

Global Trade and Genetic Resource Flow of Durian: Ecological Analysis of Regional Variety Adaptation

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Abstract This study explores the global trade dynamics and genetic resource flow of durian, with a focus on the ecological adaptation of regional varieties. It examines major durian-producing and exporting countries, key importing markets, and trade regulations influencing durian distribution. Additionally, the study discusses the genetic diversity and exchange of durian germplasm, emphasizing the role of breeding programs and biotechnology in enhancing climate adaptation and disease resistance. From an ecological perspective, it assesses environmental factors affecting durian adaptation, including climate conditions, soil characteristics, and pest and disease management strategies. Through case studies, such as the expansion of Musang King in the Chinese market and the introduction of hybrid varieties in emerging markets, this study provides practical insights into the sustainability of durian cultivation. By integrating ecological analysis with market research, this study aims to support the long-term sustainability of durian production and trade while ensuring genetic diversity and environmental sustainability.

Keywords Durian (*Durio zibethinus* L.); Global trade; Genetic resource flow; Variety adaptation; Ecological sustainability

1 Introduction

Durian (*Durio zibethinus* L.), also known as Shaozi or civet fruit, is a tropical evergreen tree belonging to the Malvaceae family. Its leaves are slender and pointed at the front, and its flowers are light yellow and bloom in clusters. The fruit of durian is large, like a football, with a hard shell and covered with thorns. The flesh is composed of aril, which is yellowish in color, sticky, juicy, and tastes special. Because of its high nutrition and special taste, it is often called the “king of fruits”. The market price of durian has always been high, and the demand is also growing. This has led to the expansion of the planting scale of major durian producing countries such as Thailand, Malaysia, and Indonesia. Today, durian has become one of the most exported and profitable fruits in Southeast Asia. The demand for durian in the international market is also rising. This export-oriented planting method not only illustrates the economic potential of the durian industry, but also reflects the structural characteristics of Southeast Asian agriculture (Teh et al., 2017; Nawae et al., 2023).

The taste of durian comes from its unique smell. Scientists have found that its pulp contains more than 50 volatile substances, most of which are sulfides, such as ethanethiol, methyl sulfide, dimethyl disulfide and trimethylamine (Aziz and Jalil, 2019). These ingredients work together to form the "stinky and fragrant" taste of durian. In order to meet market demand and increase production, many countries are also promoting new varieties and expanding the planting area of durian (Khaksar et al., 2024). Durian is also rich in nutrition and contains many active ingredients that are beneficial to the human body. For example, the calories per 100 grams of durian pulp are about 147 kcal, while apples only have 60 kcal. The energy of durian is about 2.4 times that of apples. In terms of carbohydrates, durian contains 28.3 grams per 100 grams, which is significantly higher than the 13.5 grams of apples and 10.2 grams of pears. Durian is also rich in minerals, especially potassium, which is high, with 261 mg of potassium per 100 grams. Potassium is very helpful in regulating the sodium-potassium balance in the body and can also help lower blood pressure. In addition, durian has a lot of dietary fiber, similar to apples, which can help intestinal peristalsis and facilitate defecation.

There are many types of durian, and different varieties are planted in different regions. These are the result of long-term artificial selection. Durian has a high genetic diversity, which makes it more adaptable to different climates and better resistant to pathogens such as palm phytophthora (Siew et al., 2018b; Lin et al., 2022; Numba, 2023). Now, scientists have analyzed the genes of durian varieties through some molecular marker technologies, such as SSR and RAPD, and found that there are obvious differences between different varieties. These research results also lay the foundation for future breeding and improvement. Further research also found that the genetic differences between durian varieties are the result of their adaptation to the environment in different regions (Songnuan et al., 2019).

This study focuses on the global trade and genetic resource flows of durian, explores the ecological adaptability of varieties in different regions, focuses on analyzing the market structure of major durian producing and exporting countries, evaluates changes in demand in key import markets, and analyzes the diversity and exchange mechanism of durian germplasm resources from a genetic perspective, and discusses the role of breeding programs and biotechnology in improving durian climate adaptability and disease resistance. Through comprehensive ecological analysis and market research, this study hopes to provide scientific basis and policy recommendations for durian production, trade and germplasm resource protection, and promote the long-term sustainable development of the global durian industry.

