Shiwei Xu *Editor*

Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference

Springer

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ISBN 978-3-642-54355-5 ISBN 978-3-642-54356-2 (eBook)
DOI 10.1007/978-3-642-54356-2
Springer Heidelberg New York Dordrecht London

Library of Congress Control Number: 2014939311

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

2013 World Agricultural Outlook Conference Overview

It has always been the major concern in the world to safeguard food security and to ensure the sufficient supply of agricultural products, which is also the corner stone for the world and regional stable economic growth. Taking into consideration of global agricultural development trends, agricultural production will enter into a new stage featured with high cost, high risk and much more strict resource and environment constraints in the future, which will further increase uncertainties of agricultural development. In response to the daunting task of enhancing world food security, it is imperative to make projection and analysis of the future agricultural production and market trend, to facilitate in-depth communication and knowledge sharing, to formulate policy options on the agricultural development, and ultimately to promote the predictability and management competence over agricultural market.

"2013 World Agricultural Outlook Conference (WAOC)" supported by Ministry of Agriculture of the People's Republic of China, co-organized by United Nations Food Agriculture Organization (FAO) and Organization for Economic Co-operation and Development (OECD), was hosted by Agricultural Information Institute (AII) of Chinese Academy of Agricultural Sciences (CAAS), such as FAO, OECD and IFPRI, and other countries will participate in the conference.

WAOC held on June 6–7, 2013, at Beijing Friendship Hotel, discussed current situation and future challenges facing agricultural development in the next decade. Conference contents were as following:

1. **Opening Ceremony and Press Release:** FAO/OECD presentation on 2013 World Outlook (summary), AII presentation on 2013 China Outlook (summary);
2. **Key Policy Challenges for the Next 10 Years and Approaches:** keynote speeches by FAO, OECD, IFPRI, USDA, CAAS, etc.;
3. **Global and China Commodity Outlook:** grains, oilseeds, biofuel, cotton, sugar, livestock, and dairy, by specialists from international organizations and national institutes; and

4. **Scenario Analysis on Macro-economy and Hot Topics on Food Projection:** agricultural early-warning and monitoring system, resource constraints, climate changes, biofuel, population growth and change, by specialists from different regions.

Beijing, People's Republic of China Shiwei Xu

Contents

Chapter 1
Study on Stabilizing Price of Hog Market in China

Qiao Zhang, Ke Wang, and Ran Huo

Abstract In order to provide suggestions for Chinese Government on how to stabilize the price of China's hog market, which has been witness roller coaster ride of price and brought a huge impact on the pig raising industry and the whole chain of pork industry in recent years, this paper firstly analyzes the underlying rules of China's hog price fluctuation, and then introduces the international experiences on stabilizing the hog' price, finally several suggestions on ease of price violent were posed for Chinese government. Our suggestions include: (1) the government should have the sense of risk management when seeking to stabilize hog market price, and the fluctuation risk of hog price with different magnitudes and occurrence probabilities should be managed by farmers, businessman and government using different strategies; (2) Government should take use of the ability of producers and market to mitigate and transfer the price risk.

Keywords Hog • Price fluctuation • Risk management • Price stabilization • China

In 1985, Chinese government cancelled the policy of state monopoly of the purchase and allocation in the hog and swine industry. Since then, hog price has been determined by the market, and the marketization of Chinese pig industry was becoming more mature. Since the beginning of the new century, especially since 2006, the pork market price has experienced roller coaster several times in China. The pork price surged in 2007, and crash down in 2009 and peaked again in the latter half of 2010, then rapid fall since September 2011. The ups and downs of pork market price have caused huge impact on pig farmers, processing enterprises and

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_1,

consumers in China. The extremely risky market environment has significantly discouraged the enthusiasm of hog feeder and restricted the development of pig industry. In order to stabilize pork prices and promote the sustainable development of hog industry, China government began to introduce a series of price management regulations for swine market since 2007. These policies, however, did not achieve the expected goal. The price volatility of Chinese pork market remains fierce, and the cycle of "one year profit, one year survival and one year deficit" still exist. How can keep stable in terms of the price of hog market? Does they are any underlying rules in the fluctuations of Chinese hog price? What's the risk that Chinese pig feeders and hog processing enterprises had faced? And what is the role of government in the proceedings of ease the price volatility? This paper addresses those questions by analyzing the price risk in hog industry and trying to put forward suggestions for policymakers on stabilizing Chinese hog price.

1.1 Characteristics of Price Fluctuation in Chinese Hog Market

In this paper, the monthly hog market price data from 1 January 2000 to December 2012 were used to analyze the price fluctuation characters. The approach of seasonal adjustment X11 and H-P filtering were used to decompose the pig market price movements into four parts, long term trend, cyclical fluctuation, seasonal fluctuation and stochastic fluctuation. The data were obtained from Ministry of Agriculture of China.

1.1.1 Long Term Trend of Hog Price in China

According to Fig. 1.1, we can see that long-term trend rises in a laddered pattern, and slow increase and significant increase alternate once every 2–3 years.

1.1.2 Cyclical Fluctuation

From Fig. 1.2, it can be seen clearly that there are obviously cycles in China's hog price fluctuation. These cycles have obvious regularity. First, each cycle length is about 40 months. Second, the downturn and upturn of each cycle are respectively about 20 months. Third, cycle fluctuations have a trend to become fiercer, i.e. much more drastic fluctuations are expected in future.

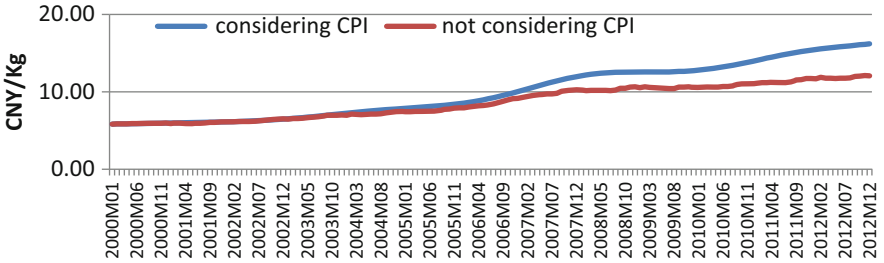

Fig. 1.1 Long term trend of Chinese hog price

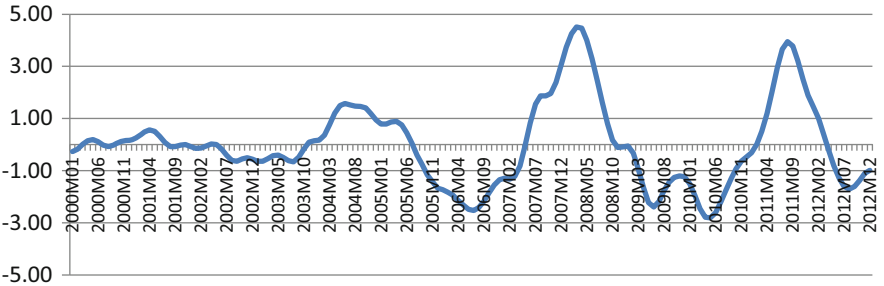

Fig. 1.2 Cyclical fluctuation of hog price in China

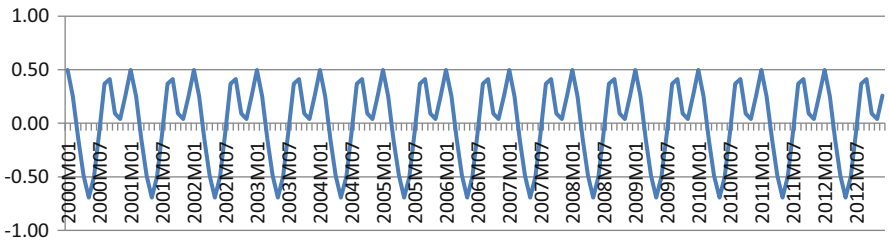

Fig. 1.3 Hog price seasonal fluctuation

1.1.3 Seasonal Fluctuation

As shown in Fig. 1.3, hog prices in China follow a regular periodic seasonal change year by year and hog prices p.a. appears with a shape of "two ends high, the middles low". Specifically, hog price reaches the highest point in January, where is the peak of seasonal fluctuation. Then it draft down at the beginning of February and in May it hits the bottom. In July, it rebounds gradually till October. In October, it witnesses a slightly downturn and continues to rise during the last few months of the years and returns its summit in January of the second year.

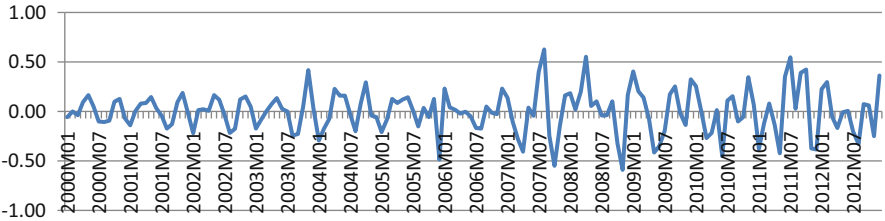

Fig. 1.4 Hog price stochastic fluctuation

Table 1.1 Contribution of each component of price fluctuation

Risk types	Cyclical risk	Seasonal risk	Risk of randomness
Contribution (%)	60.46	26.19	13.35

1.1.4 Stochastic Fluctuation

We can see from Fig. 1.4 that the magnitude of stochastic fluctuation is relatively small, but the amplitude tends to become larger with time passing by.

1.1.5 Types and Characteristics of Chinese Hog Price Risk

Through the analysis of hog price fluctuations above, the risk of hog price can be divided into three types: the risk of randomness, the seasonal risk and cyclical risk corresponding to three types of fluctuation, and different risk types have its risk characteristics (Zhang and Song 2012). The random fluctuation risk degree is the minimal although with a large probability of occurrence. Following the risk of randomness is the seasonal risk with a medium risk degree and probability of occurrence. The cyclical risk has the maximal risk degree and minimal probability of occurrence. Three types of risk are shown as follows (Table 1.1):

1.2 The International Experiences in Managing Hog Price Risk

In modern risk management theory, different risk management strategies are applied to cope with different types of risk according to the magnitudes and frequency of the risks and the holder's risk bearing ability. After review relative documents, we classify the methods of hog price management in the world into three types: risk reduction strategy, risk transfer strategy and risk coping strategy.

1.2.1 Strategy of Risk Reduction by Producers and Operators

Risk reduction strategy refers to the strategies that producers and operators take action by themselves to decrease the risk probability or reduce the risk influence. This strategy is suitable for management of the risk with properties of small damage and high frequency, such as the randomness type of price risk. Producers and operators can protect against risks by timely adjusting their scale of production or operation and enhancing the ability of storage and processing to prolong the period of supply. Besides that, producers and operators can also unite to build professional cooperation organizations or bind the supply and purchase cooperative relations with industrial leading enterprises to strengthen the systematization and improve the market impact and bargaining power. This is also a popular way to reduce the impact of market price fluctuations. Many pork producers have established their own industrial associations in EU. In Denmark-the world's largest pork exporter, three slaughtering cooperatives lead to build a pork industry association. The association is also a contract system under which hog farmers sign sales contract with one of slaughtering cooperatives and then through contracts, stable purchase price and payment system are formed to ensure hog producers stable and timely payment. Moreover, the association has its own subsidiary to run pork export on behalf of the three cooperatives (Wang 2010). In Japan and the region of Taiwan, Agricultural Associations are responsible to collect market information, provide technical and consulting services and help members improve the production level and play important role to stabilize market sales price. Since the 1970s, the integrative producing mode of farmers and the slaughterhouses has gradually established in Brazil. Under this mode, the slaughterhouses provide piglets, fodder and technical guidance to hog farmers. The hog farmers only take care about raising pigs, and after the hogs grow up to slaughter, the hog farmers sell the hogs to the slaughterhouses according to the contract price. This mode transfers the market risks from the hog farmers to slaughterhouses that have more capability to undertake and manage the risks. In this way, the high-risk and cyclical fluctuations of pork prices are effectively released in Brazil (AnBang Group 2013).

1.2.2 Strategy of Risk Transfer Through Market Tools

Risk transfer strategy refers to using market risk management tools (such as, price insurance, future and option) to transfer and spread the risk. This kind of strategy mainly adopted against the risk that is large and high frequency such as seasonal risk. The reputable risk management tools in the world include "Contract farming + future mode", price index insurance and revenue or income insurance.

1.2.2.1 Contract Farming + Future Mode

"Contract farming + future mode" is a mode that the leading enterprises or associations sign contracts with farmers at a fixed price and then hedge the price risk by future. The farmers undertake small risk because they sell their products at a contract price, and the enterprises and associations pool risks from individual farmers and transfer the risks to the investors/ speculators in the future market. For instance, Chicago Mercantile Exchange introduced the hog future contract in 1966, and introduced the lean hog future contract to replace hog future contract in 1996. Now, lean hog contracts are the second most active traded contracts in CME. This mode is widely adopted by U.S. farmers, enterprises and farming associations to reduce the potential loss from price fluctuation. Outside USA, future market as a risk management tool for hog industry is also adopted in EU to stabilize the hog price and help farmers to avoid market risks. July 20th 2009, the Eurex in Frankfurt Germany debuted piglet futures and hog futures. Since then, the trading volume has been steadily grown and the introduction of agricultural product future has tasted its first success, providing great help for farmers to manage market risk.

1.2.2.2 Price Index Insurance

The price index insurance is an innovation risk management tool that proposed in recent years. Simply, the insurance companies will pay the policy holders when the market price is lower than the predetermined price. Price index insurance has been provided in Canada, the United States and Japan. For instance, Canada's Alberta hog prices (HPIP) insurance, it is an insurance program designed to be a simple and easy to understand tool Alberta beef producers can use to help manage risks for Alberta hog producers (AFSC 2013). Similarly, there are livestock price insurance in America, ensuring bottom prices for cows, lambs and hogs. In Japan, the regional hog price stabilizing fund has realized the price compensation for the hog producers when the hog prices plummet. The mechanism of fund is similar to the price index insurance: the regional pork price stabilizing fund sets a protective price each year, and hog farmers voluntarily participate in the fund program. When the monthly pig wholesale price is lower than the protective price, the participants will get compensation from the fund.

1.2.2.3 Revenue or Income Insurance

The revenue or income insurance is also an innovation of agricultural insurance products. It overcomes the shortcoming of the traditional yield insurance. The yield insurance can only cover yield volatility risk and has nothing to do with the selling prices fluctuations of agricultural products. On the contrary, income insurance is mainly aimed at protecting the policy holders from the loss caused by price

fluctuation. For instance, the Livestock Gross Margin (LGM) is an insurance that against the decrease of gross margin (market income minus feed cost) for cow, milk and swine (RMA 2013).

1.3 Strategies of Risk Coping by the Government

Government intervention strategy refers to that government takes measures to cope the catastrophic risk events or introduces counter-cyclical policies when private sectors fail to handle the risk through market risk instruments. This strategy is suitable for large price swings, low frequency periodic risk. Globally, government intervention measures commonly include: (1) Temporary stocking. For instance, the EU encourages the private sectors of its members to purchase and stock pork by providing subsidy when the pork prices are less than 103% of baseline and EU also encourages the governments of its members to dwindle the stockpiling. (2) Minimum (maximum) price guarantee. For example, Japan launched the law of animal products price stability. The law grants the government to determine the ceiling and bottom price of pork prices (published in March of each year), and when the price exceeds the limits, the government implements the reverse operation to stabilize the market price (Zhou 2010). (3) Risk compensation fund. In 2000, the government established the "national animal industry fund (NAIF)" to stabilize the meat price in the region of Taiwan. NAIF collects and monitors daily meat product wholesale prices, and when the prices are above the historical average prices, it will increase mean imports to increase supply; when prices fall below the average, NAIF will subsidize the farmers to encourage them to curtail production and subsidize the processing enterprises to encourage them increase inventory and reduce the supply (Hwang et al. 2010).

1.4 The Role of Government in the Hog Market Risk Management

According to the pervious analysis, the hog market prices volatility does not contains only randomness and seasonal fluctuations, but also has strong cyclical fluctuation characteristics, therefore, government should take measures to assist producers and operators dealing with the risks that are small but happen frequently, encourage innovation of market tools to transfer and disperse the seasonal market risks, and most importantly, to design and implement effective policy to cope with abnormal fluctuation of price. Chinese producers and operators, market bodies and government need to take their own duties meanwhile in the managing of hog price risk. Finally, we had made the following recommendation for Chinese government.

1.4.1 Training and Guiding the Producers and Operators to Deal with Risks

Agricultural risk management is still a relatively unfamiliar conception in China, especially for the small-scale agricultural producers. The risk awareness of hog feeders is still very weak. The governments should organize some training to educate hog farmers and small-scale producers and increase their risk awareness. Improving the risk resistance ability of hog feeders and operators will help them to apply the strategy of risk reduction more automatically and effectively.

1.4.2 Encouraging the Development of Market Risk Management Tools

Although some market tools such as insurance, future and option are effective risk management tools and has been played a very critical role to manage the price risk in developed countries, at present there are few risk management tools in Chinese swine market. It is believed that Chinese government should encourages private sectors to develop innovated agricultural risk management tools, and government can also provide helps in the making use of market risk management tools.

1.4.3 Enforcing the Price Monitoring and Early-Warning

The effective access of data is one of preconditions for market players to make the right decisions. Government has unique advantages and irreplaceable responsibility in aspects of data collection, compilation and dissemination, and to monitor and early-warning of the hog price fluctuation. Thereby Chinese government needs to enforcing the hog market monitoring and early warning system, publish the related price information transparently and timely by which can help producers and operators to make ration decisions, timely adjustment, and avoid the blindness of producing and speculating. In addition, the effectiveness of some risk management tools, such as price index insurance, also depends on the timely and precise market price information published by the government.

1.4.4 Improving the Counter-Cyclical Intervention Ability of the Government

The government needs to conduct deep research of the agricultural product market, especially the hog market to have profound understanding of the price fluctuation

rule. Furthermore, the government needs to optimize the market policies and measures of regulation and control by accurately seizing the right time to put forward and applying compound policies. Last but not the least, the government needs to take various cross effects of different policies into consideration when applying the possible combination of these policies to intervened market.

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Chapter 2
Analysis and Outlook of China's Sugar Industry Development

Xue Xu and Hailong Xia

Abstract In this paper, sugar's production, consumption and trade status in China are reviewed systematically, and the background and reasons for the substantial increase in sugar import are analyzed. We found that the main reasons for China sugar industry's weakness and low international competitiveness include inefficient production technology, low level of domestic support and protection, and high production cost. And now it is difficult to resist the dumping of foreign sugar with lower price, and China sugar industrial's safety issue therefore has been highlighted. Based on the analysis and forecast of the gap between domestic sugar production and demand in 2020, we put forward policy options for further developing china's sugar industry.

Keywords China's Sugar Industry • Industry Safety • Policy options

Sugar is one of the four important agricultural products in China. As a strategic industry, it is of vital importance to the nation's economy and the people's livelihood. After more 60 years rapid development since the founding of new China, now the total domestic sugar yield has reached approximately 12–15 million tons, over 50 times of 260 thousand tons in 1949, and the yield per unit area of sugar material has tripled over the period. We make it real that 80 % national sugar consumption is based on domestic production. At present, China is the fourth largest sugar producing country in the world after Brazil, India and European Union, and the third largest sugar consuming country after India and European Union. Along with the rapid growth of production and consumption in the decades, China's sugar industry is encountering a development bottleneck in terms of its backward productivity and low international competitiveness.

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_2,

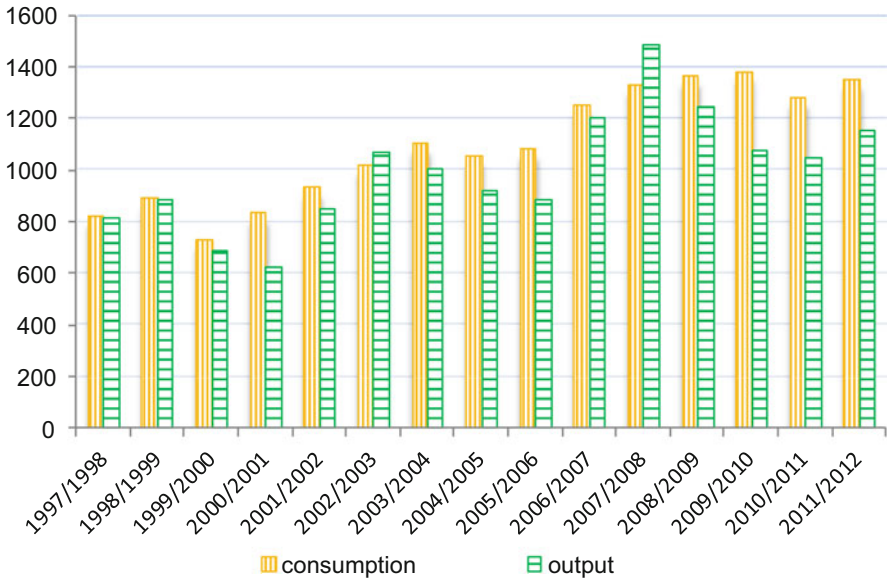

Fig. 2.1 China's sugar output and consumption (Unit: 10,000 ton). (Data source: China Sugar Association)

2.1 The Production Is Stagnating, While the Gap Between Supply and Demand Is Widening

2.1.1 Future Consumption Will Grow Persistently and Rapidly

China is the third largest sugar consuming country, but the sugar consumption per capita is very low. The average level of world per capita consumption is 24 kg per annum, while that of China is only 11 kg. In East Asia countries, taking Japan and Korea as examples, the annual sugar consumption per capita is 29 kg and 36 kg respectively. In developed countries, Australian annual sugar consumption per capita is 47 kg and that of America is up to 68 kg. In the future, with the raising of China's population and upgrade of people's consumption, especially the acceleration of urbanization, sugar consumption will increase sustainably and rapidly. According to the forecast by International Sugar Organization (ISO), based on annual average growth rate of 2.02 %, the global sugar consumption of 2020 will reach 201 million tons, while in China the number will be 22.1 million tons. China will then become the second largest sugar consumption country instead of European Union (19.7 million tons) after India (32.7 million tons) (Fig. 2.1).

2.1.2 Sugar Industry Development Is Impeded by Low Productivity of Sugar Materials

China's sugar material production is mostly located in economically underdeveloped regions. Its productivity is the lowest among four chief crops (grain, cotton, oil and sugar) in China. Sugar cane is mostly planted in the dry slope land with rare irrigation condition; the sugar cane varieties are single and aging; pests; droughts; floods happens frequently; the level of mechanization and social service are seriously lagging behind. As one of the chief crops, sugar material production is given the least governmental support and protection in China. In recent years, sugar material production costs rose sharply as the rapid increase in the price of labor and production materials. The cost rise of sugar materials exceeds its purchasing price increase. Sugar farmers' income per Mu is only RMB 500–800 Yuan. Sugar material production inputs and farmers' production enthusiasm are serious insufficient. The yield per unit area of sugar materials and ingredients are stagnating or even decreasing, sugar material producing area and yield have been mired in sluggish growth. Meanwhile, sugar cane production labor shortage is an increasingly serious problem of which is a long-term development bottleneck of China's sugar industry. At present, the average age of sugar cane production labor is 45-years old; the labor shortage problem will be further worsen and thus damage the basis of industrial development.

