, accounting for only a small proportion of the raw materials for paper making [15].

## 5. Conclusion

On the whole, the fiber raw materials of China's paper industry will inevitably develop along the direction of continuously increasing the proportion of wood pulp and waste pulp. In the foreseeable period, it is still necessary to pay attention to the utilization of foreign resources while striving to expand domestic fiber raw materials. Under the

condition of giving full attention to non-wood fiber raw materials, the gradual decline of their proportion will also be an irreversible inevitable trend. To deal with this bottleneck, we need to have a sense of urgency, make a comprehensive plan, do more practical things, and be resilient. We should not give up any domestic and foreign resources that can be reasonably utilized.

Based on the reality of China, it is necessary and possible to make full use of the abundant non-wood resources in China. Forage raw materials have played a decisive role in the development of China's paper industry, which cannot be ignored. For a long time to come, straw pulp is still indispensable in China's paper industry and will still play an important role. In the future, the proportion of wood pulp will increase rapidly, and the proportion of grass pulp will gradually decrease, but the absolute amount of non-wood fiber pulp will still gradually increase. The utilization of non-wood fiber papermaking resources in the development of China's papermaking industry must not be ignored.

---

## References

- [1] Zhang Z, Zhang H. L, Zhang H. Q (2022). Green construction and sustainable development from engineering companies of pulp and paper making engineering based on the "Carbon Peak and Carbon Neutrality" goals. *China Pulp & Paper*, 41 (3): 92-96.
- [2] Cheng Y. J, Zhang L, Wang H. S, Jia X. Y, Dong Y (2022). Carbon emission characteristics and "Double Carbon" target path of China's paper industry. *China Pulp & Paper*, 41 (4): 1-5.
- [3] Fu X (2022). Potential and development of bamboo pulping and papermaking in China. *World Bamboo and Rattan*, 20 (1): 54-57.
- [4] Guo C. Y (2022). Overview of world paper industry in 2020. *China Pulp & Paper*, 41 (4): 133-137.
- [5] Osong SH and Norgren E. Processing of wood-based microfibrillated cellulose and nanofibrillated cellulose, and applications relating to papermaking: a review [J]. *Cellulose*, 2016, 23: 93-123.
- [6] Boufi S. Nanofibrillated cellulose as an additive in papermaking process: A review. *Carbohydrate Polymers*. 2016, 154: 151-166.
- [7] Johnson D. A. Paradis MA. Billodeau M. et al. Effects of cellulosic nanofibrils on papermaking properties of fine papers. *Bioresources*, 2020, 54: 1419-1427.
- [8] Liu Z, and Wei X. Carrageenan as a dry strength additive for papermaking [J]. *Plos One*, 2017, 12 (3), 189-197.
- [9] Jia H, Fei B. H, Sun F. B, Ma Q. L, Su N (2022). The importance of establishing the storage mechanism of bamboo chips for papermaking. *Journal of Bamboo Research*, 41 (1): 74-79.
- [10] Liu W. C, Song K. M, Zhang Yu F (2022). Advanced treatment paper-making wastewater by catalytic ozonation. *Industrial Water Treatment*, 42 (1): 154-157.

- [11] Bajpai P. Brief description of the pulp and papermaking process, *Journal of Biotechnology for Pulp and Paper Processing*, 9-26, 2018.
- [12] Cai B, Deng J. Z, Tang X, Ma R. F, Ren P. Y (2022). Dangerous characteristics and influencing factors of fly ash from papermaking sludge incineration. *China Pulp & Paper*, 41 (1): 1-5.
- [13] Malik S. Rana V. Joshi G. et al. Valorization of Wheat Straw for the Paper Industry: Pre-extraction of Reducing Sugars and Its Effect on Pulping and Papermaking Properties [J]. *ACS Omega*, 2020, 5 (47): 30704-30715.
- [14] Fang G. G, Sheng K. Z, Li X. L, Shi J. Q (2021). Supply strategy of fiber sources for China's paper industry under policies of restriction usage of plastic and banning solid wastes importation. *China Pulp & Paper*, 40 (7): 1-7.
- [15] Guo S H (2021). The high quality development strategy of paper industry under the background of new era. *Hunan Papermaking*, 50 (3): 8-10.