2 Global Trade and Market Trends of Durian

2.1 Major durian-producing and exporting countries

At present, Southeast Asia is still the world's most important durian production area. Among them, Thailand, Malaysia and Vietnam are the three largest durian exporters. Thailand is the world's largest durian exporter, accounting for more than 80% of the global market supply. As early as 2003, Thailand became the first country allowed by China to directly export durian. Thailand's high-quality varieties such as "Monhong" are particularly popular, and once accounted for more than 90% of the Chinese market. Thailand's durian is mainly grown in the east and south, such as Monthong, Chane and Kradumthong, which are the main export varieties. Thailand can maintain its leading position in the international market for a long time, mainly because it has a stable supply chain, government support policies, and a special trade agreement signed with China (Siew et al., 2018b; Nawae et al., 2023).

In recent years, Vietnam's durian industry has developed rapidly. In 2022, China officially approved Vietnam to export fresh durian, which greatly improved its market competitiveness. In 2024, drought and pests affected the production and quality of durian in Thailand, and Vietnam seized the opportunity to enter the market with cheaper transportation costs and prices. By October 2024, Vietnam has surpassed Thailand to become the largest supplier of durian to China. Durian in Vietnam is mainly grown in the central highlands and the Mekong Delta.

Malaysia is also an important durian producer. However, its export volume is not as good as Thailand because it mainly exports high-end varieties such as Musang King and Black Thorn. Another reason is that most of Malaysia's durian can only be exported frozen due to plant quarantine restrictions. Recently, the Malaysian government has been expanding the planting area and improving post-harvest processing technology in the hope of improving export quality (Siew et al., 2018b).

Indonesia and the Philippines are emerging durian producers, and their market share is slowly expanding. Indonesia has a large durian planting area, but most of it is only for domestic consumption. The Philippines signed a trade agreement with China in 2023 and began to export durian to the international market (Belgis et al., 2017).

2.2 Main trade routes and times of durian in China

China now mainly imports durian from three countries: Thailand, Vietnam and the Philippines. In 2023, China's durian imports from Thailand accounted for 65.19% of the total import volume and 68.05% of the import value; durian imported from Vietnam accounted for 34.55% of the volume and 31.76% of the value (Zhou et al., 2021). Durian generally enters China through ports such as Guangzhou, Pingxiang, Guangxi, Kunming and Hekou. Among the 28 durian importing provinces in the country, Guangdong, Guangxi, Yunnan and Zhejiang all import

more than 100 000 tons. China does not export much durian, and currently there is only one export route, which is to export to Russia through Heilongjiang.

The import time of durian is also obviously seasonal. The durian in Thailand generally matures from April to September each year, while in Vietnam it matures a little later, mainly from the end of July to October. Affected by the production seasons of these two countries, China's durian import peaks are concentrated in the second and third quarters of each year. In 2023, the import volume in the second quarter accounted for 48.83% of the total annual volume, and the third quarter accounted for 31.71%. Since China's durian exports are still relatively small, the monthly export time fluctuates greatly and has not yet formed a stable trend (Aziz and Jalil, 2019).

2.3 Trade regulations and phytosanitary standards

Durian must pass strict plant quarantine standards to be exported to other countries. Before export, durian needs to be pre-inspected, fumigated, and obtain relevant certification. These practices are to prevent the spread of pests and diseases. Exporting countries must also meet some international food safety standards, such as good agricultural practices (GAP), hazard analysis and critical control points (HACCP), and sanitary and phytosanitary measures (SPS) (Zhou et al., 2021). These standards ensure that durian remains safe and fresh during transportation. Scientists are now also using molecular markers and genetic fingerprinting to trace the origins of durian varieties. These technologies can verify the true identity of durian and help protect fair competition in the market (Lin et al., 2022).