2.1.3 Sugar Demand Gap Will Continue to Expand

China's sugar production change cycle is 5–6 years. China's sugar output has continuously declined since the highest historical recording of 14.83 million tons in 2007/2008 production year. In recent 3 years, the gap between supply and demand is 2–3 million tons. In 2011/2012 production year, the sugar output rose slightly to 11.52 million tons with demand gap of two million tons. It is predicted that the sugar output will reach 13.3 million tons, making demand and supply in balance. According to China's sugar industry "twelfth 5-year" development plan, annual sugar output plans to approach 16 million tons in 2015. However, the hope is rather dim under such current situation. In the long run, China's sugar production output growth will be constrained by land area and multiple adverse climate impact, and the demand gap will be widening. In 2020, the gap may reach five million tons, sugar imports will continue to increase, accounting for about 10 % of the total global trade, and trade dependence will be up to 1/3.

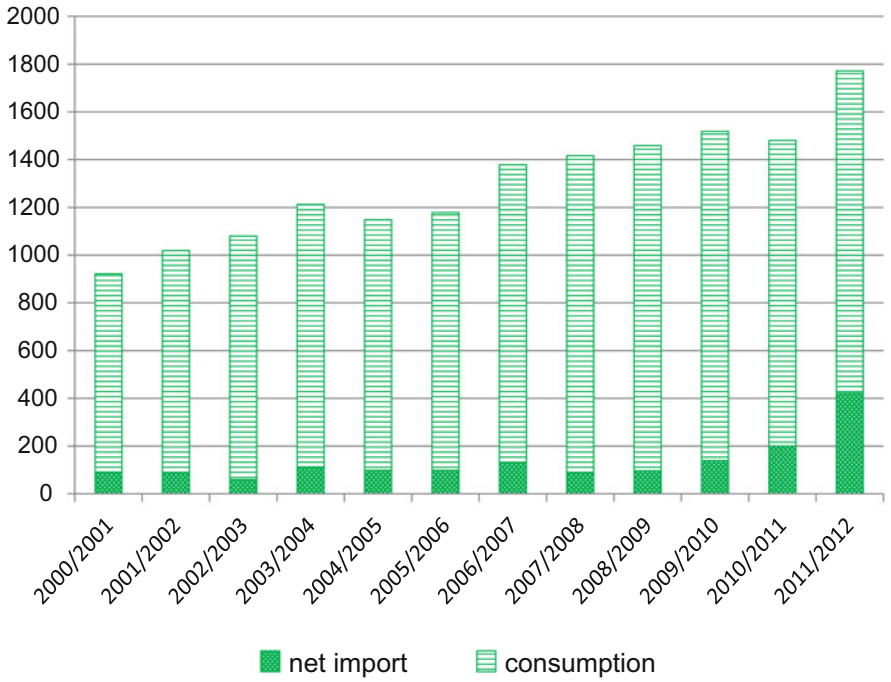

Fig. 2.2 China's sugar net import and sugar consumption (Unit: 10,000 ton). (Data source: China Sugar Association, General administration of customs of People's Republic of china)

2.2 Sugar Import Is Surging

China's sugar imports remained at 1–2 million tons since the twenty-first century. Annual average import is 1.15 million tons during 2000–2010, import dependence (import accounted for the percentage of domestic consumption) remained below 10 %. However, in recent 2 years, because of the international sugar CIF is substantially lower than the wholesale price in China's sugar main producing areas; sugar import stays a new stage of expansion. According to Customs statistics, in 2010/2011, China's sugar imports increase to 2.06 million tons, accounting for 4.1 % of the global sugar trade (50.4 million tons, released in Dec 2012, U.S. department of agriculture), import dependence up to 15.6 %; in 2011/2012, China's sugar imports doubled over the previous year (4.26 million tons), accounting for 8.5 % of the global sugar trade (50.27 million tons), import dependency up to 31.2 %, and then China has become the world's largest sugar importer in this year. Imported sugar has occupied a large share of domestic sugar consumption leading to a high stock level of local sugar, posing threat on China's sugar industry, making huge loss to sugar farmers and sugar companies. The reasons for the rapid growth of China sugar imports recently mainly lie in two aspects (Fig. 2.2).

2.2.1 Sugar's High Producing Cost and Lack of Price Competitiveness

China's sugar material production condition and the level of mechanization are seriously lagging behind. Farm input material and labor costs remain high, and sugar material producing cost accounts for 70 % of the total cost of sugar making, which is twice as the world main sugar producing countries, such as Brazil, India, Thailand and Australia. Especially continuously increased labor costs are nearly 50 % of the total sugar making cost. At present, China's sugar making costs are about 5,800 Yuan per ton after tax, while in Brazil, the total sugar cost is only 18 cents per pound (about 2,500 Yuan per ton). China sugar's high making cost led to a lack of international price competitiveness and weak resistance to international low-price sugar dumping.

China's sugar production has declined dramatically over three consecutive years since 2008/2009. The supply and demand gap reaches three million tons, resulting in domestic sugar price climbing up to 8,000 Yuan per ton in 2011, which is twice as 2001. In 2011/2012, China's sugar got into an output rise cycle, the domestic sugar price gradually fell. The average price is 5,356 Yuan per ton in May 2013, which has fallen far below the average sugar making costs. Nevertheless, international sugar price is still substantially lower than China's sugar price. From April 2011, the dutiable price (quota tariff) of Thailand sugar arriving in our shores is significantly lower than domestic sugar price, even 1,300 Yuan lower per ton than the wholesale price of China's sugar cane. In May 2013, sugar average international price is 17.1 cents per pound, Thailand's sugar CIF after tax is 4,534 Yuan per ton, which is 882 Yuan per ton cheaper than China's sugar price. Therefore, local companies are importing large quantities of sugar in order to achieve great profits and sugar smuggling is being repeated. Domestic sugar market turns to oversupply from the original inadequate production, leading to a constantly falling of domestic sugar price. The central government has to continuously purchase excessive sugar brought by imported as national sugar reserve. Currently, national sugar reserve has reached the highest level in history, which is a tremendous pressure on domestic market (Fig. 2.3).

2.2.2 Low Tariff Protection

Sugar is one of the highly protected agricultural products in most countries. In developed countries, the average imported tariff rate is 122 %, while China's sugar tariff rate is 15 % within quota, 50 % out of quota (China's sugar import quota is 1.945 million tons after 2004). China's sugar protection level is the lowest in the world. After joining WTO, the linkage between China's sugar market and international market is significantly enhanced. From the twenty-first century, China's sugar imported quota utilization rate is below 70 %. After 2010/2011, international

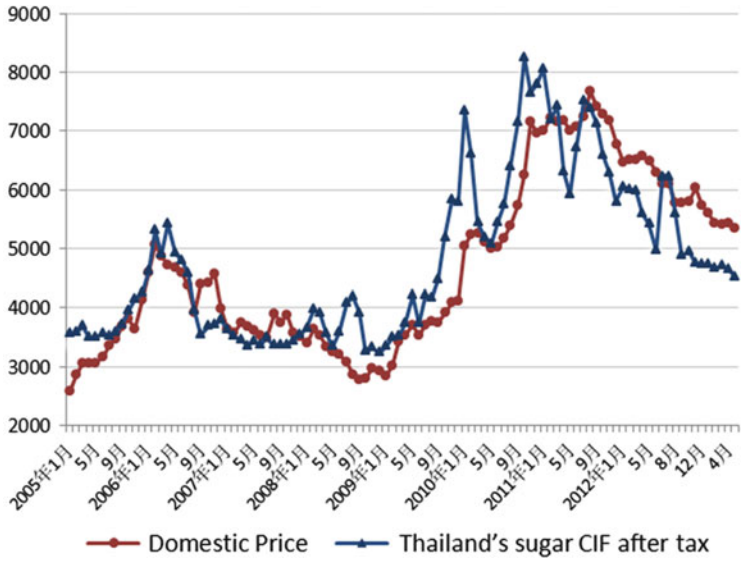

Fig. 2.3 Comparison of China's sugar price and Thailand's sugar CIF after tax (Unit: RMB Yuan/ton). (Data source: Sugar Network in Guangxi, www.gsmn.com.cn)

sugar price fell sharply. China sugar's low tariff was difficult to resist the invasion of international low-price sugar. Therefore, a large number of ultra-quota sugars were imported, which brought an enormous strike on domestic sugar industry.

2.3 Outlook: China's Sugar Imports Will Continue to Expand

In recent 5 years, the increase of world sugar production is greater than the increase of consumption, leading to an increasing world sugar stock. At the end of 2012/2013, sugar stock will reach 38.3 million tons. The huge inventory is unable to push international sugar price rising up. In the next 5 years, the international sugar price is expected between 16 and 25 cents per pound. Imported sugar is more likely significantly outnumber the gap between domestic supply and demand in China. The foundation of China's sugar industry will be severely impacted and the industry safety is therefore threatened.

2.4 Policy Suggestions

1. Formulate a national sugar industry's development strategy, and definite the production distribution of sugar crops and its development goals.
2. Transform traditional sugar production pattern, and comprehensively promote the "4-modernization" simultaneous development in sugar crops plantation, i.e. seed variety improving, mechanization, irrigation and scale production, to improve per unit yield and sugar degree. The ultimate goal is to finish the transition of sugar industry from traditional to modern one, and maintain the Self-sufficiency rate above 70 %.
3. Encourage the transfer of sugarcane field, and develop appropriately scaled operations; provide socialized services during the process of seeding, plowing, transporting, selling, to reduce costs and enhance efficiency.
4. Provide subsidies to sugar cane and beet producing farmers to stabilize the interest of farmers, and increase the security of sugar industry.
5. Establish early warning mechanism of China's sugar supply and demand. Based on the forecast of the domestic and international sugar production, demand, stock and prices, we could optimize the government's macroscopic regulation and control of sugar, and ensure smooth running of domestic sugar market.

Chapter 3
Perspective on the Trend of Soybean Production and Trade in China

Qing Zhang and Lifeng Liu

Abstract In this article, the development of soybean industry in China since its admission of WTO was reviewed in a systematical manner in terms of soybean production, market and trade; China's experience in meeting various challenges and utilizing opportunities since its admission of WTO was summarized and a perspective on the trend of soybean production and future consumption was also given; finally, countermeasures and suggestions were put forward for the development of soybean industry in China.

Keywords Soybean • Soybean production • Soybean market • Soybean trade

Soybean is not only an important edible oil fat and ingredient for protein in food, but also an important source of protein feeds in the farming industry, therefore it has a significant position in the national food produce security. Currently, soybean production ranks number four in the world while soybean processing and consumption ranks number two, making China the largest soybean importing country. At the same time, soybean and oil fat are the agricultural produce market that first opened in China and has received great attention since China joined the WTO. As a place of original production of soybeans, China was once the largest soybean producing and exporting country in world. However, for the past two decades, due to little change in the plantation area and slow growth in single production, the total soybean production of China has lagged behind. Meanwhile, demand for soybean in China

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_3,

rose drastically. Since 1996, China's soybean import gradually rose and reached over ten million tons in 2000, exceeding a quarter of the world's trade total of the year and China became the largest soybean importing country in the world. After this, China's soybean import broke over 20 million tons, 30 million tons, 40 million tons and 50 million tons thresholds respectively in 2003, 2007, 2009 and 2010. Ever since China's inclusion in the WTO, features manifested in three aspects in China's soybean market and trade which aroused generally shared anxiousness for the soybean industry of China among the people; firstly, soybean imports far exceeds domestic production and the domestic soybean industry had suspended in growth and the self-supply rate dropped drastically; secondly, multinationals took dominance in the soybean crushing industry in China and became a monopoly, forcing the national industrial capitals out of the market; and thirdly China has no power for pricing in the international soybean industry and is therefore restricted by others in international trade while interests are not protected. In this context, this paper aims to analyze the development trend of China's soybean market and trade since it's joining of the WTO, take a prospective look at the future development and to summarize challenges facing China's soybean industry and experiences of taking advantage of opportunities.

3.1 Soybean Production in China After Joining WTO

China has a soybean plantation history of thousands of years. Before 1930, China had always been the largest soybean production country in the world, with average annual production exceeding ten million tons, taking up 90 % of total soybean production of the world. However in 1960, China was replaced by the U.S. as the largest production country and was surpassed by Brazil and Argentine in 1974 and 1998, respectively. For over a decade's time since China joined the WTO, general soybean production in China had come to a standstill. In some years, there even showed dramatic declines. Currently, area of soybean plantation in China is around nine million acres; annual production reaches just around 15 million tons except for certain years such as 2007 and 2012 when the production was merely over 12 million tons. Different from the area of plantation and total production, unit production growth of soybean in China remained stable. Despite the climate impact over several years, unit production of soybean in China never exceeded the highest level in 2002 but remained around 1.8 ton per acre. Due to the ever increasingly complexity and fierce international competition and gap in the price competitiveness and quality competitiveness of domestically produced soybeans, soybean production has been under increasing pressure. Currently, there is a large gap between soybean production and the fast growing demand in China, leading to gradual decline of the self-supply rate of domestic soybean production.

Since joining the WTO, China's soybean production development has been influenced by the following factors; firstly, the continued implementation of state policies relating to soybean prices. In 2000, due to the further deepening of food

produce logistics system reform, the state made significant adjustments to policies for protective pricing of corn, wheat, rice and other major food produce. Some areas and produce exited the range of protective pricing. At the same time, the state implemented the "corn-soybean rotation scheme" and "northeast China soybean development project" etc. in the northeast regions and to a certain extent protected the motivation for soybean plantation among farmers. This is the reason why in the past several years, there has not been drastic decline of soybean production in China despite the severe international competition. Secondly, there is the factor of driving force of market demand. Along with improvement of living standards of urban and rural area residents, the livestock and aquaculture industries have been stimulated into stable development, driving significant growth in consumer demands for soybean in China. These factors promoted the adjustment of plantation structure in certain key production regions, resulting in basic stability of the soybean plantation area. Thirdly, there is the role of science and technology in the promotion of the industry. In recent years, the state increased investments in soybean production and scientific research. The Ministry of Agriculture implemented initiatives including the high-oil content and high-production soybean demonstration project and general soybean production capability technology improvement in the northeast regions. In addition, the model pilot initiative of delivering technology to rural households in the agricultural sector of China which commenced in 2005 also had model promotion of new soybean products and technologies included, which showed apparent promotional effects on the improvement of unit production of soybean in China.

It needs to be noted that despite the general stable development of soybean production in China since its joining of the WTO, compared to the three key production countries of the U.S., Brazil and Argentine, the development rate has been slow, leading to continued decline in status of China's soybean production in the world market. In terms of plantation area, though there has not been apparent decrease in absolute value of soybean plantation area in China, the percentage over the total plantation area of the world has dropped below 10 %, which is lower than ever before joining the WTO. On the other hand, along with the static growth of soybean production in China and even severe decline, the percentage of the world total also dropped from 9.1 % in 2002 to 8.2 % in 2005 and to 4.8 % in 2012. In addition, there is still a gap between unit production of soybean in China and the world level. In 2004, the average unit production of soybeans in the world was 2.2 tons per acre, with the U.S. reaching 2.8 tons per acre and Argentine and Brazil reaching 3.1 tons per acre, while China remained at 1.8 tons per acre, creating apparent gap. These figures show that joining the WTO has brought long-term implications and impact on the soybean production in China and effective strategies are needed to actively respond to it.

Table 3.1 Production and import and export of soybean of China

	Total volume (in 10,000 ton)			Soybean price (Yuan/tons)		
Year	Domestic production	Total import	Total export	Domestic market	International market	(Domestic – International)
2000	1,541	1,042	21.5	2,485	1,598	887
2001	1,541	1,394	26.2	2,405	1,490	915
2002	1,651	1,131	30.5	2,418	1,664	754
2003	1,539	2,074	29.5	2,857	1,995	862
2004	1,740	2,023	34.9	3,682	2,384	1,298
2005	1,635	2,659	41.3	3,359	1,921	1,438
2006	1,507	2,824	39.5	3,285	1,827	1,458
2007	1,273	3,082	47.5	3,821	2,408	1,413
2008	1,554	3,744	48.4	5,814	3,292	2,522
2009	1,498	4,255	35.6	4,431	2,753	1,678
2010	1,520	5,200	20	3,986	2,655	1,331
2011	1,510	5,234	20	4,049	2,758	1,945
2012	1,280	5,838	20	4,920	3,486	1,434

Data source: Report on China's Agricultural Development (preceding years) etc. (Ministry of Agriculture of the People's Republic of China 2004)

Note: Domestic soybean prices are the prices of medium quality yellow soybeans; international soybean prices are the No.1 yellow soybean prices converted at the medium exchange rate throughout the year

3.2 Soybean Trades in China Since Joining the WTO

Since joining the WTO, the most notable feature of soybean trade in China is that there has been drastic increase in the import of soybean and soybean oil. China has become the largest soybean and soybean oil importing country in the world. During this period, soybean has become the only agricultural produce which domestic production is less than imports and by year 2012, for a consecutive 10 years, the production had been lower than imports. As shown in Table 3.1, in 2012, China imported 58 million tons of soybeans, which is 5.6 times the 10.42 million tons in 2000, and 2.9 times the 20.23 million tons in 2004. Soybean imports to China over the total import of the world also increased from 28.6 % in 2001 to 40 % in 2004 and all the way up to 56 % in 2012, making China the largest soybean importing country in the world. In terms of the source of soybean imports, the paradigm of soybean import into China has also changed since it joined the WTO. There are two major sources of imported soybean, soybean oil and meal and other products; one being the U.S. in the North America (marketed in October every year, similar to China's market seasonality) and the other being Brazil and Argentine in South America (marketed in April every year, off-season compared to China). From 1996 to 1998, nearly 80 % of soybean imports to China were from the U.S., which showed a decline in the ensuing years. Currently soybean imports from the U.S. have dropped to only 40 % while the percentage of imports from Brazil and

Argentine rose to 60 %. After joining the WTO, there has been a shift in the source of imports of soybean and soybean oil to China from the U.S. to Brazil and Argentine, in actuality reflecting the changes in the paradigm of international soybean production and processing industry (Ke Bingsheng et al. 2002). In 2003, soybean production of South America exceeded that of the U.S. for the first time in history, putting an end to the U.S. absolute dominance in the international soybean market. At the same time, due to relatively higher crushing costs in the U.S. compared to Brazil and Argentine, the soybean crushing industry also moved gradually to South America regions. As a result, Brazil and Argentine in South America started to replace the U.S. as the key supplier of soybean and soybean oil to the international market.

China's soybean import and reliance on the international market rose drastically, which is most directly attributed to the difference in production costs and the significant difference between domestic and overseas soybean market prices. Starting from 2002, with China's official commitment to cancellation of tariff ration of soybean and adoption of single tariff administration, import soybean costs have become a key reference price for domestic soybean prices, greatly increasing the correlation between domestic soybean prices and international soybean prices. Generally the features are that domestic soybean prices are far higher than those in the international market with pricing difference showing gradual increase along the volatility. In 2008, domestic market price was 2,500 Yuan higher than that in the international market. In 2012, the price difference reached nearly 1,500 Yuan. As the most important soybean importing country, China's domestic and overseas soybean market prices are interrelated and inter-dependent while the impact of overseas soybean market on China's soybean market is greater than vice versa. China's soybean industry highly relies on the overseas market and there is significant influence and impact of international market prices on the domestic market. Volatility in international market prices mainly derives from climate factors in the three major production countries of U.S., Brazil and Argentine while China's soybean market prices fluctuate under the fluctuations of international market prices and domestic and international market prices are volatile along with the price levels. When soybean prices in both domestic and international markets rise, the price different between the two markets is expanded; on the other hand, when domestic and international market prices drop, price difference between the two markets diminishes. As shown in Chart 3.1, between 2002 to 2003, 2007 to 2008 and 2012 to 2013, mainly due to natural disasters, production dropped to different extents in the three key production countries of the world and international soybean prices rose; at the three high price points, price differences between domestic and international markets reached 1,298 Yuan, 2,522 Yuan and 1,945 Yuan respectively. This correlation between domestic and overseas soybean market prices shows the great reliance on the international market and the lack of pricing power, and that China is controlled by others in the international soybean trades. With any change to the supply and demand of soybean in the international market, the multinational groups and international hot money often took chance to speculate, pushing up costs of soybean materials in China (Ke Bingsheng 2003).

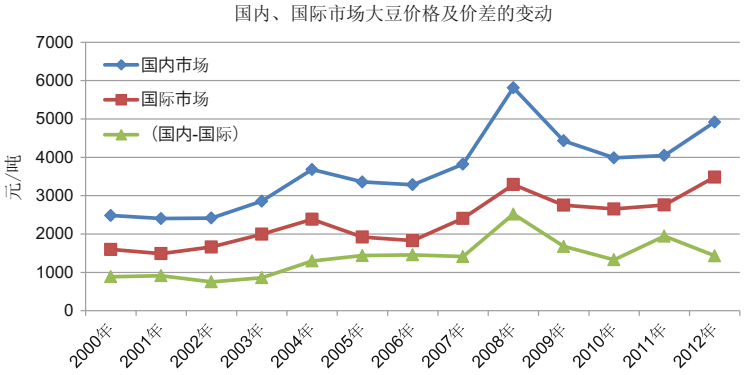

Chart 3.1 Changes in prices and price differentials of soybean in domestic and international markets

China's soybean imports and reliance on the international market have risen sharply. The fundamental reason lies in the lack of competitiveness of China's soybean industry and that the domestic production is unable to meet the fast growth of demand. Soybean is a typical land-intensive agricultural product. Soybeans in China are mainly planted in small scale by rural households. Compared to the key production countries of the U.S., Brazil and Argentine where production is from large scale farms, the costs are high, and consistency and stability of quality are hard to be guaranteed while production cannot increase significantly. Meanwhile, domestic demand for soybean has risen sharply. Firstly, there is a drastic increase in demand for soybean oil which cannot be met by domestic production. In recent years, with improvement of income and increase of catering consumption among people, demand for consumption of plant oil among rural and urban residents has increased dramatically. Compared to peanut oil and rapeseed oil, soybean and soybean oil are highly traded internationally and are of lower prices, therefore have become the key product to meet the fast growing consumer demands among urban and rural residents. This is an intrinsic driver for the fast growth of soybean and soybean oil consumption since China joined the WTO. Secondly, the fast development of the livestock industry has resulted in increased demand for soybean meals (Ke Bingsheng 2005). The improvement of income has also brought fast increase in consumption of meat, eggs and milk among urban and rural residents, especially consumption of dairy products, aquaculture products and poultry. As a main protein source for feeds, soybean meals are demanded increasingly along with the development of the aquaculture industry. Thirdly, there has been continued growth in the domestic soybean processing product market, with scales of the processing enterprises continuously expanding and demand for imported soybeans growing rapidly. Due to the drastic increase in demand for soybean oil and meals in China, the domestic soybean crushing industry is presented with an opportunity for expansion. Currently there are over 5,600 oil processing enterprises across the country, with total processing capacity reaching over 50 million tons. Among

them, large enterprises with daily processing capacity of over 1,000 tons have reached over 70 and there are 30 enterprises with over 2,000 tons of capacity. The domestic soybean crushing industry has entered a rapid expansion phase with processing capacity reaching far beyond domestic production capacity, making large quantity of imports a necessity.