3 Genetic Resource Flow and Durian Variety Exchange

3.1 Historical and contemporary genetic exchange

The diversity of durian varieties is closely related to its cultivation and exchange in Southeast Asia. Durian has been spreading and developing in different regions for a long time, which also allows us to see many different varieties today. For example, Thailand's very famous "Golden Pillow" durian (Thai: หมอนทอง, English: Monthong) has a very long history. Many commercial varieties currently circulating in the market, such as some durians in Malaysia and Indonesia, were actually first spread from Bangkok, Thailand (Aziz and Jalil, 2019). According to some data, as early as 1908, a Thai cookbook mentioned the extra-large durian produced in the Chinese community. This shows that the Golden Pillow variety has a planting history of at least more than 100 years, and it is likely that it was promoted by early Chinese through grafting (Nawae et al., 2023).

3.2 Genetic diversity and cross-breeding for adaptation

The genetic diversity of durian is very important, which allows different varieties to adapt to various different growth environments. Researchers used molecular marker methods such as SSR (simple sequence repeats) and ISSR and found that there are great genetic differences between durian varieties in Malaysia and Indonesia (Siew et al., 2018a). Lin et al. (2022) analyzed 32 durian genotypes in Hainan. They used whole genome sequencing methods and RAD sequencing technology, and developed a set of SSR marker tools. These works laid the foundation for the protection of durian germplasm and breeding research. The study also used some analytical methods, such as genetic similarity (IBS), phylogenetic trees and principal component analysis, to divide the 32 genotypes into two groups. Many of the genotypes in the first group are repeated, while the genotypes in the second group have many common genetic characteristics with the first group. They also pointed out that the main varieties cultivated in Hainan include D24, D101, Musang King (MSW), Golden Red (JH), D163, HFH and NLX-5. They also developed more than 70 000 different SSR molecular markers.

3.3 Intellectual property rights and genetic resource protection

Nowadays, there are more and more varieties of durian, and intellectual property protection is becoming more and more important. If durian clones, variants or cultivated varieties can be accurately registered and classified, it will help protect genetic resources and manage commercial interests (Siew et al., 2018b). With the development of molecular marker technology, such as SSR and ISSR, people can more clearly identify the origin of durian varieties. These tools not only help us protect resources, but also support the commercial development of varieties (Prakoso and Retnoningsih, 2021).

In recent years, the number of Chinese people eating durian has increased year by year, with an annual growth rate of more than 20%. However, more than 90% of durian in China is still imported. Now, domestic durian such as Hainan “tree-ripened” has begun to be promoted, indicating that domestic breeding technology has made a breakthrough. And the issue of intellectual property protection of these varieties has also received more and more attention. Durian is a tropical specialty fruit, and its varieties (such as Malaysia’s Musang King and Thailand's Golden Pillow) have obvious regional characteristics. According to the Convention on Biological Diversity (CBD), the genetic resources of durian belong to the country of origin; but if it is a new variety, the breeder can also own the variety rights. At this time, it is necessary to balance the relationship between resource ownership and innovative results.

In China, new durian varieties can apply for exclusive rights under the Regulations on the Protection of New Plant Varieties, and the general protection period is 15 to 20 years. However, because durian breeding takes a long time and is asexually reproduced, it sometimes affects the recognition of the "uniqueness" of new varieties. If there are new breeding techniques or planting methods, invention patents can also be applied for. In addition, geographical indications and trademark protection such as "Hainan Tree-Ripe Durian" are also a key direction for brand building in the future. This requires the establishment of a strict quality control system to cooperate.

4 Ecological Adaptation of Durian in Different Regions

4.1 Environmental factors affecting durian growth

Durian is a tropical fruit with high temperature requirements. It needs to grow in a high temperature climate throughout the year, and the average annual temperature should be between 22°C and 30°C. During the fruiting period, if the temperature is below 20°C, the fruit may not develop well or even fall. Durian also needs sunlight. There must be 8 to 10 hours of sunlight every day to make the leaves grow lush, the flowers bloom well, and the fruits are plump and juicy. The strong and long sunlight in tropical areas creates good conditions for the growth of durian.

Water is also very important for durian. It likes a humid climate, and the annual precipitation is preferably between 1000 and 3000 mm. The water requirements are different in different growth periods. In the seedling stage, the soil should be kept moist, but there should be no stagnant water, otherwise the roots will rot. In the flowering and fruiting period, there should be sufficient water, otherwise the flowers will fall easily and the fruits will not grow well. Different durian varieties also adapt to the environment differently. For example, the varieties Kradumthong, Monthong and Puangmanee show different adaptability, some are drought-tolerant and some are moisture-tolerant (Khaksar et al., 2024).

In Hainan, China, the climate conditions are very similar to those in Southeast Asia. The annual average temperature is around 24°C, and the rainfall is relatively high, exceeding 1 500 mm. These conditions are very suitable for durian growth. The successful cultivation in Hainan also shows that as long as the climate is suitable, the right variety is selected and scientific management methods are adopted, durian can also be grown well in China (Figure 1) (Lin et al., 2022).

4.2 Regional adaptation of key durian varieties

Durian is a tropical fruit, and different varieties have different adaptability to different environments. Temperature, humidity, light and precipitation will affect its performance. At present, most commercially cultivated durians are concentrated in Southeast Asia. Thailand's Golden Pillow (Monhong) is drought-tolerant and suitable for cultivation in the east and south. It can also be grown in Hainan, China and Xishuangbanna, Yunnan, but attention should be paid to cold protection in winter. Kanyao prefers well-drained soil and is suitable for the central plains of Thailand. Chanee is more tolerant to moisture and is suitable for rainy areas in southern Thailand.

Malaysian Musang King prefers a high temperature and high humidity environment and is suitable for small-scale planting in Hainan and Xishuangbanna. Black Thorn is sensitive to temperature differences and is difficult to introduce; Red Prawn is more tolerant to moisture and is suitable for hot and humid areas such as Hainan and Guangdong in China. Vietnam's Rí6 variety is more drought-tolerant and can adapt to poor soils. It is suitable for

planting in southern Vietnam and some dry and hot river valleys in Guangxi and Yunnan, China. Indonesia's Tomani variety has strong disease resistance and is suitable for hot and rainy areas.

In China, durian is mainly grown in tropical or subtropical areas such as Hainan, Yunnan, Guangdong and Guangxi. However, these places still face many challenges in terms of temperature, precipitation and soil. Durian is suitable for places with an average annual temperature of more than 24°C. If it is below 10°C in winter, it will cause flowers and fruits to fall. Southern Hainan is the most suitable place for growing durian, and other places need to build greenhouses or take insulation measures (Zhou et al., 2021; Jiang and Han, 2024).



Figure 1 Early stage of cultivation of Hainan durian

4.3 Climate change and future adaptation strategies

Climate change has brought many impacts on durian cultivation. Some are challenges, but there are also new opportunities. When the temperature is too high, such as over 35°C, the flowers are easy to fall and the fruits do not grow well. If the temperature is below 10°C in winter, the durian tree is also prone to freezing, and in severe cases, it may even die. Changes in rainfall also have a great impact. In some areas, it is too dry, so the fruits are small; in some places, there are many heavy rains, which can easily cause root rot. Climate warming also expands the range of pests, and fungal diseases such as anthrax and root rot are increasing.

Now, scientists are studying more drought-resistant and cold-resistant durian varieties, and some use gene editing to speed up breeding. In terms of planting, people have begun to use windbreaks and awnings to adjust the microenvironment; use drip irrigation and drainage systems to control water; and improve soil structure. For pests and diseases, people have also begun to use natural enemies and biological pesticides for prevention and control, and introduce Internet of Things technology for early warning. In addition, some production areas have begun to move to higher altitudes or latitudes, or try to grow durian in greenhouses. For example, in order to cope with heavy rains, Pahang, Malaysia, switched to waterlogging-resistant rootstocks and adopted high ridge cultivation methods. Hainan, China, also carried out “durian + coconut” intercropping to improve the microclimate of orchards (Aziz and Jalil, 2019; Xiao et al., 2022; Zhang et al., 2024). These practices show that as long as traditional experience and modern technology are combined well, the durian industry can better adapt to climate change and achieve long-term development.