3.3 Prospect of Soybean Production and Trade Development in China

Looking prospectively at the future period, in terms of China's soybean production, demand and import, a general judgment is that the demand for soybean in our country will continue to increase, the gap between supply and demand will continue to enlarge, imported quantity will further increase and there will be even fiercer competition in the soybean processing industry.

In terms of production, soybean production in our country is expected to maintain stable development. However, from the long-term perspective, it will be difficult to increase soybean production significantly by each year as the potential is limited, mainly due to that on one hand, after joining the WTO, our government has launched various policies aiding the soybean production, which will continue to be effective in the coming years and there is little possibility of a dramatic decline of motivation for soybean plantation among farmers and a drop in soybean plantation areas; on the other hand, affected by agricultural land, natural and climate conditions and comparative benefits of soybean, cotton and other food produce, the potential of great increase of soybean production in our country is very much limited. There is little wasteland to be reclaimed in the key production regions. There are also measures of retrieving from agricultural production to recover the forestry and protect the wetlands in our country. The possibility of increasing soybean plantation area by exploring wastelands is minor. Meanwhile, the plantation habits of farmers and the need of rotating plantations also restrict the expansion of soybean plantation areas. For instance, corn which are in direct competition with soybeans offer plantation benefits no less than those of soybean plantation. Therefore, it is not realistic to expect any significant increase in the production scale and the production of soybeans in our country.

In terms of demand, with population growth, changes in the urban and rural demographic structure and improvement of living standards of residents, the future demand for soybean will continue to increase driven by demand for plant oil and soybean meal consumption. Soybean consumption in China mainly includes the three major categories of soybean for processing and crushing, soybean for food and soybean meals. In the coming years, demand for crushing soybeans and soybean meals will continue to grow. On one hand, compared to developed countries and regions, plant oil consumption per capita in our country is still low, especially in the rural regions, consumption of plant oil is even lower. Therefore,

for soybean oil as a key plant oil product, there is huge potential for growth in demand. On the other hand, compared to the plantation industry, the livestock industry is less restrained by land resources and can fully utilize labor resources abundant in the rural areas and has become an advantageous industry under strengthened development in our country after China joined the WTO. In the coming 3–5 years, the livestock industry in China will continue to develop rapidly, implying stable increase in demand for soybean meals. Therefore, future demand for soybean oil and meals will continue to drive further increase in domestic soybean demand (Liu Hongman and Guo Xiangyu 2004).

In terms of trades, driven by the huge consumer demands domestically, our country will be under huge pressure to import soybeans for a long time. Domestic crushing enterprises choose to use imported genetically modified soybeans as raw materials mainly because there is a significant competitive advantage. There are many genetically modified soybeans products from the U.S., offering oil yield on average of 18.5 % while the figure for domestically produced soybeans is only 16.5 %. There is obvious benefit in using import soybeans as raw materials. Take the example of crushing enterprises in Guangzhou region, import soybeans are priced at 3850 Yuan per ton, the processing costs are 100 Yuan per ton and the oil yield is 18.5 % and meal yield is 78.5 %, price of grade four soybean oil is 8,900 Yuan per ton and for soybean meals it is 3,100 Yuan per ton. Profit yield of the oil plant is around 130 Yuan per ton. If they use domestically produced soybeans as raw materials, as the oil yield decreases by around 20 kg, the crushing earnings of 130 Yuan per ton will be eroded. Therefore, import soybeans will continue to cast severe impact on the domestic soybean industry and domestic soybean processing industry will continue to be under severe pressure throughout the industrial chain from plantation, production to sales.

3.4 Strategic Recommendations

The soybean industry is one with a very long industrial chain, involving many industries including production, oil and fat processing, food processing, aquaculture, medicine and fiber etc. There is a population of 100 million in China whose employment and living depend on the soybean industry, among whom are the nearly 60 million farmers and 1 million employees of the soybean processing enterprises. Giving up the soybean crushing industry would imply giving up huge economic interests and vast employment opportunities. Current development of soybean industry in China is obviously appropriate to the soybean consumption of China. Therefore in considerations for safeguarding the domestic supply and stabilizing domestic market, the state needs to further perfect the support system for the soybean industry and to promote healthy development of the soybean industry of China from three aspects of stabilizing plantation, industrialization of operations and utilizing the international market. On these grounds, the following recommendations are proposed in this paper:

1. Improve and implement soybean development plans and create sound conditions to promote soybean production. Specific measures include: further strengthening agricultural infrastructural development with water conservancy construction as core, enhance capability of resistance against natural disasters of soybean production and increase stability of soybean production; increase input in scientific research of soybean seeds, expand the scale and scope of subsidies for high quality seeds to create conditions for regionalized and economies of scale in plantation, as well as purchase, sales and logistics of production by products; greatly promote high quality and high productivity technologies of soybeans, achieve standardization in production and improve quality while increasing production of soybeans (Liu Lifeng 2005); fully take advantage and actively expand the functions of existing food produce and oil information organizations in China, perfect the statistical guidance and information services for the social sector soybean processing industry, and establish comprehensive, systematic and accurate soybean industry information reporting systems and release platforms.

2. Continue to launch favorable policies and improve conditions for purchase, sales and storage logistics of soybeans. Currently in the purchase, storage and logistics of domestically produced soybeans, there are problems of mixing products, small batch quantities and difficulty in meeting requirements of large crushing enterprises. Therefore, general measures should be taken to thoroughly resolve existing problems in the purchase and sales of domestically produced soybeans. Specifically such measures include: enhance enterprise business management standards and testing means to change the problem of mixed collection and storage of different products and to standardize and specialize in the purchase processes; attempt to enhance motivation of purchase and sales by products among enterprises by providing subsidies and building large produce storage stations; develop large purchase and sales enterprises to enhance capability of organizing produce sources of the distributors to meet requirements for supply of soybeans by the large crushing enterprises.

3. Promote technological advancement and increase own innovation capabilities of the soybean processing industry. Strengthen policy guidance and industry development guidelines; strictly control the blinded expansion of production capacity of soybean oil to avoid competition out of order. Increase investment in soybean processing technologies, strengthen scientific research and development and improve own innovative capabilities, promote industrial upgrading and promote the industrialization of traditional soybean product processing technologies; restructure and consolidate a number of food produce and oil processing machinery equipment manufacturers to achieve synergy to enhance enterprises' research and development capabilities and equipment manufacturing standards. Promote industrialization of traditional products, enhance overall utilization of soybean processing, extend industrial chain and increase product added values (Sun Lixin et al. 2003). Perfect the soybean processing product quality systems, clean production standard systems and testing and inspection systems development.

4. Establish a security protection mechanism for orderly importing of soybean. Scientifically estimate the total demand and self-supply level of soybean in our

country; establish soybean import quantity, price and quality security alarm mechanism to guide orderly import of soybeans. When the difference between soybean imports and expected demand is lower or higher than the crushing quantity of a month, the government may issue quantity alarm information via authoritative information organizations; when port wholesale prices of imported soybeans rises or drops in a single month by over 10 % or by 15 % in 2 months accumulatively, price alarm information should be issued; in case of severe quality and security problems of import soybeans, quality security alarm information should be issued along with adoption of testing and quarantine measures. Actively guide, coordinate, centrally plan, organize and arrange external procurements, gradually enhance international influence, improve price bargaining power and reduce procurement costs (Tang Yanli 2002).

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Chapter 4
Study on Rural Microcredit Risk Management and Micro-repayment Insurance

Ran Huo and Qiao Zhang

Abstract Chinese financial authority has been releasing the regulation and policies on rural microcredit in recent years, hence giving microcredit institutions more autonomy in developing their business. Consequently, risk management is becoming an increasing important issue in the establishment of rural financial system. This paper analyzed the risk management status quo of microcredit banks and their general difficulties. Based on that, we believe microcredit repayment insurance is an effective and operable means to conquer these difficulties. Furthermore, we put forward risk control principles and suggestions for the micro-repayment insurance.

Keywords Risk management • Microcredit repayment insurance

4.1 Introduction

Microcredit was born in Bangladesh 1970s, for the purpose of providing credit for unprivileged farmers in rural areas to help them escape poverty. But with the development of microfinance, people began to realize that microcredit is not only an effective means of rural poverty alleviation, but also a successful business model. For instance, the pioneer of rural microcredit-Grameen Bank has become the largest bank in Bangladesh with profit of tens of millions dollars p.a. (Wen Gao 2008). Nowadays, microcredit is widely acknowledged as a self-reliance or even profitable business operated according to business rules rather than just a means of poverty alleviation program supported by the governments or international NGOs. However, microcredit institutions' operation is quite different from traditional

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_4,

banks for they are confronted many difficulties traditional banks do not have. Thereby, microcredit institutions' risk management is an important issue and well worth studying, especially in China where the microcredit is experiencing the transformation from an unprofitable program into a business in recent years.

Rural microfinance was introduced in China 1993 as the official poverty relief program. After 30 years' development, microcredit has witnessed great changes. Especially after 2005, the central financial regulators have introduced a series of policies and measures to stimulate the development of rural finance, including establishing commercial microcredit pilots, lowering the microcredit entrance threshold, etc. In the past, microcredit institutions were operated mainly by governmental financial institutions and the loans were via discount-interest loans from governmental budget, but now the operators of microcredit are diversified: including Rural Credit Cooperatives (RCCs), Post Saving Bank of China (PSBC), and other new private institutions built after the polices of releasing regulation such as rural commercial banks and thousands of private microcredit companies all around China. There are also foreign microcredit companies entering Chinese rural financial market such as ACCION. Large expansion represents the booming of the industry but also implying risk management problems. Currently, microcredit institutions generally have the problems of low adequacy capital ratio and high bad debt rate which are jeopardizing the healthy development of microcredit institutions. Take rural commercial banks for instance, according to statistics at the end of 2009, China's rural commercial banks had non-performing loans (NPL) of 27 billion yuan (nearly $41.5billion), accounting for 2.76 % of all loans, meanwhile the NPL rates of the main commercial banks, urban commercial Banks, and foreign Banks were 1.59 %, 1.30 % and 0.85 %,[1] respectively.

As mentioned above, microcredit institutions are faced with unique risk characteristics and must explore their own risk management strategies distinct from other financial organizations. Before conducting risk management, the sources of risks must be identified. Information asymmetry has been regarded as the origin of risks of microcredit for a long time ever since the theory of information asymmetry was put forward (Akerlof 1970; Stiglitz and Weiss 1981). However, some recent studies break through the explanation conducted by the traditional theory (the theory of information asymmetry) and look for other risks causes of microcredit, such as, group loans increasing moral hazard, creditors pursuing loan quantity instead of quality because of small scale and low profit of a single loan business, etc., (Godquin 2004; Sharma and Zeller 1997). Other scholars add structural variables such as population, religious factors in the risk analysis (Al-Azzam Md et al. 2011). Chinese scholar Zhongming Zhou (2003) believes that China's rural microcredit risk is mainly caused by imperfect microcredit institution and system. Wenhui Pu (2009) suggests that part of reason of microcredit risk lies in the lack of effective credit system in rural areas. Zhuanfang Zhang (2003) divides risk causes into

[1] The statistics is according to "2009 commercial Banks non-performing loans situation table" released by China Banking Regulatory Commission (CBRC).

objective reason and subjective reason. He believes that subjective reason is mainly that the credit concept of farmers living in the remote areas is inadequate, and the objective reasons include frequent occurrence of natural disasters, market price fluctuations and inappropriate administrative interventions. In this paper, we suggest that there are two main objective reasons for rural microcredit risks. First is that agricultural industry is a high risk industry. Farmers are rather vulnerable in face of the shock of natural disasters and fierce market price fluctuations both of which happen quite frequently, thus, their incomes are unpredictable and unstable. Another reason is that farmers in China lack of collaterals, (lands and houses are not accepted as collaterals to obtain loans). These two reasons restrain financial organizations' incentives to offer loans to farmers and bring huge difficulties to risk management of microcredit.

At present, the studies of microfinance risk management focus on the sustainability of microfinance institutions, as well as inclusive rural financial system, etc. (Zhiming Zeng 2010). The so-called "sustainability" refers to that microfinance institutions has sufficient liquidity to meet the normal demand for loans and their revenue can cover the operating and capital costs; most importantly, microfinance institutions are able to defense the external risks' shock, which is represented, to a large extent, by meeting regulatory requirements, such as capital adequacy ratio, bad debt reserve ratio and so forth. To strengthen microfinance risk management and financial sustainable ability, Chinese and foreign scholars have put forward various suggestions. Some studies propose supervision indicators according to the characteristics of the microcredit institutions, such as PAR (portfolio at risk), RCR (risk coverage ratio) (Ahlin et al. 2011; Mersland and Strom 2010; Gonzalez 2007). Some studies design risk management model to evaluate the operation efficiency of the rural microcredit institutions, such as the scorecard system (Simbaqueba et al. 2011). Fernando (2002) proposes to refer to other kinds of small scale loans (consumer loans) risk management principles as the principles to manage risks of microcredit, such as ASA (Cost-effective and Sustainable Microfinance Model). Yong Nie (2009) sets up the performance evaluation system of the rural microcredit based on the analytic hierarchy process (AHP) to assess comprehensive performance of rural microcredit. However, these methods all focus on the internal management and control of microcredit institutions. However, we believe, although extremely crucial, internal risk control is not enough to strengthen the microcredit institutions' risk management and sustainability, and other kinds of model innovations from external parts are also required.

In recent years, agricultural insurance industry become booming in China, not only policy-based insurance, but also private insurance business. Some new innovative business models like combination of microcredit and insurance come up in the countryside. These models integrate microcredit and insurance, which means farmers, as the policy holders, can use the policies as collateral to get loans from microcredit institutions, and when the risk events happen, microcredit institutions claim the indemnity as the beneficiary. Now, there are various types of microcredit-insurance products in the market, such as microcredit-life insurance, microcredit-property insurance and so on. In 2008, a new model-microcredit repayment

insurance began to pilot in some areas of China. Although the new model is still being explored and needs further improvement, it has shown tremendous prospect. Though analyzing the risk management status quo of microcredit institutions and the general difficulties they are faced, we suggest that microcredit-repayment insurance is an effective and operable model to conquer these difficulties. Furthermore, we put forward risk control principles and suggestions for the companies running microcredit-repayment insurance.

4.2 Rural Microcredit Risk Analysis

Since its introduction in China in 1990s, rural microcredit has made great achievements in the past two decades; however, it is still far from satisfying the farmers demand for small credit loan (Daguang Yang and Chen 2010). According to statistics released by CBRC, The huge gap between the supply and demand can be largely explained by the risk management difficulties faced by the microcredit institutions. The microcredit institutions, like other financial institutions, are facing various kinds of risks, such as credit risk, liquidity risk, price risk, law risk, operation risk and strategic risk, In this paper, we summarized these risks into the following three categories: financial risk, operation risk and strategic risk (as shown in Fig. 4.1).

At present, the most common and serious risks that the microcredit institutions desperately need to mitigate are credit risk, transaction risk and fraud risk. Through further analyzing these three risks, we can know the difficulties of risk management are mainly due to the following reasons.

1. High risk of agricultural industry causes high credit risk

Because agricultural output depends on the growth of plants and animals and heavily relay on natural environment, which is the nature of agricultural industry, this nature determines that agriculture is a high-risk industry. Moreover, agricultural producers are generally threatened by both natural disaster risk and economic risks (such as market variables). Farmers are very vulnerable to the shock of high frequency natural disasters occurrence and violent market price fluctuations which seem to be alternative-when natural disaster occurs, the decrease of production elevates the price and vice versa, the harvest and excessive supply may hold down the price, therefore their income are unstable and unpredictable. In order to reproduce after the destructive impact of risk events on production and income, agricultural producers have pressing needs for loans, but conversely, the high risks of agricultural production impede farmers to obtain loans from financial institutions. Even though the borrowers have willingness to repay, they have to default without risk indemnity means. So, the high-frequency of natural disasters occurrence and fierce price fluctuations cause the high credit risk of rural microcredit. It can also be seen that a perfect agricultural financial system which requires the participation of multilateral financial institutions' participation and cooperation, like insurance

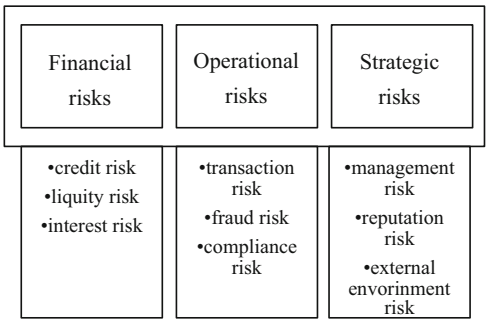

Fig. 4.1 Microcredit risk categories

agencies, in particular, as a professional risk management institutions. Agricultural producers need agricultural insurance to ensure agricultural production revenue or ease the revenue fluctuations, then, it can be relatively easier for the agricultural producers to get loans from microcredit institutions to maintain the sustainable production.

2. Difficulties in background investigation cause high cost and risk of transactions

Originally, microcredit aims to offer loans to the unprivileged farmers in remote countryside to help them get out of poverty. The objective of microcredit determines that each rural microcredit is very small scale, and the debtors are mainly geographic dispersedly in remote rural areas. Therefore, investigating the loans qualification cost the microcredit institutions more effort and time than other types of credit institutions, but single loan proceeds are relatively limited because of the small scale, so the cost-benefit ratio of microcredit is significantly higher than that of credit institutions. On the other hand, compared with employees of other financial institutions, the employees of microcredit institutions need more professional trainings to service the customers. The lack of professionals of microcredit brings problems of substandard loans which increases high transaction risk. Faced by these difficulties, microcredit institutions desperately need effective investigation system or model to realize large-scale standardized produces to offer loans in order to reduce the cost and risk of transaction.

3. Loan applicants lacking collaterals

For many unprivileged and low-income families, a small sum of loan may make a big difference to their life (Zheqing Yuan 2008) and help them start off a profitable career. Although very poor, farmers do have the potential ability to repay the loan and they are creditworthy. This point has been proved both in Bangladesh and in China (Jingfu Wang 2002). However, from creditor's angle, it is too risky to lend money to someone who has no property as collaterals, even though the potential debtor is creditworthy. In China, because of policy reasons, the farmland and rural housing property cannot be the collaterals accepted by microcredit institutions to offer loans, and it causes large amount effective demand of loans cannot be satisfied. Thus, the lack of collaterals greatly constrains the

supply of loans from microcredit institutions. On the contrary, if farmers can have something as collaterals, they can obtain loans meanwhile the creditors risk pressure can be largely reduced.

According to the analysis on the risks and difficulties of microcredit, we can see that there is a huge gap between the debtors' conditions and creditors' requirement. On one hand, the microcredit institutions need effective investigation model to reduce their transaction costs and acceptable collaterals to reduce the credit risks. On the other hand, the farmers need the third part to enhance their credit when applying loans from microcredit institutions. Microcredit repayment insurance, however, as a financial innovation can bridge the gap between the debtors' conditions and creditors' requirement, because insurance policies can be collaterals.

4.3 Micro-repayment Insurance in China

In recent years, new insurances began to introduce in rural areas to defend against credit risk of microcredit. These insurance products closely combine with microcredit, so they are called bank-insurance cooperation mode. Essentially farmers buy the credit-insurance cooperation products (insurance products) and use the policies as collaterals to apply loans from microfinance institutions. When the risk accidents happen, the insurance company is responsible to pay the indemnity, allowing farmers to repay the loans. In fact, in most of these insurances, microcredit lenders are the beneficiary. This new credit-insurance mode changes the original credit-debtor relationship which merely relies on the farmers' credit to repay loans. These bank-insurance cooperation products include life insurance-microcredit, AD&D insurance-microcredit, property insurance-microcredit (for instance vegetable greenhouse insurance), and most recently micro-repayment insurance.

For microcredit institutions, credit-insurance mode can effectively reduce the default risk and transaction cost, and save part of risk management cost. For farmers (policy-holders), credit-insurance products not only enhance their credit level to help them obtain loans, but also make their life or property guaranteed by insurance, improving their ability to resist risks. For insurance companies, the credit-insurance products help them open the rural market. Farmers, because of relatively low level of income, are still outliers of insurance. It is very difficult for non-agricultural insurance companies to directly enter the rural market; however, through the medium of microcredit, insurance companies can rapidly expand their products in rural market. For the construction of inclusive financial system, rural credit-insurance model, as a critical financial innovation, contributes the goal of poverty alleviation.

Microcredit repayment insurance (hereafter be shorted for micro-repayment insurance) is a kind of third part insurance, that is, insurance company undertake the unintentional defraud risk of debtors who apply microcredit and when the risk event happens, the insurance company repay the loan for the debtors. Insurance

companies, as a professional risk management organization, take part in microfinance and bridges the farmers and microcredit institution. On one hand, micro-repayment insurance helps farmers who have no collaterals obtain loans from the microcredit institutions at a lower interest rate. On the other hand, insurance company can uses its professional risk management techniques and institutional arrangements (such as reserve system and diversifying risk tools) to help microcredit institutions reduce default risk, ease the pressure on the microcredit's risk management, decrease the investigation cost of microcredit in issuing microcredit, and mitigate impact of risk events on microcredit institutions.

Rural microcredit repayment insurance is a new kind of insurance product, coming out in recent years in China, but around the world it is quite uncommon. In 2008 Anxin Agricultural Insurance Cooperation in Shanghai and Shanghai Rural Commercial Bank jointly introduced the micro-repayment insurance product for farmers' professional co-operatives loans, which is the first program of rural microcredit insurance. In 2009, People Insurance Company of China (PICC) cooperating with local Banks in Foshan (Guangzhou province) and Ningbo (Zhejiang province), launched micro-repayment insurance products. In 2011, micro-repayment insurance businesses also come out in Wenzhou (Zhejiang) and Chongqing, but these products focus on urban microcredit for small and medium enterprises.