5 Pest and Disease Management in Global Durian Cultivation

5.1 Common pests

Durian is often affected by pests during cultivation. These insects affect the health of the fruit trees, reduce yield and quality, and also reduce farmers' income. The more common pests are as follows. The larvae of the fruit borer (*Conogethes punctiferalis*) will drill into the fruit, destroy the flesh, and cause the durian to fall prematurely. The

psyllid (*Allocarsidara malayensis*) will cause the young leaves to curl up and turn yellow, affecting photosynthesis and the tree to grow poorly. Scale insects (Pseudococcidae) suck sap and secrete honeydew, which can easily cause sooty mold and affect the entire plant. Termites (Isoptera) will bite the trunk and roots, causing the tree to weaken or even die.

In southern Thailand, there is another common mosquito in plantations - *Aedes albopictus*. Studies have found that it has varying degrees of sensitivity to some pesticides (such as cypermethrin, chlorpyrifos, carbaryl and imidacloprid). Although chlorpyrifos is still effective, the effects of other drugs are getting worse, indicating that pests are beginning to develop resistance, which requires more cautious use of pesticides (Ratisupakorn et al., 2021).

5.2 Disease resistance in durian varieties

In addition to insect pests, durian is often threatened by a variety of diseases, among which the most influential are: *Phytophthora palmivora*, dry rot (*Lasiodiplodia theobromae*), and leaf blight (*Pestalotiopsis* spp.). These diseases can cause tree roots to rot, bark to crack, branches to dry, leaves to necrotize, tree health to suffer, and yields to decrease. Studies in Thailand have found that *Phytophthora* has developed resistance to the commonly used fungicide metalaxyl, but agents such as azoxystrobin and dimethomorph still have an effect on the pathogen (Kongtragoul et al., 2021).

Some durian varieties are more resistant to diseases, for example: *D. graveolens* is relatively resistant to *Phytophthora* root rot, and Monthong is also somewhat tolerant to leaf blight. Researchers are also introducing these disease-resistant traits into commercial varieties through breeding. In addition to breeding, methods such as selecting disease-resistant rootstocks, scientific pruning, and using probiotic fungi (such as *Trichoderma* spp.) can also reduce the occurrence of diseases. Disease-resistant varieties can reduce the use of pesticides and ensure yields, which is an important direction for sustainable cultivation (Mooney et al., 2022).

5.3 Sustainable disease prevention and management

In order to reduce dependence on pesticides, the durian industry is now promoting the “integrated pest management (IPDM)” approach. This approach combines multiple strategies, including using beneficial insects to control pests; adjusting orchard management methods; using pesticides only when necessary; and regularly monitoring the occurrence of pests and diseases.

Healthy soil is also important. Maintaining proper soil moisture, using organic mulch, and intercropping can help enhance durian's disease resistance (El-Saadony et al., 2022; Scortichini, 2022). Future durian breeding will also focus more on disease resistance. Researchers will use modern technologies, such as marker-assisted selection, to screen for more disease-resistant varieties. In terms of environmental protection, microbial fungicides (such as *Bacillus subtilis*) and plant essential oils have also been widely studied. These methods can reduce chemical residues and have less impact on the environment (Pongpisutta et al., 2023).

For the durian industry to develop sustainably, pest and disease management is critical. Growers need to combine natural disease resistance, scientific management, and new technologies to reduce losses, ensure high yields and high quality of durian, and meet the growing market demand. In the Philippines, a participatory research method allows farmers to participate in the formulation of disease control plans. Depending on the situation of different farmers, they can choose management methods with low, medium, or high inputs (Daniel et al., 2014).

6 Case Studies of Durian Variety Adaptation in Global Markets

6.1 Successful cases of domestic durian

The durian currently grown in China is mainly golden pillow and blue ni. In recent years, the planting area has grown rapidly, mainly distributed in Hainan, Guangdong and Yunnan. Baoting Li and Miao Autonomous County in Hainan is a typical successful example. Through scientific and technological innovation, cultural publicity and the development of the entire industrial chain, the local area has found its own way to develop durian.

With the help of the Chinese Academy of Tropical Agricultural Sciences, Baoting has solved many technical problems in durian cultivation. They selected good varieties suitable for the local climate and shortened the time

from 7 to 8 years to 4 to 5 years, greatly improving the benefits. They also innovated the intercropping model of “durian + coconut”. Coconut trees can provide shade, allowing durian to grow better and improve land utilization. This method can generate more than 100 000 yuan per mu (Tan et al., 2020).

In order to enhance the cultural value of durian, Baoting also held events such as the “Tropical Fruit Festival”, combining durian cultivation with local Li and Miao culture and rural tourism to create its own brand. In terms of the industrial chain, in addition to selling fresh fruits, local products such as durian pastry and durian coffee have also been developed. The supporting cold chain logistics system also allows the “tree-ripened” durian to maintain its flavor and quality (Sangpong et al., 2021). Baoting has also established a cooperation model of “scientific research units + enterprises + farmers” to provide technical support and market guarantees. This has allowed the local durian to develop step by step from trial planting to a large-scale planting industry. This case shows that as long as the technology is advanced, the culture is distinctive, and the industrial chain is complete, China can also develop an internationally competitive durian industry.

6.2 Expansion of monthong in non-traditional growing regions

Golden pillow (Monthong) is the most planted durian variety in Thailand. It has large fruits, a non-pungent taste, and tastes sweet and mellow, so many consumers like it (Figure 2) (Arsa et al., 2021). Originally, Golden Pillow was mainly planted in eastern and southern Thailand. Now, it has also begun to be planted in non-traditional areas such as Australia, Sri Lanka, and South America. However, to grow durian well in these places, the soil needs to be improved and a good irrigation system is required. For example, growers in northern Australia have adopted drip irrigation technology to solve drought problems. Golden pillow is also considered to be rich in antioxidants, which makes it more attractive as a healthy fruit (Charoenphun and Klangbud, 2022).

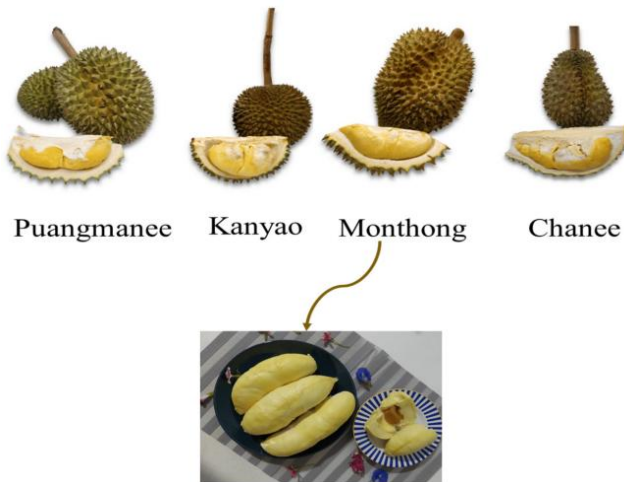


Figure 2 Local cultivars of Thai durian: monthong (MT), chanee (CN), puangmanee (PM) and kanyao (KN) (Adopted from Arsa et al., 2021)

Nawae et al. (2023) found that golden pillow has high genetic diversity. This allows it to adapt to a variety of climates and soils and grow well in different regions. They also pointed out that near-infrared spectroscopy can be used to determine the origin of golden pillow, which helps to ensure stable quality and authenticity identification (Chanachot et al., 2023).

6.3 Performance of hybrid varieties in emerging markets

Malaysia's durian industry is vigorously expanding its market in China through breeding innovation and green planting models. The Malaysian Agricultural Research and Development Institute (MARDI) has bred several new varieties, such as the early-maturing MDUR 78 and the disease-resistant MDUR 88. These varieties retain the taste of Musang King, but have a shorter fruiting time and a 25% increase in yield. This makes them more competitive in the Chinese market. In order to adapt to the tastes of Chinese consumers, hybrid varieties have also been optimized, such as removing bitterness and adding milky flavor. In cities such as Guangzhou and Shanghai, these varieties can sell for 2 to 3 times the price of golden pillow durian.

Malaysia has also launched a “durian agroforestry system” to mix local tree species in durian orchards, which can not only protect the ecology but also enhance carbon sequestration capacity. Through the green channel agreement with China, such products can also enjoy tax incentives (Nawae et al., 2023). In 2023, Malaysia’s exports of hybrid durian to China increased by 67% over last year. Among them, the repurchase rate of new products such as “Black Thorn X Musang King” on e-commerce platforms is as high as 58%.