4.4 Suggestions on Micro-repayment Insurance Risk Control Principles

Rural micro-repayment insurance belongs to high-risk insurance whose occurrence of risk events does not follow the law of large number, as the risks have high spatial correlation, like agricultural risks. Thereby, prudent risk management is critical for micro-repayment insurance. Although there have been some pilots of micro-repayment insurance, the practice of this financial innovation is far from perfection, and the research is also insufficient on this field. According to the characteristics of the micro-repayment insurance, we put forward the following management principles:

1. Individual risk control principle

As mentioned above, because the occurrence of micro-credit defraud risks does not follow the law of large number, and the risks high spatial correlation, each loan must be capped in order to avoid the excessive concentration of individual risks. Also, the insurance companies need to conduct prudently investigate the background of applicants and monitoring the use of the loans. There are many ways for insurance companies to obtain the information from cooperation system with local banks, RCCs, farmers' co-operatives and so forth. Moreover, the insurance company can use the professional advantages through a variety of ways (like reserve system and reinsurance) to diversify ensured risk.

2. Risk-sharing principle

In order to reduce the moral risks of micro-credit institutions, insurance companies need to establish risk-sharing mechanism with lending institutions. When the risk event happens, the microcredit institutions must undertake part share of the loss, rather than letting the insurance companies bear all the repayment. In this way, microcredit institutions have stimulation to conduct due risk management. In practice, some micro-repayment insurances have risk-sharing mechanism, for instance, the ratio is 7:3, i.e. the insurance company only bears 70 % of repayment for the defraud loans. Even though risk sharing principle is indispensable, the specific sharing ratio can flexibly and dynamically adjust according to the actual circumstances of the debtors to realize the optimal risk sharing between the lending institutions and insurance companies, for instance, when the debtors repay the loans timely after 1 or 2 years, the insurance company can bear higher proposition of the defraud risks. In addition, both microcredit institutions and insurance companies need to strengthen cooperation and information sharing, such as information on customers' background, credit decisions, delinquent loans, and so forth.

3. Stop-loss principle

As mentioned above, rural microcredit insurance has systemic risk characteristics, i.e. there is probability to occurrence large scale of risks, and therefore, the insurance company must set stop-loss mechanism to lock in the maximal liability. These mechanisms include capped indemnity, nonperforming loan ratio stop mechanisms, and so on. These mechanisms restrict the loss caused by the macroeconomic volatility and the shock of natural catastrophes within the affordability of the insurance companies.

Micro-repayment insurance has made remarkable achievements in practice, but in order to provide more convenient financing channel for farmers, at the same time, improve the efficient and sustainable risk management for microcredit institutions, micro-repayment insurance needs to further improvement and perfection. In addition to the above principles, we have other suggestions on micro-repayment insurance risk management. First, the insurance institutions need to establish long-term rural household credit database, and weed out the unqualified applicants, and moderately reduced insurance premiums for creditworthy policy-holders, etc. This is not only helpful to reduce their operating costs, but also necessary to establish a good credit environment in service area. Insurance companies also can consider cooperating with the local bank, rural credit cooperatives, farmer's co-operatives and local governments to dig the policy-holders' multi-azimuth information. Second, conducting background checking and qualification of debtors requires insurance professional personnel, thus, the insurance companies need pay attention to staff trainings and institution construction. Third, in order to quantify the risk, insurance companies can design some specific rating indicators to conduct real-time monitoring. We believe that micro-repayment insurance, as an assistant for microcredit, has great potential to help more farmers to solve the credit difficulties in the future and contribute to the establishment of the inclusive financial system.

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Chapter 5
The Analysis of *Laminaria japonica* Industry and International Trade Situation in China

Hao Yue, Yingze Sun, Hu Jing, Shouying Zeng, and Haiying Ouyang

Abstract *Laminaria japonica* is an important commercial algae in China. It occupies a significant position in China fishery industry. The export of *Laminaria japonica* from China has covered 88 countries and regions. In this study, we analysed the global production and trade situation of *Laminaria japonica*. We also systemized the trade data of *Laminaria japonica* from 2006 to 2011 in China and inductively analysed the *Laminaria japonica* culture situation including production, import & export pattern, etc. The suggestions on the development of *Laminaria japonica* trade are also provided in this research.

Keywords *Laminaria japonica* • Culture • Import & Export • Statistical data • Trade

Laminaria japonica, also called "Kun Bu", "Sha Bu", "Sha Baicai", is a perennating macro-algae. The leaves of *Laminaria japonica* are banded, the length can be 2–4 m (maximum length is 6 m); the width can be 20–35 cm (maximum width is 55 cm). The middle part of leaves is thicker and the stalk (4–6 cm long) is always cylindrical. The sporohore of *Laminaria japonica* is composed of leave, stalk and holdfast. The holdfast consists of multiple double branched cylindrical fake root which has sucker in the end. *Laminaria japonica* is cold-water and sessile living algae and accustomed in water-flow and clear marine area.

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_5,

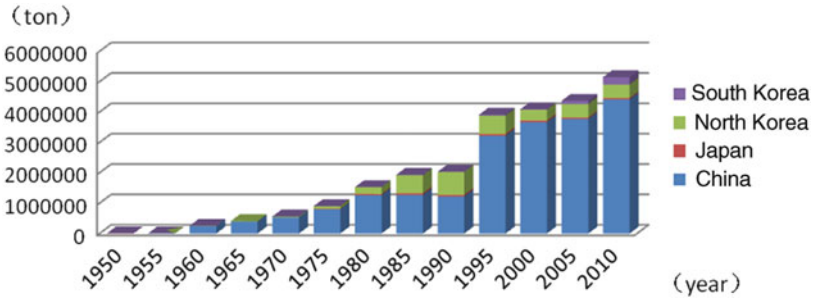

Fig. 5.1 Global yield in recent 60 years

5.1 The Current Situation of *Laminaria japonica* Industry in the World

Laminaria japonica is native to Japan. It distributed naturally in the north part of Japan, Hokkaido and south marine area of Thousand islands in Russia. *Laminaria japonica* is an endemic species in cold temperature zone in west part of North Pacific.

5.1.1 The Global Culture Area and Yield of Laminaria japonica

According to the statistical data from FAO, the yield of *Laminaria japonica* in the world has been increased for a few years. The rapid growth of *Laminaria japonica* industry mainly focus on Asia, especially China. The annual yield of *Laminaria japonica* in America and Europe is less than 100 tons (Fig. 5.1).[1]

The production of *Laminaria japonica* is mainly from Asia. The culture areas are Japan, North Korea, South Korea and China. Among of these countries, the yield from China accounts for 85 % of global production and 83–87 % global production in the recent 10 years (Fig. 5.2).

Table 5.1 shows the changes of Laminaria japonica yield in main breeding countries from 1950. The trend of yield change in China accords with the rapid development of Laminaria japonica culture industry owing to the technology break through (Chang 2012).

[1] Fund: the public welfare industry (agriculture) special research project "Economic seaweed seed industry technology research and demonstration" (200903030).

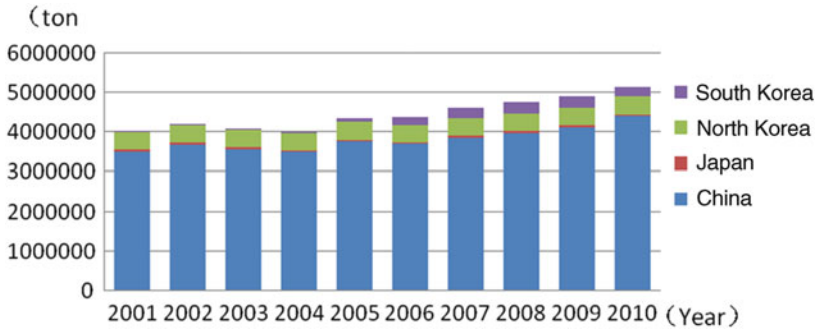

Fig. 5.2 Global yield in recent 10 years

5.2 The *Laminaria japonica* Industry in China

5.2.1 Main Culture Areas and Yield

Laminaria japonica growing naturally was found in Dalian Siergou in 1927. It has been proved to be introduced by the merchant ship on woods from Hokkaido to Dalian (Wang et al. 1997). For now, *Laminaria japonica* in China distributes naturally in Shandong and Dalian coastal area.

The cultivation of *Laminaria japonica* begins 1950s. *Laminaria japonica* culture has been the most successful example of aquaculture with the support of biotechnology after the breakthrough of summer seeds technology, cultivation in south part of China, cutting growth and explanation of genetic regularity. *Laminaria japonica* has been crucial species in marine aquaculture for many years (Pang 2011).

The cultivation of *Laminaria japonica* mainly concentrate on Liaoning, Shandong, Jiangsu, Zhejiang and Fujian coastal area, also Hebei and Guangdong. Table 5.2 shows provincial yield and the sum yield of Liaoning, Shandong and Fujian almost equals the national yield in China. For example, the percentage of above three provinces in the whole yield in 2011 is 22.2, 52.3 and 23.7 %, the sum of percentage is 98.2 % (Fig. 5.3).

The above figures and tables show that the culture of *Laminaria japonica* in China developed rapidly owing to the achievements on culture type and superior species breeding by fishery scientists (Jin 2009). The fact that the yield is decided by *Laminaria japonica* germplasm and culture technique has been proved in the yield in China.

Table 5.1 Global *Laminaria japonica* yield from 1950 to 2010 by country (ton)

	1950	**1951**	**1952**	**1953**	**1954**	**1955**	**1956**	**1957**	**1958**	**1959**
China	0	0	328	688	1,529	3,167	3,356	12,981	37,521	145,680
Japan	4,717	3,000	2,000	2,000	2,000	2,000	2,200	1,000	1,000	1,500
North Korea	621	756	920	1,119	1,362	1,658	2,018	2,456	2,989	3,637
South Korea	0	0	0	0	0	0	0	0	0	0
	1960	**1961**	**1962**	**1963**	**1964**	**1965**	**1966**	**1967**	**1968**	**1969**
China	250,000	250,000	250,000	300,000	400,000	400,000	500,000	500,000	500,000	600,000
Japan	1,000	800	1,500	600	600	600	800	700	500	500
North Korea	4,426	5,387	6,556	7,979	9,710	11,818	14,382	17,503	21,302	25,924
South Korea	0	0	0	0	0	0	0	0	0	0
	1970	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
China	529,800	669,800	793,700	668,700	723,535	799,705	752,130	1,111,055	1,257,060	1,200,685
Japan	284	665	3,340	7,681	10,201	15,759	22,087	27,249	21,890	25,291
North Korea	31,550	38,397	46,730	56,871	69,213	84,233	102,512	124,759	151,834	184,783
South Korea	0	0	0	0	2,334	2,758	8,342	2,122	5,516	5,192
	1980	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**
China	1,264,535	1,097,590	1,094,790	1,156,480	1,253,305	1,269,195	1,017,185	894,500	1,082,075	1,364,565
Japan	38,562	44,221	42,980	44,345	62,756	53,593	54,143	49,582	59,696	64,383
North Korea	224,884	273,687	333,081	405,364	500,000	600,000	700,000	914,000	919,000	1,024,000
South Korea	940	1,963	3,987	11,606	7,927	11,796	9,445	9,980	11,612	2,617
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
China	1,221,530	1,783,300	2,470,645	3,009,135	3,169,505	3,222,230	3,719,230	3,685,936	3,591,825	3,982,646
Japan	54,297	42,619	72,924	59,966	57,757	55,056	61,121	60,103	50,123	48,251
North Korea	750,000	800,000	943,000	973,000	667,349	604,371	635,579	375,577	370,000	370,000
South Korea	8,084	8,938	9,560	17,180	30,421	27,295	35,640	33,466	7,931	25,447
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
China	3,663,403	3,503,586	3,687,744	3,583,939	3,504,761	3,773,631	3,704,291	3,877,355	3,988,755	4,139,825
Japan	53,846	63,200	51,128	50,978	47,256	44,489	41,339	41,356	46,937	40,397
North Korea	360,000	444,295	444,295	444,295	444,295	444,295	444,300	444,300	444,300	444,300
South Korea	14,160	17,506	24,873	25,259	22,510	108,327	201,919	250,049	285,221	306,183
2010										
China	4,418,010									
Japan	43,251									
North Korea	444,300									
South Korea	241,322									

Data resource: Database of Fao Figis

Table 5.2 The yield of *Laminaria japonica* from 1960 to 2011 in China (ton)

Year	Hebei	Liaoning	Jiangsu	Zhengjiang	Fujian	Shandong	Guangdong	Guangxi	Sum
1960	72	18,605	210	3,120	9,091	18,294			49,392
1970		21,787	2,896	11,652	9,800	42,159			88,294
1980		66,078	11,935	15,021	28,115	131,756	2		252,907
1990		48,205	1,442	4,706	63,159	126,794			244,306
2000		189,577	317	11,541	276,867	352,108			830,410
2001		168,478	184	9,520	296,172	323,376			797,730
2002		193,633	390	8,473	328,828	310,127		89	841,540
2003		165,708	172	8,442	338,795	305,044	607		818,768
2004		172,114	209	9,529	350,161	268,468	647		801,128
2005		181,275	142	9,663	375,277	295,552	920		862,829
2006		170,976	204	8,543	388,151	277,866	1,472		847,212
2007		138,118	1,692	6,782	371,930	255,747	1,202		775,471
2008		135,577	3,263	5,452	419,028	233,148	1,283		797,751
2009		138,812	5,980	12,246	431,631	236,335	2,961		827,965
2010	250	173,049	3,926	10,367	452,096	240,896	3,018		883,602
2011		201,808	1,665	11,319	474,825	215,510	3,094		908,221

Data resource: Yearbook of China Fishery Statistics from 1949 to 1978

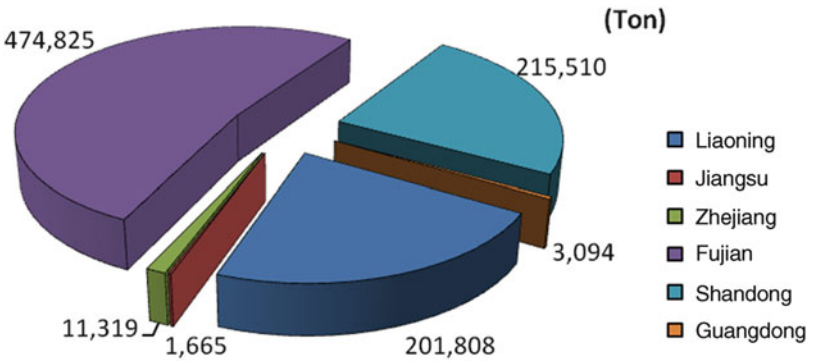

Fig. 5.3 *Laminaria japonica* yield and percentage in 2011 in China

5.2.2 *The Development Situation of* Laminaria japonica *Processing Industry*

In present, *Laminaria japonica* processing products are traditional salted kelp, kelp knot, kelp roll and shredded kelp. The reprocessing products are scarce. The extraction of bioactivator mainly focus on polysaccharide, iodine, dietary fibre, alginic acid and mannitol. It is a great loss and the limitation for the wilder use and conversion that people did not get the full advantage of *Laminaria japonica* resource (Cheng 2011).

With the permission from department of ocean and fishery in Shandong Province, the lowest price of light dry kelp is 4.6 RMB/kg in 2011, which improved 0.4 RMB compared with the price in 2010. In recent years, the price of algae chemical products such as gum, iodine and mannitol improved rapidly. The export price of pure sodium alginate rose 3,000–3,500 $/t. The amplication is upto 17 % (Teng 2012)

The price of traditional products like kelp knot and kelp roll in 2012 ranges from 4,000 to 20,000 RMB. The profit of factory is very low. For example, Qingyutan Algae Processing Factory in Rongcheng City has processed 7,200 t kelp but the profit is only more than one million RMB. The profit will be continuously decreasing with the increasement of product costs without doubt.

Another successful example is Kaipu Biology Company located in Rongcheng City. This company cooperated with Yellow Sea Fishery Institute of Chinese Academy of Fishery Sciences and expanded the products to the high value-added products such as sodium alginate, iodine and mannitol. The products value has been upto two billion RMB.

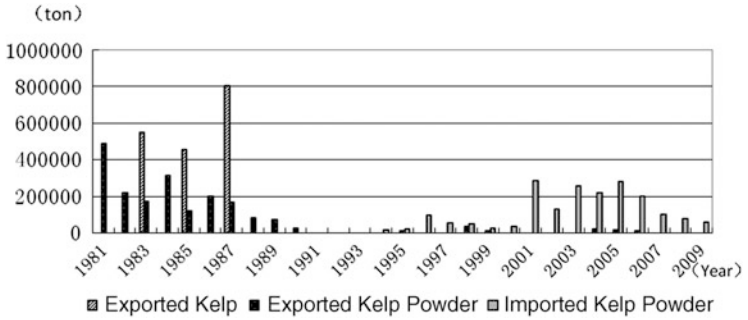

Fig. 5.4 *Laminaria japonica* trade in Korea

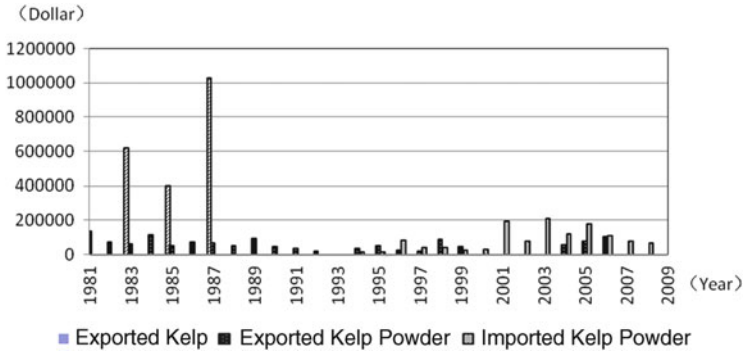

Fig. 5.5 Trade value of *Laminaria japonica* in Korea

5.3 *Laminaria japonica* Trade and Value

5.3.1 Laminaria japonica *Trade in Korea*

The trade of *Laminaria japonica* in Korea started from 1980s is export-based. The export amount decreased from 1990s and the import amount increased after 2000.

The amount of exported kelp powder maintains 10×10^4 t, even more than 20×10^4 t (Fig. 5.4).

The international trade of imported kelp powder mainly focused on import & export trade. The transaction of imported kelp powder reached to 10×10^4RMB but the exportation is less (Fig. 5.5).

Although the import exceeds export for kelp powder, the unit price of export is much higher than import after comparison the average deal unite price after 2000 (Fig. 5.6).

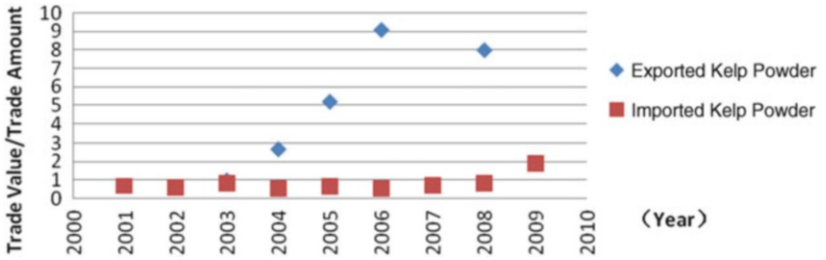

Fig. 5.6 Trade average unit price of *Laminaria japonica* in Korea

5.3.2 *The Import & Export Trade of* Laminaria japonica *in China*

According to the statistical information from customs, the trade of *Laminaria japonica* in China has been divided in to "fresh kelp", "Kelp(Including cold, frozen or dry)", "salted kelp" and "miso kelp". On the basis of statistical results from customs, the import & export *Laminaria japonica* in China is mainly "Kelp(Including cold, frozen or dry)". The export of "salted kelp" increased after 2009. Table 5.3 shows the international trade of *Laminaria japonica* in China.

The trade of *Laminaria japonica* in China primarily export and the amount of export can be upto 1.5×10^4 t per year. The value of export maintains 2×10^7~4×10^7 $ with the slow growth. The amount of export is 2×10^4 t and the value of export is 6×10^7 $ (Fig. 5.7).

The export of salted kelp jumps in 2011 may leads to the increasement of export value.

The export of *Laminaria japonica* in China covers 88 countries and regions, especially the exports in Japan, Taiwan and Russia which accounts for 77–87 % in all past export amount and 80–90 % in all past export value (Fig. 5.8).

The amount and value of import of *Laminaria japonica* in China maintains 500 t and 10×10^5 $. The amount of import is 1,200 t and the value of import is 1.5×10^5 $ (Fig. 5.9).

The target country of *Laminaria japonica* trade in China is steady. The import amount from Japan accounts for 90 % of yearly import amount during 2006–2010. The import in 2011 is from Japan and Peru. Although the percentages of import value for Japan and Peru are 42 and 48 %, the percentages of import amount are 5 and 77 %. The price of *Laminaria japonica* from Japan is 14 times from Peru.

Table 5.3 Trade of *Laminaria japonica* in China

Product	Category	2006	2007	2008	2009	2010	2011
Kelp	Export amount (ton)	16,296.47	14,851.63	16,532.97	12,861.39	12,902.03	10,019.48
	Export value (10,000 dollar)	2,234.806	2,356.18	3,266.648	2,754.156	2,833.98	2,967.027
	Import amount (ton)	232.294	256.892	240.819	267.195	198.209	983.567
	Import value (10,000 dollar)	79.99	80.288	54.801	67.295	65.53	131.966
Salted Kelp	Export amount (ton)				2,472.785	3,796.496	9,328.849
	Export value (10,000 dollar)				300.291	767.77	3,101.975
	Import amount (ton)				111.381	287.951	210.696
	Import value (10,000 dollar)				11.442	38.13	13.153

Data resource: Yearbook of China Aquatic Products Trade Statistics from 2006 to 2011

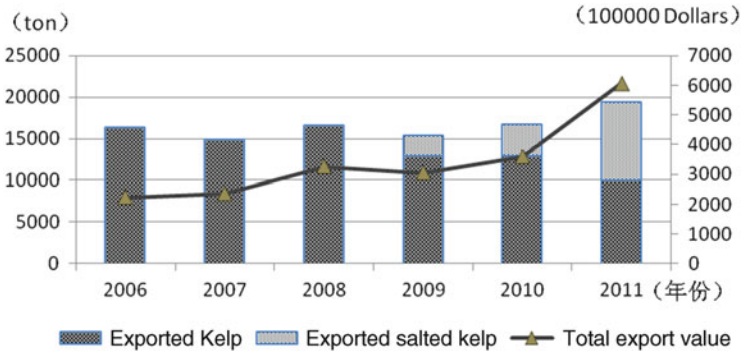

Fig. 5.7 Export amount and value of *Laminaria japonica* in China

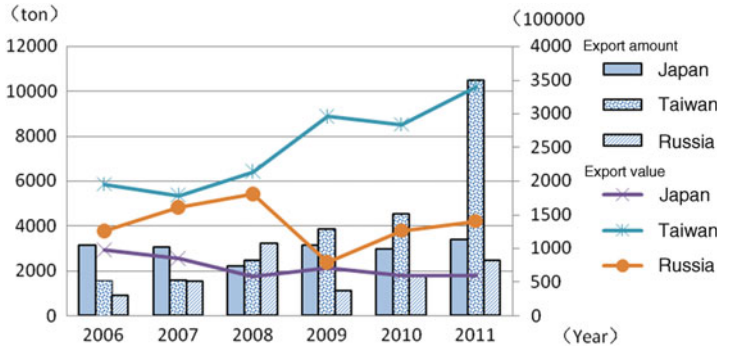

Fig. 5.8 Trade on export of *Laminaria japonica*

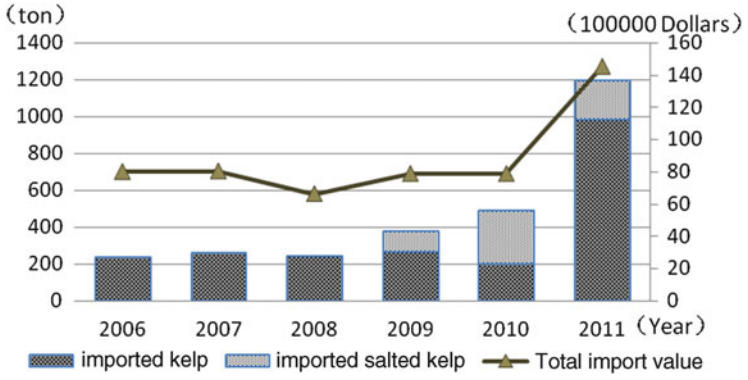

Fig. 5.9 Import amount and value of *Laminaria japonica* in China

5.4 The Thought on International Development of *Laminaria japonica* Trade

5.4.1 *The Current Situation of* Laminaria japonica *Industry Abroad*

Many fishery-developed countries such as Japan, America, Britain, Canada and Norway, has developed several kelp foods. Especially in Japan, the technology on kelp foods processing ranks high in the world, either types or amount (Cheng 2011).

Algae Processing Industry: There are more than 4,000 factories of algae foods processing in Japan which can produce more than 200 types of algae foods and consume 3×10^5t dry algae. The dominant foods in Japan are algae capsule, algae tea, algae drinks, algae wines, algae tofu, algae candy, algae cake, algae bread, algae noodle, algae salad and algae can, which can satisfy all the needs. The mixed natural condiment from kelp juice and skipjack juice can be used as condiment for Japanese noodle and other foods (Teng 2012).

5.4.2 *The Suggestion on* Laminaria japonica *Industry in China*

5.4.2.1 Sustainable Science Investment on *Laminaria japonica* Breeding

The modern ocean agriculture is facing the crucial period from "Scale and Yield Type" to "Quality and Benefit Type". The development potential of *Laminaria japonica* is very huge. However, the lack of improved variety cannot satisfy the need of multi-type aquaculture and the expanding space. The contraction of traditional aquaculture area and the decreasing productivity limit *Laminaria japonica* cultivation capacity (Zhang 2011). The enhancement of modern genetic improvement, the increasement of efficiency and quality of improved variety breeding, the acceleration of the speed of blue seed industry and the improvement of the ability of healthy and high-producing improved variety will lead modern oceanic agriculture development to success and be important security of improvement of production ability (Liu 2011).

5.4.2.2 The Research on High Value-Added Product

Processing and utilization: More than 50 % in *Laminaria japonica* products are used as edible vegetable and 40 % are used as chemical materials. In the whole production, the processing rate for edible vegetable is only 30 % and the primary product of alginate can be upto 90 % (Liu 2011).

The characters of food are quick and convenient except safety and nutrition with the improvement of life level and pace of life. The products of *Laminaria japonica* which meets the above needs can be divided in to two types: one is convenient food and meal for family and individual; the other one is mass food for restaurants and cafeterias. The products like this will play important role in the restaurants and families (Teng 2012).

The export products of *Laminaria japonica* in China should develop finish machining, deep processing and enhance the technological content of science and value-added comparison with the situation in foreign countries. Under the circumstance of huge export amount, we should changing the export pattern of *Laminaria japonica* and increase trade value through high value-added products

5.4.2.3 Develop Market by Multiple Methods

Laminaria japonica is a nourishing edible brown algae and has more than 60 nutritional ingredients, also alginic acid, cellulose, mannitol and many microelements. *Laminaria japonica* contains rich, plenty mineral, moderate protein and low calorie. *Laminaria japonica* is an ideal natural oceanic food.

Laminaria japonica has a lot of healthcare functions, such as promoting intelligence, prevention and treatment of thyromegaly, reducing blood pressure and blood fat, protection from radioactive material, caring skin and hair, immunoregulation and anticancer. Many countries value the research on the health function of *Laminaria japonica*, especially on polysaccharide, iodine and dietary fibre (Wang 2008).

We also suggest to cultivate market, strengthen advocation and expand products types. Even though the number of export targets countries has been upto 88, there are still new markets to be found. People should learn more about *Laminaria japonica* products by means of different methods and increase the export amount in one country. Then the more widen market will be open.

5.4.2.4 Protection of Intellectual Property and Brand Management

The enterprise must consider more about international brand management if it plans to develop well in the world. The enterprise also need to know the protection of intellectual property and win the initiative. But most of companies in China lack of legal awareness and professionals.

Laminaria japonica industry has huge potential on trade value in spite of being a small industry for now. Main countries on *Laminaria japonica* production in the world according to FAO-FIGIS are China, Japan, North Korea and South Korea. The export of *Laminaria japonica* has covered many countries and regions. China should be dominant country as the greatest product of *Laminaria japonica* in the world.

Besides strengthening product research and brand management, the enterprise should improve the protection and awareness of intellectual property at the same time. These methods will develop new space to grow for the international trade of *Laminaria japonica*.

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Chapter 6
China's Current Development Status and Prospect of Foxtail Millet Trade and Industry

Meng Liu, Fei Liu, Yu Zhao, Shunguo Li, and Huijun Wang

Abstract Foxtail millet originated from China, grown in China, India, Eastern Europe, and Western Asia, the main food crop in the world's arid and semi-arid areas. This article tells China's foxtail millet trade and current foxtail millet industry development status. It tells China's current foxtail millet industry status from the aspects of production, circulation, processing, and scientific research based on statistical analysis of the related data from FAO, the China Chamber of Commerce for Import & Export of Foodstuffs, Native produce & Animal By-Products, and National Bureau of Statistics of China, and finally elaborates the development trend and prospect of China's foxtail millet industry.

Keywords Foxtail millet • Trade • Industry development • Prospect • China

Chinese foxtail millet, also known as millet, called xiǎomǐ meaning "little rice" after its hull is removed, is botanically named ***Setaria italica*** of the Poaceae grass family (Yongqiang Wang et al. 2009). Foxtail millet originated from China with a history of cultivation of 8,700 years. It is the world's oldest crop, China's superior traditional crop, food and fodder crop, and crop with properties of drought resistance, barren-tolerance (Houyuan Lv et al. 2009; Wenhua Chen 2000). Foxtail millet is rich in nutrition, containing all kinds of ingredient such as starch, protein, fat, amino acid needed by humans, vitamin, and minerals, the composition of which is balanced. As it contains much dietary fiber and organic selenium, it is a food crop

Ministry of Agriculture & Ministry of Finance "Special Fund for Modern Agricultural Research and Development System" (CARS-07-12.5-A18)

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_6,

with nutrition and health care effect, a main crop in the recently-rising global fad for cereal crops (Chao Zhang et al. 2007).

6.1 Current Status of Foxtail Millet Production

6.1.1 Current Status of Foxtail Millet Production in the World

Foxtail millet is widely distributed across the world, mainly in southeast of Asia, Eastern Europe, Central Africa and Central Asia. Asia accounts for 97.1 % of the world's seeded area of foxtail millet and 96.7 % of the world's output of foxtail millet. As far as countries are concerned, China has the largest cultivated area and the greatest output of foxtail millet in the world. In addition, foxtail millet is also widely planted in India, former Soviet Union, Pakistan, Mali, and the Sudan. Currently foxtail millet is consumed by people all over the world as food, generally in the form of millet. But some countries have their own research organizations. For example, Australia has its special research institution for foxtail millet as forage grass. Africa and South America have research organizations growing related millet species as forages. France has special organizations breeding foxtail millet as birdseed.

6.1.2 Current Status of Foxtail Millet Production in China

In 2000, the world's planted area of millet was 37.1 million hectares with a total output of 27.67 million tons. In 2009, the planted area was 33.69 million hectares with a total output of 26.7 million tons. In China, the primary species of millet is foxtail millet. In 2000, China's planted area of foxtail millet accounted for 3.4 % of the world's planted area of millet and the output accounted for 7.7 % of the world's total output of millet. China's planted area of foxtail millet decreased rapidly. In 2009, China's planted area of foxtail millet dropped to 2.3 % of the world's planted area of millet and the output dropped to 4.6 % of the world's total output of millet. In 1937, China's foxtail millet area reached 11.33 million hectares. After China's liberation (1949), it was about ten million hectares. As staple crops such as wheat and corn develop, the planted area of foxtail millet in China has decreased rapidly (see Fig. 6.1). In 2011, the planted area of foxtail millet in China was only 745,000 ha.

Foxtail millet is widely grown across China with different cultivated varieties in different cropping systems in complex natural conditions, resulting in disparities of different regions. Foxtail millet is widely distributed across China, but it is mainly distributed in the northern provinces between latitude 32–48° north and longitude 108–130° east. It is rarely grown in the southern provinces (see Fig. 6.2).

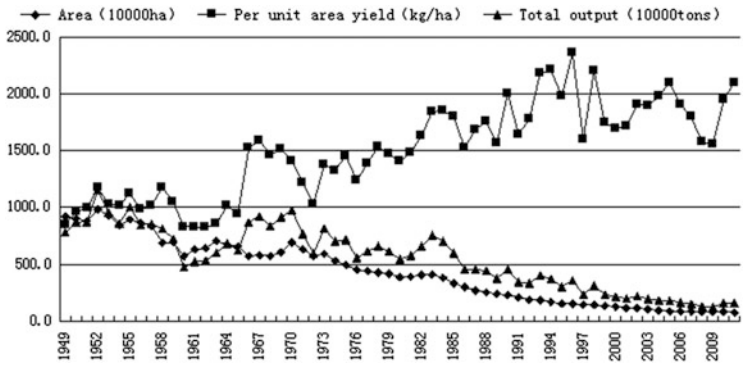

Fig. 6.1 Changes of China's foxtail millet area, per unit area yield and total output from 1949 to 2010

Fig. 6.2 Distribution map of the main producing areas of foxtail millet in China

According to the natural conditions, geographic latitudes, planting patterns, and variety types, China's foxtail millet producing area is divided into four cultivation regions: the spring foxtail millet region on the Northeast China Plain, including Heilongjiang, Jilin, Liaoning, and the north of Inner Mongolia; the summer foxtail millet region on the North China Plain, including Henan, Hebei, and Shandong; the spring foxtail millet region on the Inner Mongolian Plateau, including central Inner Mongolia, Zhangjiakou City of Hebei Province, and Datong City and Shuozhou City of Shanxi Province; and the spring and summer foxtail millet region on the Loess Plateau in upper and middle reaches of the Yellow River, including the south central Shanxi, Shaanxi, Ningxia, and Gansu.

Although the fluctuation in production in the four regions is different from region to region, the planted area of foxtail millet has decreased greatly since early years of new China. It dropped by 91.91 % from 9.207 million hectares in 1949 to 745,000 ha in 2011. At present, provinces and regions with larger planted areas of foxtail millet are Shanxi, Hebei, Inner Mongolia, Shaanxi, Liaoning, Heilongjiang, Jilin, Shandong, Henan, and Gansu in descending order. The total planted area of the above-mentioned 10 provinces and regions account for 97 % of China's total planted area of foxtail millet, of which 60 % is distributed in Hebei, Shanxi, and Inner Mongolia, where drought is the most severe.

The fluctuation in production in the spring foxtail millet region on the Northeast China Plain is small, and the scale of the peasants' producing foxtail millet is large. The area of foxtail millet in the summer foxtail millet region on the North China Plain decreases very much. Although currently Hebei, Shandong, and Henan are still big provinces in planting foxtail millet, the planting pattern has changed from dispersed wide-range planting to concentrated patch planting. Currently most foxtail millet planted areas concentrate in the spring foxtail millet region on the Inner Mongolian Plateau. The planted area of foxtail millet has been small all the time in the spring and summer foxtail millet region on the Loess Plateau in upper and middle reaches of the Yellow River. In recent years, although the per unit area yield has been increased by 2.5 times that of early years in new China, it is still much lower than that of wheat or corn. There is great potential in increasing per unit area yield. Currently, the yield of foxtail millet is low because it is planted in the dry and barren land where staple crops cannot grow, and the production and conditions cannot meet the requirements for the growth and development of foxtail millet.

6.1.3 Current Cultivation and Management Status

The cultivation of foxtail millet is all done manually. Foxtail millet is planted in mountainous and hilly areas where growing conditions are bad with low level of mechanization because large machinery is not available. In view of foxtail millet producing regions, North China summer foxtail millet region lies on the North China Plain, where mechanized production is applicable, but currently, mechanized sowing and harvesting machinery is under research and development, the technology is not mature, so the level of mechanization is low, and seeds of foxtail millet are sowed with a drill, a very old method of sowing.

The thinning of foxtail millet and weeding take a lot of work. Research and development institutions have worked out light and simplified cultivation technologies applicable to foxtail millet production, such as Jigu No.31, chemically-controlled thinning, and refined sowing.

Affected by regional climate, foxtail millet in different regions suffers from different plant diseases and insect pests and natural disasters. The tracking survey in recent years indicates that foxtail millet is primarily affected by natural disasters rather than by plant diseases and insect pests, such as the great drought of Liaoning

Table 6.1 Cost-effectiveness of foxtail millet in every region in China

			Unit: kg/ha	*yuan*/ha
Region	Northeast region	Northwest region	North China	Average nationwide
Per unit area yield	3,499.2	3,142.8	3,855.8	3,499.3
Labor cost	3,819.5	3,225.6	3,254.4	3,433.2
Total cost	7,728.9	6,205.8	6,225	6,719.9
Output value	15,260.1	12,300.8	18,378.2	15,313.1
Less: Profit of labor costs	11,350.8	9,320.6	15,407.6	12,026.3
Plus: Profit of labor costs	7,531.4	6,095	12,153.2	8,593.1
Less: Input-output ratio of labor cost	3.9	4.13	6.19	4.66
Plus: Input-output ratio of labor cost	1.97	1.98	2.95	2.28

in 2009, the spring drought of North China in 2009, the north-west drought in the spring of 2010, and the rainy weather in the harvest time in Luoyang, Henan, in 2011.

6.1.4 Current Production Benefit of Foxtail Millet (Table 6.1)

The data collected by the foxtail millet crop information platform of China's modern industrial technology system indicates that the economic benefit of China's foxtail millet is about 12,026.3 yuan/ha and that among the three regions of the Northeast, North China, and Northwest, the economic benefit of foxtail millet is the highest in North China region, reaching 15,407.6 yuan/ha.

6.2 Current Status of China's Foxtail Millet Trade

China's seeded area of foxtail millet accounts for 80 % of the world's seeded area, its output of foxtail millet accounts for 90 % of the world's output, so China is the biggest producer and consumer of foxtail millet in the world. For a long time, China has been the exporter of foxtail millet. It has imported little foxtail millet.

6.2.1 Import of Foxtail Millet

According to the data of FAO, in the recent 50 years, China has imported foxtail millet in some specific years (1962, 1964, 1989, 1990, 1991, 1992, 1993,1994, 2007

Table 6.2 Import of millet to China in 1962–2010

Year	Quantity of import (tons)	Value of imports (1,000 dollars)	Unit price (dollar/ton)
1962	23,500	1,650	70
1964	29,300	2,610	89
1989	3,500	834	238
1990	3,628	827	228
1991	2,535	548	216
1992	3,912	824	211
1994	2,566	543	212
2007	13,675	3,908	286
2008	28,350	9,250	326
2010	11,828	3,918	331

Note: (1) The data comes from FAO. (2) Millet is on the data from FAO. The millet here refers to millet species. Millet species includes pearl millet (in Africa, West Africa, and India in Asia), finger millet (in the south of the Sahara, India, and Indonesia), proso millet (in China, former Soviet Union, India, and eastern region of Africa), foxtail millet (in China, India, and eastern region of Europe), little millet (in India and Southeast Asia), barnyard millet (in India and some African countries), kodo millet (in India), and teff (in Ethiopia)

and 2008, 2010), as shown in Table 6.2. According to the data of FAO, the millet imported to China in the above mentioned years is not foxtail millet. It ought to be some other species of millet in the world. Therefore, China will import a certain quantity of millet in the few years to come.

6.2.2 Export of Foxtail Millet from China

China's foxtail millet is generally exported to other countries. Only in some specific years was it imported to China, as has been mentioned above. China exports foxtail millet to more than 60 countries in the world (see Table 6.3). From 1963 to 1979, the export of foxtail millet was on the rapid rise. In the early 1980s, it decreased sharply. Beginning from 1985, the export remained steady. Then since China's entry into WTO, China's foxtail millet has been more competitive in export and the export of foxtail millet has increased slightly.

According to the current status of China's export of foxtail millet, China's export is about 15,000 tons, ranking the 5th in the world. In the future, China will remain a big country in foxtail millet export. Based on increasing the competitiveness of China's foxtail millet in quality and price, China will further expand its export of foxtail millet abroad to improve the planting benefit of foxtail millet and increase farmers' income.

Table 6.3 Changes of China's export of foxtail millet from 1962 to 2010

Year	World ranking	Export (tons)	Export value (1,000 dollars)	Unit price (dollar/ton)	Year	World ranking	Export (tons)	Export value (1,000 dollars)	Unit price (dollar/ton)
1961	11	1,500	100	67	1986	7	8,932	1,200	134
1962	18	100	20	200	1987	6	5,254	1,780	339
1963	12	1,600	110	69	1988	9	3,147	1,455	462
1964	6	8,300	450	54	1989	5	4,789	140	1,934
1965	5	9,900	520	53	1990	8	3,868	148	1,716
1966	4	10,800	580	54	1991	9	5,143	136	1,932
1967	4	15,400	880	57	1992	6	12,932	2,670	206
1968	3	17,900	980	55	1993	7	22,483	3,546	158
1969	3	19,200	1,010	53	1994	5	29,396	4,932	168
1970	4	17,000	1,130	66	1995	7	17,717	3,740	211
1971	4	23,000	1,600	70	1996	4	15,013	4,542	303
1972	3	24,000	1,800	75	1997	4	21,561	5,741	266
1973	2	33,000	3,300	100	1998	4	18,597	4,461	240
1974	4	30,000	4,500	150	1999	4	20,845	4,575	219
1975	2	56,000	8,300	148	2000	4	20,845	4,575	219
1976	2	52,000	10,000	192	2001	3	21,377	4,116	193
1977	2	37,000	7,400	200	2002	3	27,914	4,983	179
1978	2	30,000	6,300	210	2003	3	42,037	7,531	179
1979	7	20,000	2,500	125	2004	4	30,262	6,669	220
1980	11	5,000	650	130	2005	4	26,644	7,665	288
1981	16	1,000	140	140	2006	5	22,829	6,829	299
1982	11	1,963	519	264	2007	4	24,424	8,174	335
1983	11	1,600	400	250	2008	5	16,739	7,833	468
1984	12	1,900	470	247	2009	5	14,935	7,959	533
1985	8	5,074	852	168	2010	5	14,857	7,278	490

Data source: FAO

6.2.3 Countries That China's Foxtail Millet Is Exported To

Currently China's foxtail millet is exported to Europe, Africa, and Southeast Asia, including countries and regions such as Japan, Israel, Korea, Belgium, Thailand, Denmark, Britain, Germany, Italy, the Netherlands, New Zealand, Brazil, France, and South Africa. In 2011, China exported 4,764 tons of foxtail millet to Japan, 2,566 tons to South Korea, and 2,138 tons to Thailand (Table 6.4).

6.3 Current Status of the Circulation and Processing of China's Foxtail Millet

6.3.1 Circulating Ways of Foxtail Millet

From production to consumption, foxtail millet is roughly circulated in the following ways:

Table 6.4 Countries that China's foxtail millet is exported to

Country	2007		2008		2009		2010		2011	
	Export (tons)	Export value (10,000 dollars)	Export (tons)	Export value (10,000 dollars)	Export (tons)	Export value (10,000 dollars)	Export (tons)	Export value (10,000 dollars)	Export (tons)	Export value (10,000 dollars)
Indonesia	1,342.4	45.39	1,102	34.84	1,172	39.63	1,334	47.76	2,001	96.82
Israel	117.9	4.45	105.4	4.89	106	5.31	177.6	9.39	188.8	10.86
Japan	7,680.5	228.3	4,880.3	232.7	5,204	227.6	6,058.4	244.1	4,764	184.2
Singapore	0	0	9	1.29	84.3	4.75	42	2.54	21	1.37
South Korea	4,033.8	159.1	3,053	139.6	1,890	76.59	2,713	145.6	2,566	179.8
Sri Lanka	41	1.3	43	1.7	0	0	0	0	4.8	0.49
Thailand	258.9	8.11	103.2	4.53	130.5	4.75	1,291.6	57.66	2,138	103.7
South Africa	1,002.6	29.47	311.8	12.8	396.5	16.62	135.3	6.81	632.1	35.91
Belgium	936.2	33.3	792.2	31.9	228.8	11.05	40	3.05	133.2	11.49
Denmark	0	0	0	0	16.8	2.11	27.5	2.6	25	2.49
Britain	1,184.4	50.81	647.3	28.9	866.8	50.71	406.9	25.68	239.1	17.23
Germany	569.6	31.03	827.4	52.56	679	80.18	463.9	46.62	414.4	67.37
France	98.6	6.84	593.2	44.43	629.1	55.89	379.8	36.52	531.6	46.88
Italy	1,830	53.45	1075.1	48.03	619.1	29.88	431.2	21.03	245.3	10.95
The Netherlands	452.5	14.4	808	38.86	688.3	55.74	345.7	29.01	445.9	37.27
Portugal	739.3	22.62	378.6	16.58	251.4	9.61	236.4	11.06	205.1	9.81
Spain	202	6.17	184.7	8.4	86.2	4.54	109.7	5.27	154	8.45
Sweden	41.8	1.36	21.5	0.95	16.2	0.86	35.3	2.22	15.7	1.01
Brazil	207.3	6.54	197.3	8.31	312.3	13.84	234.8	11.36	226.6	11.65
Canada	41.4	2.87	5	0.44	21.1	3.11	0	0	2	0.16
USA	78.5	4.41	15.4	1.8	0	0	0	0	0	0
Australia	655.9	19.68	6	0.67	19.8	2.26	0	0	12.3	1.57
New Zealand	289.2	10.45	26	2.4	32.5	2.79	26.4	1.31	15.8	3.06

Data source: China Chamber of Commerce of Import and Export of Foodstuffs, Native Produce and Animal By-Products

Millet farmer—consumer: After milling the millet, farmers directly sell the millet that they produced to consumers, which is common in marketplaces of every town in the main producing areas of foxtail millet. The circulation scope is small and dispersed. Farmers' economic benefit is low. It is the primitive sales method of foxtail millet.