The success of hybrid varieties depends on “three adaptations”: adapting to the climate and being able to be grown in southern China; adapting to the supply chain, not easy to spoil and convenient for transportation; adapting to consumer culture, the flesh is suitable for making Chinese desserts (Lin et al., 2022). As the RCEP tariff reduction policy is further implemented, Malaysian hybrid durian is expected to establish a complete industrial chain in China, extending from high-end fresh fruits to processed foods, and even changing the durian trade pattern in Asia as a whole.

7 Concluding Remarks

Durian is a famous tropical fruit, originating from Malaysia. Its flesh is rich in nutrients and has a unique taste. Durian trees grow tall and bear fruit slowly. Generally, it takes 5 years for them to bear fruit, and they have high requirements for the growing environment. At present, the commercial cultivation of durian is mostly concentrated in countries and regions close to the equator. There are many varieties of durian in the world, and different countries mainly grow different varieties. At present, the main production areas of durian are Indonesia, Vietnam, Malaysia and Thailand. Common mainstream varieties include Musang King, Golden Pillow, Qingni, Kalun, Sultan King, Tomani, and Ganyao. Among them, Musang King, Golden Pillow, Sultan King, and Ganyao are the most popular because of their thick flesh, sweet and rich fragrance. The planting cycle of durian is very long, and it generally takes 5 years to bear fruit, which is relatively difficult to grow. Thailand and Malaysia currently occupy most of the international market. In recent years, Guangdong and Hainan in China have also begun to grow durian. In addition to Southeast Asia, some places also have a small amount of planting, such as China, India, Sri Lanka, the West Indies, Florida and Hawaii in the United States, as well as northern Australia, Madagascar, Singapore, Papua New Guinea and the Polynesian Islands.

Now, the area of durian cultivation in China is slowly increasing. The southern part of Hainan Island is the most concentrated planting area, and the current planting area has exceeded 30 000 mu. In 2023, there were 1 400 mu of durian trees in Hainan, with a total output of about 50 tons. In 2024, the fruiting area expanded to 4,000 mu, and the main varieties planted were Jinzhen, Ganyao and Mao Shanwang. In recent years, China has made significant progress in durian cultivation, especially in off-season cultivation technology. For example, in early 2024, the experimental base in Sanya successfully achieved winter flowering and spring fruiting. This achievement mainly depends on flower control technology and the breeding of adaptive varieties. This breakthrough allows durian to fill the gap in the market. At present, Sanya, Baoting and other places in Hainan have moved from small-scale trial planting to larger commercial production. Some orchards have an output of more than 1 000 kilograms per mu. Because domestic durian is “tree-ripened”, the taste is getting closer and closer to imported durian. This development is very important and can help reduce dependence on imported durian. China now eats more than 1 million tons of durian every year, 90% of which are imported from Southeast Asia. If domestic durian can be developed, it can reduce many supply chain risks. At the same time, the economic benefits of durian are also very high. In Hainan, the per mu output value of some pilot orchards has reached 100 000 to 150 000 yuan, allowing many farmers to obtain tangible benefits.

However, there are still some difficulties in the development of domestic durian. For example, the ability to adapt to the climate is limited, the management of pests and diseases is not mature enough, and the cold resistance of varieties needs to be improved. Next, it is necessary to strengthen the breeding of cold-resistant varieties and the research and development of green pest and disease control technology. In terms of brand building, create a geographical indication brand of “Chinese durian” and compete with Southeast Asian durian products in a differentiated manner. At the current development speed, it is expected that in the next five years, the market share of China’s self-produced durian may reach 10% to 20%. At the same time, more deep-processing products can be

developed, such as freeze-dried durian slices, durian beer, and durian ice cream. Through international cooperation, China's durian industry can also introduce more planting and processing technologies, providing new opportunities for industrial upgrading. At present, the successful trial planting of off-season durian in Sanya marks that China's durian has moved from the introduction and trial stage to real commercial planting. As long as we persist in technological innovation and improve the industrial chain, China's goal of "durian freedom" is not far away. In the future, the development of Chinese durian may also have a profound impact on the global durian market.

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Conflict of Interest Disclosure

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