Millet farmer—processor—consumer: Millet farmers sell their millet to processors or sign orders with processors. Processors primarily process the millet they have collected, and then sell the millet to consumers by wholesale or refined packaging. The sales method of selling millet by wholesale is used by small-size, workshop type processors, such as local small-size processors and small cooperatives, and the benefit is low. The sold millet after refined packaging can bring high benefit. Typical representatives using this method are Shanxi Qinzhouhuang Foxtail-millet Millet (Group) Co., Ltd., and Shanxi Fenzhouxiang Millet Processing Co., Ltd.

Millet farmer—wholesaler—processor—retailer—consumer: Farmers sell their millet to wholesalers, whole then sell it to processors. The processors here have the advantages of concentration of enterprises and large quantities of production. They pack the processed millet in large packages, and sell it to supermarkets and grain and oil markets or have millet wholesalers sell it in marketplaces, and finally it is bought by consumers. Typical representatives are Mazhuang Millet Collecting and Distributing Center of Hebei Province and Mengcun Village Millet Collecting and Distributing Center of Hebei Province. Foxtail millet produced in the Northeast and Chifeng of Inner Mongolia is sent here and processed by processors here. Then it is delivered to all parts of China (Huijun et al. 2011), including the Northeast and Inner Mongolia.

6.3.2 Current Status of Processors

In 2011, according to the investigation and network monitoring, 265 processors of foxtail millet in China passed Pollution-free Certification, Green Certification, and Organic Certification, of which 107 processors passed Pollution-free Certification, 78 processors passed Green Certification and 80 processors passed Organic Certification (Table 6.5).

6.3.3 Processing and Distributing Centers of Foxtail Millet

6.3.3.1 The Millet Distributing Center of Zhuluke Town, Jianping County, Liaoning Province

Zhuluke Town, Jianping County, Liaoning Province is a millet distributing center well-known all over China. There are more than 50 minor cereal crops processors in

Table 6.5 Status of pollution-free certification, green certification, and organic certification with some foxtail millet processors across China

	Unit: Processor		
Province or city	Pollution-free certification	Green certification	Organic certification
Henan Province	6	3	0
Heilongjiang P1rovince	46	14	5
Jilin Province	11	9	5
Liaoning Province	7	14	8
Inner Mongolia Autonomous Region	2	4	15
Ningxia Hui Autonomous Region	1	0	0
Shandong Province	7	2	26
Shanxi Province	27	27	8
Hebei Province	0	5	2
Beijing	0	0	7
Tianjin	0	0	4
Total	107	78	80

the town and more than 100 purchase and sales outlets with annual sales of more than 200,000 tons of millet. Products of millet include high, intermediate, and low levels. Some products are sold to supermarkets in China and indirectly exported to countries such as South Korea and Japan.

6.3.3.2 The Millet Distributing Center of Mazhuang, Gaocheng, Hebei Province

The Millet Distributing Center of Mazhuang, Gaocheng is the largest distributing center in North China. It has a long history of millet processing and business. Starting from the 1980s, after more than 20 years of rolling development, the whole village boasts more than 80 minor cereals processors with more than 2,300 employees. Mazhuang minor cereals wholesale market with nationwide distribution network and the largest minor cereals distributing center in North China have been developed with North China as their support. The annual turnover reaches 380 million *yuan*, 300,000 tons of minor cereals such as millet are sold per year, and farmers' income can be increased by five million *yuan*.

6.3.3.3 The Millet Distributing Center of Mengcun Village, Hebei Province

The Millet Distributing Center of Mengcun Village is workshop-type processors of millet voluntarily organized and developed by farmers in the 1980s. Currently, there are more than 50 millet processing workshops. Foxtail millet for these

workshops comes from the Northeast and Inner Mongolia. After being processed, the foxtail millet is packaged and sold in large quantity to southern provinces and cities such as Henan, Jiangsu, and Shandong. Recently, the county government has attached great importance to the development of the foxtail millet industry. It is bringing millet processors into its plan. It plans to bring the scattered enterprises together through integration and establish a development mode with local characteristics for agricultural products.

6.3.3.4 The Transfer Station of Minor Cereals of Jijiazhuang Town, Yu County, Hebei Province

Currently, the area of minor cereals of Yu County is about 33,300 ha, of which the perennial planted area of millet is 11,300 ha with a total production of about 50 million kilograms. The major varieties are 8,311 and Zhang Zagu, mainly distributed in the hilly area on the dry slope. The Transfer Station of Minor Cereals of Jijiazhuang Town has begun to take shape. Currently there are more than 50 small-scale trade warehouses, each of which has annual sales of 20 million *yuan* for the recent years.

6.3.4 Current Status of Processed Products of Foxtail Millet

At present, foxtail millet is generally consumed in the form of millet. After several years of survey of foxtail millet production, we find that foxtail millet is primarily consumed in the form of millet porridge and in a few places in the form of cooked millet. Whether millet porridge or cooked millet, foxtail millet is consumed in no other form than millet. According to our investigation of urban residents' consumption of millet, nearly 90 % of urban consumers of millet are sure to drink millet porridge every day, that is, 90 % consume foxtail millet in the form of millet porridge, which indicates that urban residents in China consume foxtail millet mainly in the form of millet. There are few highly processed products of foxtail millet.

Currently, China's highly processed products of foxtail millet include millet wine, millet vinegar, millet nutrition powder, instant millet porridge, millet pancakes, and millet noodles, but all of them are produced in small quantity and small scale in a simple way. In addition, they have narrow market. There are not enough standardized large-scale leading enterprises for highly processed products of foxtail millet.

6.4 Current Status of Researches on Foxtail Millet in China

From the late 1960s, more than 30 R&D institutions in China began to tackle key problems with hybrid millet. Later many R&D institutions gave up halfway as the problems were too difficult. In more than 10 years from the end of the twentieth

century to the beginning of the twenty-first century, great changes and adjustment were made on the scientific research of foxtail millet. Restricted by objective conditions such as lack of scientific research funds, the reform of scientific research system, plus the sharp decrease of the planted area of foxtail millet in the whole country, many researchers changed their professions and their research directions. Talents and resources were seriously lost. Technical innovation like foxtail millet breeding actually came to a stop. In this period, many foxtail millet scientific research teams of scientific research institutions weakened or disappeared. Only a few scientific research institutions have persisted in innovative research of foxtail millet. Now there are only two professional research institutions of foxtail millet in China, one in Hebei and the other in Shanxi. Others are just small scientific research teams kept by some individual provincial or municipal agricultural institutes.

In 2007, Ministry of Agriculture and Ministry of Finance launched the modern industrial technology system. In 2008, the modern industrial technology system for foxtail millet was officially launched. In the construction of the modern agricultural industry technology system in the12th Five-Year Plan of China, proso millet is included in the foxtail millet industrial technology system, named the foxtail millet and proso millet industrial technology system. It is established as the national technology research and development center for foxtail millet and proso millet industry, under which are established breeding and seed research laboratory, plant diseases and insect pests prevention and control laboratory, cultivation and soil and fertilizer laboratory, comprehensive laboratory, and 19 comprehensive experiment stations in the main producing regions in China such as North China, Northwest, and Northeast Regions. There are five demonstration counties in the region of each comprehensive experiment station. All the foxtail millet researchers of China are linked by the foxtail millet industrial technology system. The 19 comprehensive experiment stations and 20 post scientists take in more than 200 researchers.

6.5 Future Development Trend and Prospect of the Foxtail Millet Industry

6.5.1 Future Development Trend of the Foxtail Millet Industry

The planted area of foxtail millet increases gradually, and advantageous regions are gradually developed

Currently, the price of foxtail millet is on the rise. The local governments of the main producing regions of foxtail millet are attaching great importance. Processed products after production are gradually increasing and consumer demand for foxtail millet is increasing. It is predicted that the area of foxtail millet will increase gradually in Chifeng, Handan, Yan'an, Liaoning, and Changzhi in the few years to come. With the promotion of land transfer and the increase of the selling price of

foxtail millet, major producers are gradually increasing the sizes, and specialized cooperatives are gradually increasing. The regional benefit and economies of scale of the special industry of foxtail millet will further be improved and advantageous regions will gradually be developed.

Technical innovation achievements that support the development of the foxtail millet industry, such as light and simplified production technology, good quality and high-yield variety, and combination of farm machinery and agricultural technology, will further be promoted for application

As thinning of foxtail millet and weeding take a lot of work and effort, subjects such as light and simplified production technology, high quality variety screening and breeding, R&D of supporting machinery will be researched all over China. Construction of demonstration bases will be promoted. Demonstration and popularization of new varieties and new technologies will be accelerated. Technology integration such as plant diseases and insect pests prevention and control, coordination of farm machinery and agricultural technology, light and simplified production will manifest its advantage in promoting the increase of both production and income.

Industrialization development needs to be cultivated rapidly

China's foxtail millet production is scattered and the whole industry development still stays on the raw grain processing stage although the development level of the foxtail millet industry has been constantly improved and modern industrialization organizations such as leading enterprises plus demonstration bases have been popularized in recent years supported by related industrial policies and required by market mechanism development and industry development. The transition from small farmer production of foxtail millet to modern agricultural large-scale and efficient operation mode depends on policy support from governments at all levels and exercise in market economy.

Joining hands to tackle key problems and technology integration will demonstrate their advantages

Through research and discussion, research and development institutions all over the country have enhanced top-level design for task objectives

6.5.2 Development Prospect of the Foxtail Millet in the Future

With the global warming and ever-increasing shortage of water resources, due to drought, high food price and global economic recession, the number of hungry and undernourished people has exceeded one billion. If millet is exported to Africa, Asia, and Latin America as a healthy and nutritious food, it will certainly drive the consumption and production of foxtail millet in the world. Currently, hybrid foxtail millet has been introduced to Ethiopia, it grows better and has higher production than the local millet species. If the planting of foxtail millet can be popularized in

the locality, the hybrid foxtail millet will be a good crop to settle the hunger issue in Africa.

To ensure the food security and ecological security in China, high water consumption crops should be properly reduced, the planted area of drought resisting crops with low water consumption such as foxtail millet should be increased. China is seriously short of water. Its water resource of per capita is only equivalent to one fourth of the world average level and water resources quantity for per unit area of farmland is only equivalent to three fourths of the world average level. An acute shortage of water in China forces us to reduce agricultural water and choose to develop drought-enduring and water-saving crops. Compared with staple crops such as rice, wheat, and corn, foxtail millet is the best choice for dry farming. Only 271 kg of water is needed to produce 1 kg of dry foxtail millet while corn and wheat need 369 and 510 kg respectively. Foxtail millet is irreplaceable in the construction of sustainable dry farming ecological agriculture. It is an important crop for disaster relief and filling shortage (Yijun Han 2012; Yuqin Li 2009).

In the recent 20 years, with the change of people's dietary pattern and way of life, "whole grains" as the staple food is continuously being decreased, mainland residents' intake of dietary fiber is decreasing year by year, and as a result, the occurrence rate of chronic diseases such as obesity, hypertension, and diabetes continues to rise. The healthy diet principles set forth in the new edition of the Dietary Guidelines for Chinese Residents are "Eating various foods, taking cereals as the staple food, collocating coarse food with refined food" (The Dietary Guidelines for Chinese Residents 2011). This requires creating and fostering demand, upgrading traditional industries, transforming economic growth patterns, and devoting greater effort to developing healthy foods. Secondly, we must develop our own brand and improve our credibility to win consumers' trust. Finally, we must reconstruct our culture and diet of whole grains and build up a healthy community of Chinese people. When foxtail millet, an example of minor cereals, becomes culture and commodity and integrates itself in people's life, it will find its own way out (Huijun Wang and Zhijun Wang 2013).

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Chapter 7
Preliminary Discussion on the Current Situations and Prospects of Cassava Starch Imports and Exports in China

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Abstract China is the largest cassava starch imports country in the world, this paper analysis the current situations and trade pattern, and forecast that the imports will grew continuously, the import price will still remains high position, and the import of cassava starch will still come from the ASEAN countries, but the exports of cassava starch will still keep current situations in the next 5–10 years, the cassava starch corporation "Going Out" will be the future trend.

Keywords Cassava starch • Imports and exports • Trade pattern

Cassava is a kind of tropical crops, known as the *king of starch*. It is easy to plant and strongly adapt to barren land with less investment and extensive use, especially cassava tubers. Cassava tubers contain high starch content, so it is widely apply to starch industry, alcohol industry, pharmaceutical industry, feed industry and food processing industry, etc. Cassava starch production is the second largest use. Through cassava starch processing, will get three kinds of products: wet starch, dry starch and byproducts. By further process it can make into modified starch, used as additives of fructose, glucose, maltose, MSG, beer, bread, biscuits, prawn crackers, silk noodles, sauces and plastic fiber, plastic film, resins, coatings, adhesives and other chemical products (Liu Haiqing et al. 2009).

Fund projects: the Ministry of Agriculture construction projects for agricultural tropical crops extension system (13RZNJ-18); The Central-level public welfare scientific research institutes for basic R & D special fund of year 2013(1630012013012); The Central-level public welfare scientific research institutes for basic R & D special fund of year 2011 (1630012013006).

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_7,

The state has adopted a series of policies to support the development of biomass energy industry since 2005, which effectively promoted the development of the cassava industry。 In October 2010, the publish of the *Opinions of the General Office of the State Council on Promoting Development of Tropical Crop Industry in the Country*, which clearly point out the orientation of cassava industry. That is to continuous import and select of a number of fine breed, strengthen the promotion of fine breed and high-yield cultivation technology, and effectively uplift the per unit area yield level. To Make full use of non-staple agricultural land for planting, promote cassava interplanting technology, and further expand the plant area. Striving to the goal that by 2015, the proportion of fine breed and high technology coverage reaches 80 %, with a total output of 7.7 million ton, and a more than 30 % of fresh potato starch content (The Central People's Government of the People's Republic of China 2010). However, after the fully implementation of China—ASEAN Free Trade Area, 90 % of the products in China and ASEAN achieves zero tariffs. Compared with Southeast Asian countries, the international competitiveness of Chinese cassava starch is almost −1, with 100 % dependence on foreign trade. So how to improve the competitiveness of cassava starch is a serious question pose to Chinese cassava industry.

7.1 Current Situation of China's Cassava Starch Import and Export Trade

China has been the world's largest importer of cassava starch since 1990s. According to the statistics from United Nations FAO, just in 2009, China's import volume of cassava starch reached 1.198 million ton with 335,621 thousand US dollars import value; while its export volume was 4,431 tons, and its export value reached 2,254 thousand US dollars, ranking seven in the world. China's customs statistics showed that import volume of cassava starch in 2010 was 735,000 tons, while its import value amounted to 330,867 thousand US dollars. In 2011, from January to August, Cassava starch import reached (FAO 2011) 556,000 tons, with import value rising to 308,384 thousand (Table 7.1).

7.2 General Situation of China's Cassava Starch Import and Export Trade

According to statistics from FAO, China's cassava starch trade deficit is surging since 1980. From 1990 on, China's cassava starch imports accounted for about 50 % of the world's, climbing to 58.11 % in 2009. The main exporters are Thailand, Vietnam and Indonesia. In 2010, import from the three countries makes up 99.65 % of the total amount, among which Thailand takes up 80.79 % with Vietnam of 18.46 % and Indonesia of 0.4 %. Other exporting countries (regions) includes

Table 7.1 Current situation of China's cassava starch import and export trade from1991 to 2010

Year	Import quantity (ton)	Import value (thousand US$)	Export quantity (ton)	Export value (thousand US$)	Year	Import quantity (ton)	Import value (thousand US$)	Export quantity (ton)	Export value (thousand US$)
1991	249,024	62,355	13	23	2001	496,091	90,919	2,201	1,217
1992	263,435	63,346	6,792	1,663	2002	647,041	119,732	4,482	2,149
1993	265,078	52,855	3,731	913	2003	870,792	152,788	2,555	1,149
1994	261,765	59,294	3,277	1,118	2004	1,087,709	209,196	2,807	1,121
1995	238,007	75,854	2,650	980	2005	760,530	189,531	3,703	1,832
1996	363,592	102,562	1,469	576	2006	1,138,697	258,010	3,548	1,731
1997	367,290	82,005	2,772	1,820	2007	892,249	256,329	3,584	1,185
1998	319,314	69,433	831	398	2008	703,218	264,115	3,067	1,376
1999	422,475	78,875	1,571	838	2009	1,197,998	335,621	4,431	2,254
2000	438,729	71,166	2,240	1,025	2010	989,707	458,934	1,758	919

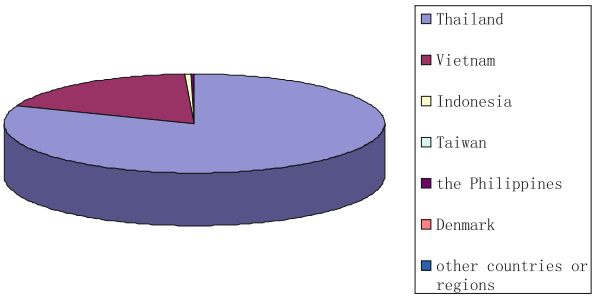

Fig. 7.1 The proportion of cassava starch importing countries or regions in China 2010 (Data source: *China's Customs Statistics Yearbook*)

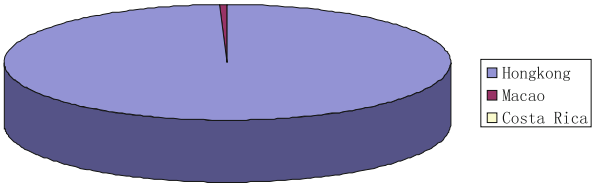

Fig. 7.2 The proportion of cassava starch exporting countries or regions in China 2010 (Data source: *China's Customs Statistics Yearbook*)

Taiwan, the Philippines and Denmark, etc. (Fig. 7.1) Importing country (region) mainly are Japan and South Korea, few Europe and America countries, Hong Kong, Macao, and other regions. China's cassava starch export was about 0.2 % of the world's (up to 0.52 % in 2002) since 1990. In 2010 China's cassava starch export to Hong Kong accounted for 99.42 % of the national exports (Fig. 7.2) (*China's Customs Statistics Yearbook* 2001; The Customs Information Network 2010).

7.3 Analysis of China's Cassava Starch Import and Export Pattern

ASEAN is the chief exporter for China, whose cassava starch has taken up above 75 % of China's gross imports since 2001, and soars to 99.67 % in 2010. Among which Thailand account for 81.09 %, with 268,300 thousand U.S. dollars, is China's most important exporter in 2010 while Vietnam occupy 18.03 % with 59,664 thousand U.S. dollars. Hong Kong is the chief importer for China. From 2001 to 2010, China's average annual export volume is 202.52 tons, and average annual export value amount to 121.95 thousand U.S. dollars. Among which Hong Kong takes up 99.21 % with 135.53 thousand U.S. dollars in 2010 (Table 7.2) (*China's Customs Statistics Yearbook* 2001; The Customs Information Network 2010; Zhan Ling et al. 2010).

Table 7.2 The variation of import and export countries(regions) proportion of cassava starch in China from 2001 to 2012

	Export countries (regions) proportion					Import countries (regions) proportion						
2001	Hong Kong	Macao	Taiwan	USA	South Korea	Vietnam	Thailand	Netherlands	Germany	Denmark	Singapore	other
	60.52	10.74	9.72	8.70	4.60	46.36	39.54	4.73	2.95	2.63	1.03	0.66
2002	Hong Kong	Macao	Canada	Vietnam	Japan	Thailand	Vietnam	Netherlands	Poland	Germany	Denmark	other
	80.53	14.20	4.52	0.71	0.02	40.77	35.32	8.17	7.63	5.81	1.53	0.78
2003	Hong Kong	South Korea	Macao	Vietnam		Vietnam	Thailand	Poland	Netherlands	Germany	Denmark	other
	65.11	17.39	16.91	0.59		44.58	37.35	6.76	6.68	3.50	0.79	0.34
2004	Hong Kong	South Korea	Macao	Netherlands	North Korea	Thailand	Vietnam	Indonesia	Netherlands	Poland	Taiwan	other
	47.78	38.13	6.33	4.90	2.72	39.66	39.41	16.15	1.88	1.33	1.09	0.48
2005	Hong Kong	South Korea	Taiwan	Sweden	North Korean	Thailand	Vietnam	Indonesia	Netherlands	Poland	Taiwan	other
	48.05	38.44	5.35	3.29	2.75	48.95	44.96	2.76	1.11	0.79	0.64	0.79
2006	South Korean	Hong Kong	Algeria	Japan	Ghana	Vietnam	Thailand	Netherlands	Taiwan	Germany	USA	other
	45.49	43.56	4.28	4.24	2.34	53.51	44.97	0.52	0.36	0.16	0.1	0.38
2007	South Korea	Hong Kong	Mexico	Japan	Vietnam	Thailand	Vietnam	Indonesia	Taiwan	South Korean	Hong Kong	other
	41.60	34.32	15.12	5.92	2.52	54.64	44.13	0.66	0.42	0.042	0.033	0.08
2008	Hong Kong	Japan	Canada	South Korean	Finland	Thailand	Vietnam	Indonesia	Taiwan	Denmark	Laos	other
	72.34	11.59	9.76	6.23	0.04	63.86	33.89	1.43	0.52	0.08	0.07	0.14
2009	Hong Kong	Kyrgyzstan	Uzbekistan	Vietnam	South Korean	Thailand	Vietnam	Indonesia	Taiwan	Laos	Denmark	other
	47.76	12.92	12.92	10.33	8.2	64.82	34.00	0.62	0.36	0.09	0.03	0.07
2010	Hong Kong	Macao	Costa Rica			Thailand	Vietnam	Indonesia	Taiwan	The Philippines	Denmark	other
	99.42	0.45	0.13			80.79	18.46	0.4	0.16	0.1	0.05	0.04
2011	Hong Kong	Thailand	Madagascar	Indonesia	Guatemala	Thailand	Vietnam	Indonesia	Myanmar	Denmark	Germany	other
	54.59	33.58	5.72	3.27	1.27	62.89	33.18	3.19	0.68	0.03	0.01	0.01
2012	Hong Kong	Taiwan	Madagascar	South Korean	Japan	Thailand	Vietnam	Cambodia	Laos	Myanmar	Denmark	other
	63.89	23.57	8.26	3.13	0.77	57.41	41.37	0.46	0.37	0.34	0.02	0.03

Data source: *China's Customs Statistics Yearbook*

7.4 Outlook of China's Cassava Starch Import and Export Trade

7.4.1 Import of Tapioca Starch Goes on Increasing, While Import Price Remains High

Recent years, China's rapid economic development demands for more cassava starch. With a limited planting area and output growth, it is estimated that China's import of tapioca starch maintains an increased momentum in the following 5–10 years. The average price of import rise from 0.45 U.S. dollars/kg in 2010 to 0.55 U.S. dollars/kg in January to August, 2011, with an increase of 57.1 % over the previous year. In September 2011, the "Neuchatel" and "Rummenigge" bring serious impact on Thailand, the Philippines, Vietnam and southern China (Guangxi, Hainan, Guangdong provinces). Thus, in 2011 to 2012, Thailand's cassava production is doom to be decreased. Directly affected by the typhoons, lodging of cassava and badly broken, southern China's press quarter will be directly influenced. World cassava starch production in 2011to 2012 is predict to be sharply reduced, while post-import price remains high.

7.4.2 China's Cassava Starch Export Volume Will Maintain Much the Same Proportion of the World's

Since 2003, China's maintained an ratio of around 0.2 % of world's of cassava starch export, and mainly exported to Hong Kong, Korea, Japan and other countries (regions), for the geography proximity of low transport costs. China's modified starch industry is developing rapidly, with a huge demand for cassava starch. However, in the next 5–10 years, China's cassava starch export volume will still on a small scale.

7.4.3 Thailand and Vietnam Are the Major Exporter

ASEAN is the main producing areas of world's cassava. In 2009, ASEAN's cassava production accounted for 28.73 % of the world's. Thailand accounted for 12.9 %, second only to Nigeria, ranking No. 2 in the world's cassava production in 2009.

In January 2010, with the fully implementation of China—ASEAN Free Trade Area, comes the cassava starch zero tariffs. Importing cassava starch from those countries has a comparative advantage, so in the following 5–10 years, ASEAN is still the chief exporter for China.

7.4.4 *"Going Out" of Cassava Starch Sector—A Trend in Future Development*

In Oct. 2010, supporting cassava starch sector was given first priority based on the *Opinions of the General Office of the State Council on Promoting Development of Tropical Crop Industry in the Country*. Africa is a country with sparse population and fertile soil. Nigeria is the largest cassava starch producer in the world. Based on the realistic condition that African farmers lack of fundamental agriculture techniques, China helped build Demonstration Center of Agricultural Technology and launch sector training, demonstrated promotion and newly technique transfer of cassava starch, thus fostering cassava starch to go out. Besides, Chinese government started to set up cassava starch processing plant with the purpose of providing extravert raw material supply for the domestic cassava starch industry.

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Chapter 8
Monetary Policy and the Price Volatility of Natural and Synthetic Rubber in China

Liu Ruijin

Abstract Firstly, this paper gives two hypotheses about the impact of monetary policy on natural and synthetic rubber prices through theoretical and empirical analysis, and then validates the hypotheses based on monthly data from January 2000 to March 2013, using Vector Auto-Regression (VAR) and its extended models, which sort the variables in VAR models by Granger causality test and use generalized impulse functions. The results show that: the money supply and credit scale indices have long-run equilibrium relationships with natural and synthetic rubber prices, and loose monetary policy can boost the prices in the medium-long term; the variables about money supply and load scale have weak explanatory power for natural and synthetic rubber prices in short-term, and the proportions contributing to the forecast variances are no more than 10 % in the early 7 months after shocks; the impact on synthetic rubber prices from monetary policy is stronger than on natural rubber.

Keywords Monetary policy • Natural rubber • Synthetic rubber • Prices • VAR models

8.1 Background

Natural rubber which is the material for more than 50,000 kinds of industrial products is the one and only renewable resource among four major industrial raw materials including crude oil, steel, coal, and natural rubber, and it still is a non-alternative strategic resource in aerospace, heavy vehicle tire manufacturing, and other important industrial fields. China had been the largest consumer of natural rubber in 2001, and it consumed about 3,900,000 tons in 2011 (35 % of the word

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_8,

production), but the demotic production was only 720,000 tons. Synthetic rubber which takes crude oil as raw material is an alternative for natural rubber. In recent years, violent price-fluctuations of the prices had made a great impact on producers and downstream companies, such as tire companies. At that period, Public Bank of China (PBC) implicated the loose monetary policy in order to boost national economy. It may be the main reason why the prices of natural and synthetic rubber severely fluctuate. Although most economists would agree that monetary policy affects the price level, the quantitative degree is still in dispute, especially for the prices of some special sectors. In this paper, we investigate the relationship between monetary policy and the prices of natural and synthetic rubber in China.

In agricultural sector, Alan and David (1997) found that monetary shocks do not affect farm price. Before Alan and David (1997), Chambers (1984), Devadoss and Meyers (1987), Lapp (1990), and Belongia (1991) estimated dynamic systems containing Ml and RFP (Relative Farm Price). The first two studies find important monetary effects, but the other two studies find no important monetary effects. Saghaian et al. (2002) found that agricultural prices adjust faster than industrial prices to innovations in the money supply, affecting relative prices in the short run, but strictly long-run money neutrality does not hold.

In crude sector, Michael (2009) examined monetary policy responses to oil price shocks in a small open economy with traded and non-traded goods. Kormilitsina (2008) investigated the role of systematic U.S. monetary policy in the presence of oil price shocks.

In asset price, BjØrnland and Jacobse (2010) analyzed the role of house prices in the monetary policy transmission mechanism in Norway, Sweden and the UK, using structural VARs. House prices react immediately and strongly to a monetary policy shock. The strength and timing of response varies between the countries, suggesting that housing may play a different role in the monetary policy setting. Son (2008) investigated the various relationships between monetary policy and asset prices in the U.S. economy are investigated through steady state Bayesian VAR (SS BVAR) and revised Taylor-rule (Forward-looking rule) based on the Generalized Method of Moments (GMM). Xu and Chen (2012) suggested that Chinese monetary policy actions are the key driving forces behind the change of real estate price growth in China. Wang (2011), Su (2010), Ding (2009), and Duan (2008) investigated the relationship between monetary policy and asset price, and stock price (Wang 2003).

8.2 Review on the Changes in Chinese Monetary Policy

Macroeconomic stability and financial stability are the two main responsibilities of central bank. One of two main tools is monetary policy while the other is lenders of last-resort which the central bank will supply liquidity for financial institutions. PBC formulates and implements monetary policy, and it can use Open Market Operation, Deposit Reserve Fund, Central Bank Loan and Interest Rate to implement monetary policy, which is shown in Appendix Fig. A.1.

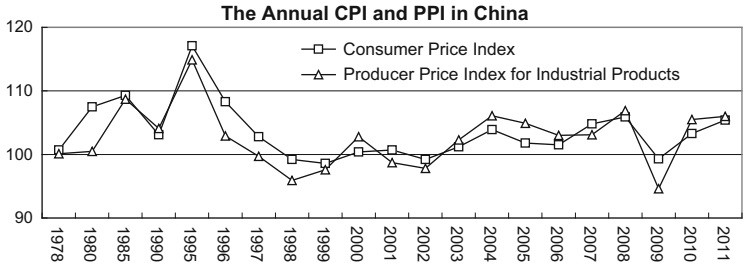

Fig. 8.1 CPI and PPI from 2000 to 2012 in China (Data source: National Bureau of Statistic of China)

In 2004, PBC began to focus on liberalization reform of interest and exchange rate, such as broadening the up-down interval of loan, Okazaki et al. (2011) studied on thesis issues. From 7/6/2012, 1-year benchmark deposit rate cut of 0.25 percentage points, 1-year benchmark lending interest rate cut by 0.31 percentage points; other deposit and lending interest rates and individual housing provident fund deposit and lending rates be adjusted accordingly. The changes in interest rates and deposit reserve rates are shown in Appendix Tables A.1, A.2, and A.3. Consumer Price Index (CPI) and Price Index for Industrial Products (PPI) which are shown in Fig. 8.1 are the vital important indices used in the decision of PBC.

8.3 The Supply of Natural and Synthetic Rubber in China

Rubber tree was firstly introduced to China in 1904, and the massive plantations began 1950s in order to ensure self-supply for military and economy. By the end of 2010, the total rubber planted area in China was one million hm^2. The demotic production of natural rubber cannot satisfy the demand, so the supply mainly depends on the import. The situation of synthetic rubber is contrast to natural rubber, as it is shown in Fig. 8.2.

8.4 Data and Hypotheses

In order to investigate how the changes in monetary policy affect prices fluctuation of natural and synthetic rubber in Chinese economic system, we collect data from the People's Bank of China and China Rubber Industry Association. Figures 8.3 and 8.4 indicate the indexes, and the summary statistical descriptions are shown in Appendix Table A.4.

The indexes of money supply contain money & quasi money (M2), money (M1), and currency in circulation (M0). M0 is important indicator of liquidity, and it

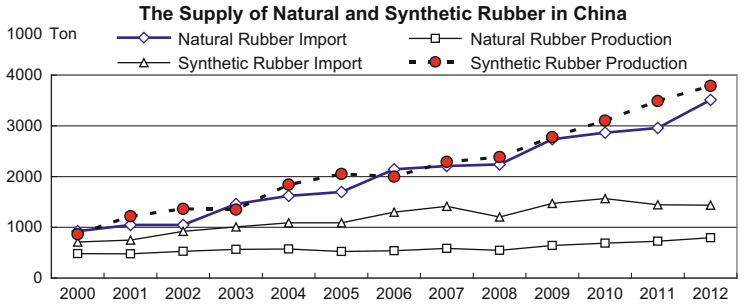

Fig. 8.2 The domestic production and import of natural and synthetic rubber from 2000 to 2012 (Data source: National Bureau of Statistic of China, China Custom, Ministry of Agriculture of the People's Republic of China)

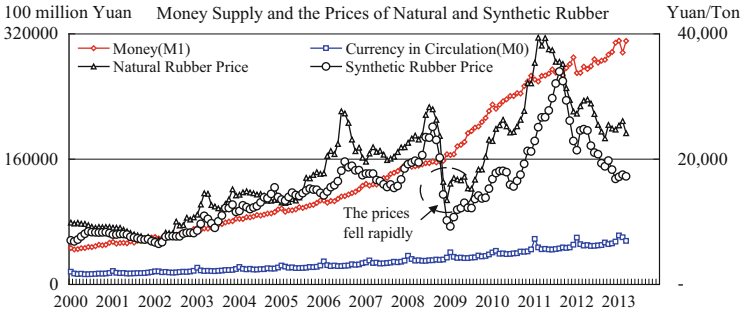

Fig. 8.3 Money supply and the prices of natural and synthetic rubber (Data source: The People's Bank of China, and China Rubber Industry Association)

significantly increases at Jan. or Feb. each year, the reason may be that people need more cash at Spring Festival.

Since 2000, narrow money and cash in circulation in the growth trend, especially in 2009; the growth rate is significantly increased. The money supply indicators can not explain the dramatic changes in rubber prices, but long-term trends can lead to the overall trend in the prices. Cognitive rubber prices are in a certain sense, when PBC implements the relaxed monetary policy. The increased money supply may boost prices.

Changes in the money supply depend on the credit scale, and the two indexes should be concerned together in the analysis of monetary policy, which play important roles in China's economic and financial system (Wu 2008). So we should pay attention to the lending scales, which are shown in Fig. 8.4. The proportions of short-term loans, medium-and long-term loans to total loans at Dec 2005 are 44.92 %, plus of which is always more than 88 %. Before Dec 2005, short-term ratios are higher than the long-term. After that, the situation is opposite. Since January 2006, financial institutions pay more attention to long-term loans, the increasing rate of which is significantly higher than the short-term, as shown in

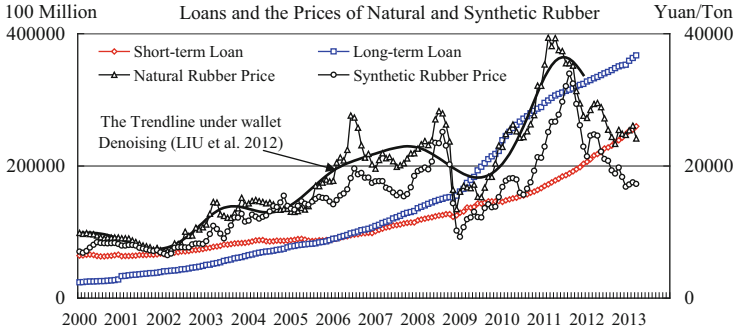

Fig. 8.4 Loan and the prices of natural and synthetic rubber (Data source: Public Bank of China, and China Rubber Industry Association)

Fig. 8.3. We can find that the trends of the prices and medium-and long-term lending scale are similar through an intuitive observation. The tire enterprises who need grand amount of medium- and long- term loan to invest and operate, consume most of natural and synthetic rubber. If it is easy to acquire loan, the demand for rubber would be enhanced, which stimulate the prices.

According to the above analysis, we have two hypotheses.

Hypothesis 1: The money supply and prices have long-run equilibrium relationships, but the changes in monetary policy weakly affect the prices in short-term.
Hypothesis 2: The credit scale entirely affects the prices, and the impact is positive.

8.5 Notations and Methods

In order to facilitate the modeling, we notate the variables.

M1: Money
M0: Currency in Circulation
SLOAN: Short-term Loans
LLOAN: Medium & Long-term Loans
DNRP: Domestic Natural Rubber Prices
DSRP: Domestic Synthetic Rubber Prices

A standard approach in measuring the effect of monetary policy on output and prices is to estimate a Vector Auto-Regression (VAR) model, characterize somehow the monetary policy shock and then plot impulse responses. So we establish the reduced and structural VARs firstly.

Let $Y_t = (M0_t, M1_t, SLOAN_t, LLOAN_t, DNRP_t, DSRP)^T$, the reduced form is

$$Y_t = \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \cdots + \beta_p Y_{t-p} + \varepsilon_t \tag{8.1}$$

In (8.1), β is vector of coefficients; ε_t is a vector of disturbances; p is the lag order.

There exists a matrix A which satisfies

$$Y_t = \mathrm{A}\varepsilon_t \tag{8.2}$$

The structural form

$$\mathrm{B}Y_t = \gamma_1 Y_{t-1} + \gamma_2 Y_{t-2} + \cdots + \gamma_p Y_{t-p} + u_t \tag{8.3}$$

The residual errors of the two forms (8.1) and (8.3) can be related by

$$A\varepsilon_t = Bu_t \tag{8.4}$$

Then the A is a lower triangular matrix, which indicates some same-term relationships, and B.

Co-integration Test. Engle and Granger (1987) figured out that co-integration implies that deviations from equilibrium are stationary, with finite variance, even though the series themselves are non-stationary and have infinite variance. The testing methods are divided into two kinds, one is based on regressed coefficient, such as Johansen Test; the other is based on regressed residual, such as CRDW (Co-integration Regression Durbin-Watson) Test, DF Test, ADF Test et al.. If time sequence contains linear trend and constant, the co-integrated equation should have included them (Johansen 1994).

Co-integration relationships exist among the components of Y_t, denoted by $Y_t \sim CI(d, b)$, if it satisfies: (8.1) $Y_t \sim I(1)$, every $y_{it} \sim I(1), i = M0, M1, SLOAN, LLOAN, DNRP, DSRP$; (8.2) exist β, subject to $\beta' Y_t \sim I(0)$.

Vector Error Correct Model (VECM). VECM is VAR model which is constrained by co-integration, so it can lead to a better understanding of the nature of any non-stationarity among the different component series. An error correction model is a dynamical system with the characteristics that the deviation of the current state from its long-run relationship will be fed into its short-run dynamics.

$$\Delta Y_t = \alpha_1 CEM_{1,t-1} + \alpha_2 CEM_{2,t-1} + \alpha_3 CEM_{3,t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \sigma_t \tag{8.5}$$

CEM denotes error correction term, and coefficient α indicate the adjust-force on the deviation from the long-run equilibrium.

Granger Causality Test. Granger test validate if they are causality. Granger causality is a statistical concept of causality that is based on prediction, and it is not economic causality. Taking for DNRP and M0 for example, the expression is

$$DNRP_t = c_N + \sum_{i=1}^{p} \alpha_i DNRP_{t-i} + \sum_{i=1}^{p} \beta_i M0_{t-i} + \mu_t \tag{8.6}$$

The null hypothesis (H0): $\beta_1 = \beta_2 = \ldots = \beta_p$. If testing can refuse the null hypothesis, the changes in M0 can not predict DNRP.

Impulse response functions and impulse response function. In economy, and especially in contemporary macroeconomic modeling, impulse response functions describe how the economy reacts over time to exogenous impulses, which economists usually call 'shocks', and are often modeled in the context of a VAR. Impulse function is use for describe how the price reacts over time to monetary shock In this paper. Aktham (2004) utilized the generalized approach to impulse response analysis in favor of the more traditional orthogonalized approach. This paper uses this generalized impulse response function. Variance decomposition measure how much of the forecast error variance of each variable can be explained by exogenous shocks to the other variables.

8.6 Empirical Results

8.6.1 Pre-treatment and Testing

In order to eliminate heteroscedasticity and reduce the probability of non-stationarity, we apply natural logarithm on the series, which also can narrow the volatility gap among terms.

Monthly or quarterly economic indexes generally contain four components, which are trend, cycle, irregular and seasonal changes. Seasonal component are caused by climate, social institute, custom, and so on. The productive activity of natural rubber is restricted by weather, which similarly changes year by year. We can find some law about the monthly prices of natural rubber by observing and comparing, for instance, the price may go up at previous months and drop at last in some years. Because the strong demand for Spring Festival, M0 significantly increases in January or February each year. This paper uses the additive model of X11 to eliminate seasonal component, and the treated variables are represented by the origin notations.

8.6.2 Stationarity Test

The results of ADF (Augment Dickey-Fuller) indicate that all of the variables are *I* (1) at the 0.01 level. Under the PFE and AIC criterions, the optimal lag is two (2), and Roots-Test of Characteristic Polynomial indicates that VAR doesn't satisfy the stability condition. As showed in Table 8.1, some of the same-term-relationships are significantly strong, such as natural and synthetic rubber prices, short-term loan and synthetic rubber prices.

Table 8.1 The estimated a matrix of Eq. (8.4)

	M0	M1	SLOAN	LLOAN	DNRP
M1	0.1823				
SLOAN	−0.1109*	−0.0897***			
LLOAN	**−0.3829*** **	−0.0034	0.3135***		
DNRP	0.3728	−0.038	**−1.2092** **	0.2113	
DSRP	−0.3846	0.2444*	0.0515	0.4721	**−0.5224*** **

Note: *** denotes rejection of the hypothesis at the 0.01 level; ** at the 0.05 level; * at the 0.1 level

Table 8.2 Unrestricted co-integration rank test (trace)

Hypothesized no. of CE(s)	Eigen-value	Trace statistic	0.05 critical value	Prob.**
None*	0.3459	160.8394	103.8473	0.0000
At most 1*	0.1933	94.6227	76.9728	0.0012
At most 2*	0.1614	61.1093	54.0790	0.0104
At most 3	0.1018	33.6592	35.1928	0.0725
At most 4	0.0845	16.9186	20.2618	0.1356
At most 5	0.0200	3.1505	9.1645	0.5530

Note: *denotes rejection of the hypothesis at the 0.05 level; **MacKinnon-Haug-Michelis (1999) p-values; Trend assumption: No deterministic trend (restricted constant)

8.7 Co-integrated Relationship

Johansen's tests finds there are three (3) co-integrated equations at the 0.05 level, which mean that there are long-term equilibriums among the monetary variables and prices. The increase in money supply and loan may boost the natural and synthetic rubber prices, and the rational explanation is that loose monetary easily stimulate the demand of the tire and its related industries (Table 8.2).

8.8 Vector Error Correct Model

Firstly, it measure the error correction term through the cointegrating equation. Secondly, the VECMs are estimated by OLS, and the variables whose coefficient is not statistical significant under the lag-order from zero (0) to six (6), will be removed. From the estimated VECMs shown in Table 8.3, it can find that all co-integrated relationship affects the price deviation from the equilibrium. The reason why the readjustment force on DSRP is stronger than DNRP, is that synthetic rubber belongs to capital-intensive industry. One-different M0 and six-lag LLOAN have adjusted force on DSRP, but they does not significantly effect on DNRP.

Table 8.3 The estimated VECMS

Dependent variable: D(DNRP)			Dependent variable: D(DSRP)		
Variable	Coefficient	Prob.	Variable	Coefficient	Prob.
CEM1	−0.0272	0.0000	CEM1	−0.0278	0.0000
CEM2	−0.0455	0.0000	CEM2	−0.0464	0.0000
CEM3	−0.0315	0.0002	CEM3(−1)	−0.0320	0.0000
D(M1)	−0.6388	0.0728	**D(M0)**	1.4323	0.0000
D(SLOAN(−2))	−1.1763	0.0065	D(M1(−2))	0.7679	0.0108
D(DSRP)	0.6991	0.0000	D(SLOAN(−1))	0.7268	0.0610
C	−0.0436	0.0090	**D(LLOAN(−6))**	0.4967	0.0626
			D(DSRP(−1))	0.2208	0.0006
			D(DNRP)	0.4394	0.0000
			C	0.0280	0.0205
Log likelihood	257.4972		Log likelihood	274.8825	
F-statistic	23.7049		F-statistic	25.78223	

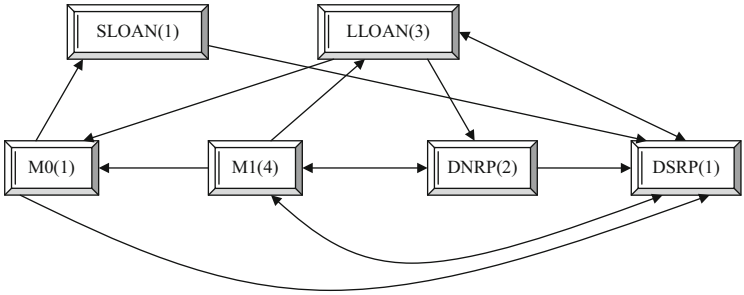

Fig. 8.5 The result of Granger casual test. Notes: The *arrow* indicates that the former is Granger cause to the latter at the 0.05 significance level. The *numbers in parentheses* show how many relationships the Granger causality to the others

8.9 Granger Causal Test

M1 is Granger causal to all of the other except SLOAN, so it has most powerful predictability. The seconds are LLOAN, DNRP, SLOAN, M0 and DSRP as shown in Fig. 8.5. The changes in money supply may be the signals to predict the credit scale and the price of natural and synthetic rubber.

8.10 Impulse Response Function

Orthogonalization process adopt the same-period-structure on error term, the biggest problem of which is a priori judgment to its VAR model structure, and it lacks of adequate theoretical basis (Bernanke 1986; Cooley and LeRoy 1985; Swanson

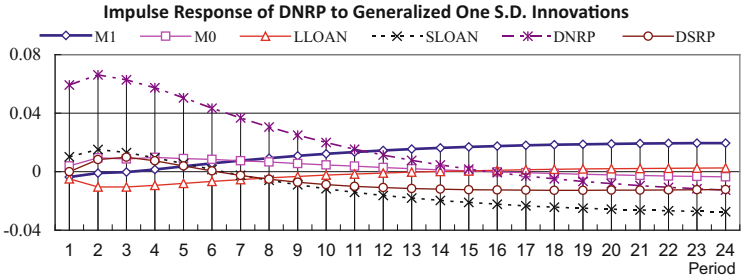

Fig. 8.6 Impulse response of DNRP to generalized one S.D. innovations

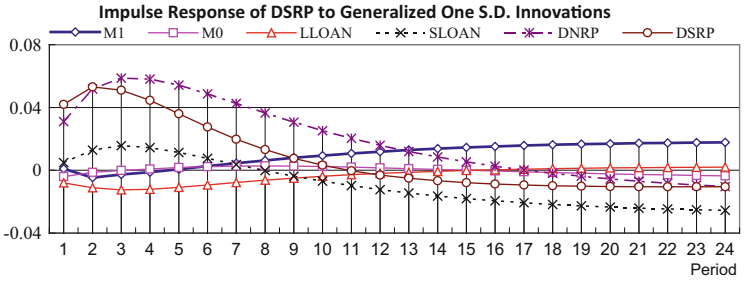

Fig. 8.7 Impulse response of DSRP to generalized one S.D. innovations

and Granger 1997). In the experience analysis, the ordering of variables plays a very important role, and different order may result in significant different conclusions. In order to solve this problem, Pesaran and Shin (1998) proposed the generalized impulse vector function, the results of which do not depend on the order. And we adopt the method.

Figures 8.6 and 8.7 indicate that the most important volatility of the prices comes from themselves instead of monetary shock. The price's responses to M0 and SLOAN are similar, which are very important indexes of liquidity. The affect of monetary shock on the price becomes more intense with the periods, especially the M1, which is a very liquid measure of the money supply and contains cash and assets that can quickly be converted to currency. Comparing to synthetic rubber, natural rubber has more important status in the economy, which is similar to Liu et al. (2010).

8.11 Forecast Variance Decomposition

Forecast variance decomposition can give out contribution rate of each market to the other one, from which we can learn the relative importance of the various markets in the system (Elyasiani et al. 2007). The decomposed results depend on

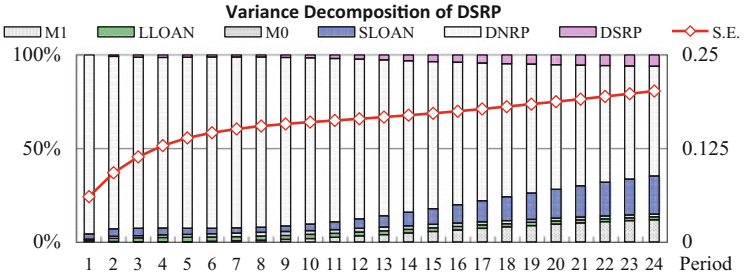

Fig. 8.8 Variance decomposition of DSRP

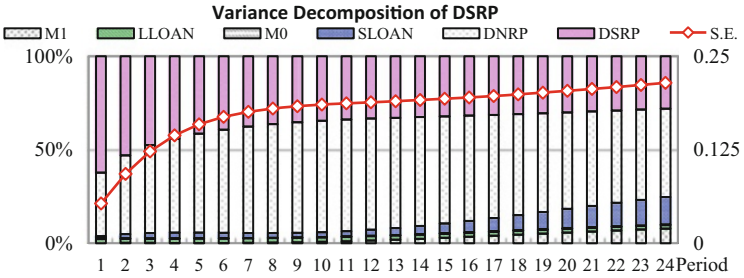

Fig. 8.9 Variance decomposition of DSRP. Cholesky ordering: M1 LLOAN M0 SLOAN DNRP DSRP

the variable-ordering in VARs under Cholesky decomposition. According to Granger test, we built VAR (M1, M0, LLOAN, SLOAN, DNRP, DSRP) and VAR (M1, LLOAN, M0, SLOAN, DNRP, DSRP), and ANOVA result finds that the VARs have no significant difference.

The indexes of monetary policy lacks of power to explain the prices innovation of predicted variance at the previous month, and the percentage less than 10 %. But the contribution rates of money supply and loan for explaining price variances are increasing, as shown in Figs. 8.8 and 8.9.

8.12 Conclusion and Discussion

Money supply, loan and the price have long-term equilibriums. On the other say, they have similar trend. When PBC implicate carries out ease monetary policy, and the prices may go up. The co-integrated relationships have adjusted force on the prices when they go away the equilibrium. M1 and Medium & Long-term Loans have stronger predictability for the price. The change in monetary policy does not affect the price immediately, and the influence strengthens with the periods. The

price volatility mainly comes from itself and substituted product market, but we should not ignore the changes in monetary policy.

We should pay attention to PBC's actions, because of that the policy is continuous during some period. The Loose monetary policy may greatly push up the price of rubber. If PBC lowered the deposit reserve rate and benchmark interest rate to reduce the down-ward pressure of national economy, the increasing of liquidity may simulate the prices.

The same period changes in monetary policy may result very different consequence among product markets, such as the capital-intensive synthetic rubber industry has more significant response to the changes. Along with the reinforcing financial feature of natural rubber reinforced, monetary policy has more obvious impact on the prices of natural rubber. Owing to the difference in resource endowments, developing model and so on, the changes in monetary policy play different role in regional economic development. We will study on this issue in the future.

Acknowledgement The paper is the progressive achievement of National Philosophy and Social Science Fund Project ("*Study on Price Volatility of Tropical Agricultural Products*", 11CJY064); we are also grateful to the financial support of Hainan province's Natural Science Foundation Project ("*RMB Exchange Rates Impact on the Prices of Import Natural Rubber*", 712137), the Fundamental Research Funds for Rubber Research Institute, CATAS ("*Study on the Undulation of Natural Rubber's Price*", YWFZX2010-02(N)).

Appendix

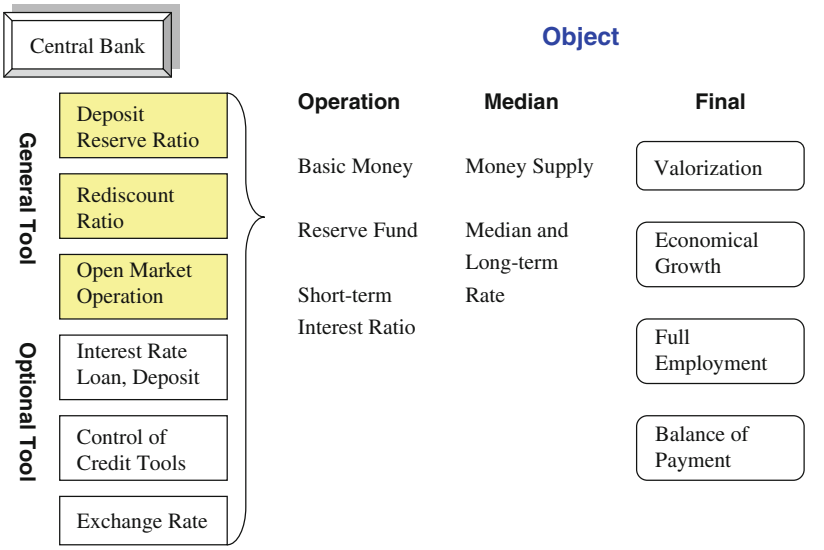

Fig. A.1 The tools and objects for central bank to change the monetary policy

Table A.1 Changes in deposit benchmark interest rate (%)

		Time deposits					
Date	Demand deposits	3-Month	6-Month	1-Year	2-Year	3-Year	5-Year
2011-4-6	0.50	2.85	3.05	3.25	4.15	4.75	5.25
2011-2-9	0.40	2.60	2.80	3.00	3.90	4.50	5.00
2010-12-26	0.36	2.25	2.50	2.75	3.55	4.15	4.55
2010-10-20	0.36	1.91	2.20	2.50	3.25	3.85	4.20
2008-12-23	0.36	1.71	1.98	2.25	2.79	3.33	3.60
2008-11-27	0.36	1.98	2.25	2.52	3.06	3.60	3.87
2008-10-30	0.72	2.88	3.24	3.60	4.14	4.77	5.13
2008-10-15	0.72	3.15	3.51	3.87	4.41	5.13	5.58
2008-10-9	0.72	3.15	3.51	3.87	4.41	5.13	5.58
2007-12-21	0.72	3.33	3.78	4.14	4.68	5.40	5.85
2007-9-15	0.81	2.88	3.42	3.87	4.50	5.22	5.76
2007-8-22	0.81	2.61	3.15	3.60	4.23	4.95	5.49
2007-7-21	0.81	2.34	2.88	3.33	3.96	4.68	5.22
2007-5-19	0.72	2.07	2.61	3.06	3.69	4.41	4.95
2007-3-18	0.72	1.98	2.43	2.79	3.33	3.96	4.41
2006-8-19	0.72	1.80	2.25	2.52	3.06	3.69	4.14
2004-10-29	0.72	1.71	2.07	2.25	2.70	3.24	3.60
2002-2-21	0.72	1.71	1.89	1.98	2.25	2.52	2.79
1999-6-10	0.99	1.98	2.16	2.25	2.43	2.70	2.88

Data source: The People's Bank of China

Table A.2 Changes in loan benchmark interest rates

	Short-term Loan		Median and Long-term Loan			Loan of personal housing accumulation fund	
Date	Less-than 6-Month	6-Month to 1-Year	1-Year to 3-Year	3-Year to 5-Year	More-than 5-Year	Less-than 5-Year	More-than 5-Year
2011-7-7	6.1	6.56	6.65	6.9	7.05	4.45	4.9
2011-4-6	5.85	6.31	6.4	6.65	6.8	4.2	4.7
2011-2-9	5.6	6.06	6.1	6.45	6.6	4	4.5
2010-12-26	5.35	5.81	5.85	6.22	6.4	3.75	4.3
2010-10-20	5.1	5.56	5.6	5.96	6.14	3.5	4.05
2008-12-23	4.86	5.31	5.4	5.76	5.94	3.33	3.87
2008-11-27	5.04	5.58	5.67	5.94	6.12	3.51	4.05
2008-10-30	6.03	6.66	6.75	7.02	7.2	4.05	4.59
2008-10-27	6.12	6.93	7.02	7.29	7.47	4.05	4.59
2008-10-9	6.12	6.93	7.02	7.29	7.47	4.32	4.86
2008-9-16	6.21	7.2	7.29	7.56	7.74	4.59	5.13
2007-12-21	6.57	7.47	7.56	7.74	7.83	4.77	5.22
2007-9-15	6.48	7.29	7.47	7.65	7.83	4.77	5.22
2007-8-22	6.21	7.02	7.2	7.38	7.56	4.59	5.04
2007-7-21	6.03	6.84	7.02	7.2	7.38	4.5	4.95
2007-5-19	5.85	6.57	6.75	6.93	7.2	4.41	4.86
2007-3-18	5.67	6.39	6.57	6.75	7.11	4.32	4.77
2006-8-19	5.58	6.12	6.3	6.48	6.84	4.14	4.59
2006-4-28	5.4	5.85	6.03	6.12	6.39	4.14	4.59
2005-3-17	5.22	5.58	5.76	5.85	6.12	3.96	4.41

Data source: The People's Bank of China

Table A.3 Changes in deposit reserve requirement ratios

			Before	After	Adjustment margin
ID	Date	Institutions	%	%	Percentage point
45	18-May-2012	LFI	20.50	20.00	−0.5
		MSFI	17.00	16.50	−0.5
44	24-Feb-2012	LFI	21.00	20.50	−0.5
		MSFI	17.50	17.00	−0.5
43	5-Dec-2011	LFI	21.50	21.00	−0.5
		MSFI	18.00	17.50	−0.5
42	20-Jun-2011	LFI	21.00	21.50	0.5
		MSFI	17.50	18.00	0.5
41	18-May-2011	LFI	20.50	21.00	0.5
		MSFI	17.00	17.50	0.5
40	21-Apr-2011	LFI	20.00	20.50	0.5
		MSFI	16.50	17.00	0.5
39	25-Mar-2011	LFI	19.50	20.00	0.5
		MSFI	16.00	16.50	0.5
38	24-Feb-2011	LFI	19.00	19.50	0.5
		MSFI	15.50	16.00	0.5
37	20-Jan-2011	LFI	18.50	19.00	0.5
		MSFI	15.00	15.50	0.5
36	20-Dec-2010	LFI	18.00	18.50	0.5
		MSFI	14.50	15.00	0.5
35	29-Nov-2010	LFI	17.50	18.00	0.5
		MSFI	14.00	14.50	0.5
34	16-Nov-2010	LFI	17.00	17.50	0.5
		MSFI	13.50	14.00	0.5
33	10-May-2010	LFI	16.50	17.00	0.5
		MSFI	13.50	–	–
32	25-Feb-2010	LFI	16.00	16.50	0.5
		MSFI	13.50	–	–
31	18-Jan-2010	LFI	15.50	16.00	0.5
		MSFI	13.50	–	–
30	25-Dec-2008	LFI	16.00	15.50	−0.5
		MSFI	14.00	13.50	−0.5
29	5-Dec-2008	LFI	17.00	16.00	−1
		MSFI	16.00	14.00	−2
28	15-Oct-2008	LFI	17.50	17.00	−0.5
		MSFI	16.50	16.00	−0.5
27	25-Sep-2008	LFI	17.50	17.50	–
		MSFI	17.50	16.50	−1
26	7-Jun-2008		16.50	17.50	1
25	20-May-2008		16.00	16.50	0.5
24	25-Apr-2008		15.50	16.00	0.5
23	18-Mar-2008		15.00	15.50	0.5
22	25-Jan-2008		14.50	15.00	0.5
21	25-Dec-2007		13.50	14.50	1
20	26-Nov-2007		13.00	13.50	0.5

(continued)

Table A.3 (continued)

ID	Date	Institutions	Before %	After %	Adjustment margin Percentage point
19	25-Oct-2007		12.50	13.00	0.5
18	25-Sep-2007		12.00	12.50	0.5
17	15-Aug-2007		11.50	12.00	0.5
16	5-Jun-2007		11.00	11.50	0.5
15	15-May-2007		10.50	11.00	0.5
14	16-Apr-2007		10.00	10.50	0.5
13	25-Feb-2007		9.50	10.00	0.5
12	15-Jan-2007		9.00	9.50	0.5
11	15-Nov-2006		8.50	9.00	0.5
10	15-Aug-2006		8.00	8.50	0.5
9	5-Jul-2006		7.50	8.00	0.5
8	25-Apr-2004		7.00	7.50	0.5
7	21-Sep-2003		6	7	1
6	21-Nov-1999		8	6	−2
5	21-Mar-1998		13	8	−5
4	Sep-1988		12	13	1
3	1987		10	12	2
2	1985	The reserve requirement ratio was 10 % for all of the financial institutions			
1	1984	The reserve requirement ratio of enterprises was 20 %, rural deposit 25 %, saving deposit 40 %			

The financial companies are not belonging to small scale financial institutions.
LFI represents Large-size Financial Institutions, and MSFI represents Median and small-size Financial Institutions.

Data source: The People's Bank of China

Table A.4 The implications of monetary tools

Year	Deposit reserve ratio[a]	Rediscount ratio	Open market operation	Benchmark interest rate[b]
2000	No change, 6 %			
2001	No change, 6 %	Increasing 0.81 %, 2.16 % → 2.97 %	Withdrawing RMB 0.8529 trillion basic money, releasing 0.8253 trillion	
2002	No change, 6 %		Between Jun 25 and Dec. 10, withdrawing RMB 1,842 trillion	Deposits ↓0.25 % Loans ↓0.5 %
2003	↑1 time, 6 % → 7 %		Withdrawing RMB 1.3186 trillion, releasing 1.0492 trillion. Issuing central bank bills 0.72268 trillion	
2004	↑1 time, 7 % → 7.5 %	Increasing 0.27 %.	Withdrawing RMB 0.669 trillion, releasing 1.6098 trillion. Issuing central bank bills 1.5072 trillion	Deposits ↑0.27 % 1.98 % → 2.25 % Loans ↑0.27 % 5.31 % → 5.58 %
2005	No change, 7.5 %		Withdrawing RMB 0.7380 trillion, releasing 0.0368 trillion. Issuing central bank bills 2.7882 trillion	
2006	↑3 times, 7.5 % → 9 %		Issuing central bank bills RMB3.65 trillion	Deposits ↑0.27 % Loans ↑0.27 %
2007	↑10 times, 9 % → 14.5 %		Repos RMB1.27 trillion. Issuing central bank bills RMB4.07 trillion	Deposits ↑1.62 %, 2.52 % → 4.14 % Loans ↑0.27 % 6.12 % → 7.47 %
2008	↑5 ↓3 times, 14.5 % → 15.5 %	4.32 % → 1.80 %	Repos RMB3.3 trillion. Issuing central bank bills RMB4.3 trillion	Deposits ↓1.89 % 4.14 % % → 2.25 % Loans ↓2.16 % 7.47 % → 5.31 %
2009	No change, 15.5 %		Repos RMB4.0 trillion. Issuing central bank bills RMB4.2 trillion	
2010	↑6 times, 15.5 % → 18.5 %	1.80 % → 2.25 %	Repos RMB4.2 trillion. Issuing central bank bills RMB2.1 trillion	Deposits ↑0.5 % Loans ↑0.5 %

(continued)

Table A.4 (continued)

Year	Deposit reserve ratio[a] Rediscount ratio	Open market operation	Benchmark interest rate[b]
2011	↑6 ↓1 times, 18.5 % → 21 %	Repos RMB1.4 trillion. Issuing central bank bills RMB2.5 trillion	Deposits ↑0.75 % Loans ↑0.75 %
2012.1-6	↓2 times, 21 % → 20 %	Repos RMB0.944 trillion	Deposits ↓0.5 % Loans ↓0.56 %

Data source: "China Monetary Policy Report" from the People's Bank of China

[a]The reserve requirement ratios in this table for Large-size Financial Institutions and more details are shown in Table A.4. ↑ (↓) represents increasing (decreasing)

[b]The changes in interest rate are for all of the deposits, and the other ones one-year deposits and loans

Table A.5 Summary statistical description

	Money (M1)	Currency in circulation (m0)	Short-term loan	Long-term loan	Natural rubber price	Synthetic rubber price
Mean	143,489	28,686	142,190	117,250	18,701	15,029
Median	114,846	24,964	100,566	96,654	17,491	14,614
Std. Dev.	82,538	12,883	107,622	51,768	8,103	6,047
Kurtosis	−1.0268	−0.5597	−0.8306	0.2277	−0.4651	0.2540
Skewness	0.6196	0.7083	0.7802	1.0703	0.5049	0.6932
Maximum	311,229	62,450	367,239	259,872	39,382	33,969
Minimum	44,679	13,006	23,851	62,958	7,114	6,481
Observations	159	159	159	159	159	159

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Chapter 9
Analysis and Forecast of World Corn Market Trade and Policy

Yantao Yang, Zhongli Zhou, and Fu Qin

Abstract In 2012, the world corn production decrease is in the second consecutive years, which indicated the situation of supply and demand is tense. International maize prices have generally risen, and the quantity of corn trade has decreased, so the export pattern has changed. The Chinese maize production continuously increases in 2012, caused by the corn planting area and unit production increase. The amount of corn consumption remains rigid growth, and the relationship between corn supply and demand is still in tight balance; the corn market prices reflect the trend of increase before and decrease latter in "the turning point of September"; corn imports increased significantly over the previous year. In view of the existing problems in the development of China's corn industry, it put forward to rely on science and technology to improve corn unit yield, to implement the strategy of import country diversification, to improve the range of the corn price growth for the temporary storage and other suggestions.

Keywords Corn • Market • Trades • Policy

9.1 The Analysis of World Corn Supply and Demand, Market and Trade Changes in 2012

9.1.1 Analysis of World Corn Production

The global corn output continuously reduces from 2012 to 2013, especially for American's reduction. According to the forecast of US Department of Agriculture in January 2013, the world corn yield is 852,300,000 tons from 2012 to 2013, 3.54 %

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_9,

less than 2011/2012. Unit area yield is 4.89 tons/ha, 6.14 % lower than last year, which is the second year after the reduction in year 2010/2011. This is mainly caused by the reduction of the United States, Brazil, and other main producing countries, in which the reduction range of the United States is bigger than other countries, reduced 13.2 % than last year. The main reason for reduction is the weather calamity.

9.1.2 Analysis of World Corn Consumption

World maize consumption has grown over the previous year. Among the consumption, the industrial consumption has been further compressed, feeding consumption is rigid growth, the ratio of inventory and consumption has continued to decline, and the situation of supply and demand is tense. According to the forecast of US Department of Agriculture in January 2013, the world corn consumption in 2012/2013 will reach 873.9 million tons, 1.18 % more than the year before; the ratio of inventory and consumption is only 13.27 %, 1.99 % lower than the previous year, far below the warning line. The ratio of corn stock consumption remains at low level, and the price maintains at high, which cause that: the corn planting area enlarged violently because of the growing benefits of planting corn in some main production countries, like the United States, China, Argentina, Ukraine, Brazil; the animal feeding grains and the growing fields gradually diversified since the substitutes of wheat is increasing in the global from the summer in 2011.

9.1.3 Analysis of World Corn Market

① The prices of world corn have fluctuated in a wide range, but they are significantly increasing in general.

Influenced by the tense situation of supply and demand in 2012, the international corn price remains high, and has experienced the second high point since April of 2008. The corn quote price of CBOT is 771.2 % per bushel, higher than the high point of April, 2008 (619.4 % per bushel) and April, 2011 (756.4 % per bushel).

② The correlation between the price of international corn and oil is comparatively high.

Due to more and more corn are used to produce biofuel of ethanol, seen from Fig. 9.1, the correlation between the price trend of international corn and oil is comparatively high (the correlation coefficient reaches 0.83 or over). Thus, the corn gradually shows its financial attribute and political attribute.

9.1.4 Analysis of World Corn Trade

World corn trade volume of 2012 has declined, and export pattern has changed. According to the United States Department of Agriculture forecast, the world corn

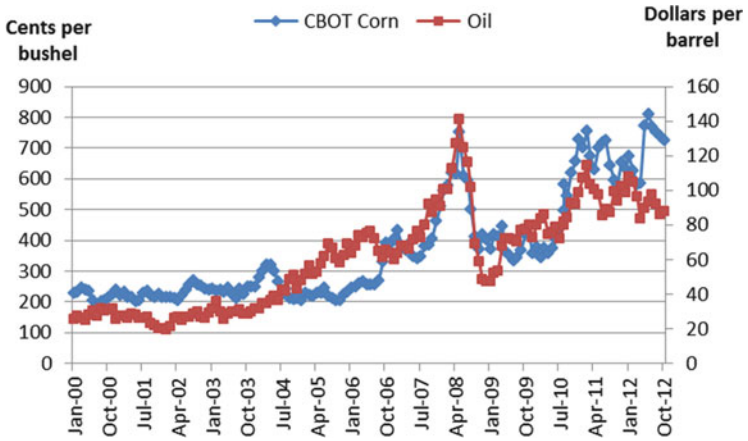

Fig. 9.1 The change of CBOT corn price and international oil price (Source of data: the United States Department of Agriculture)

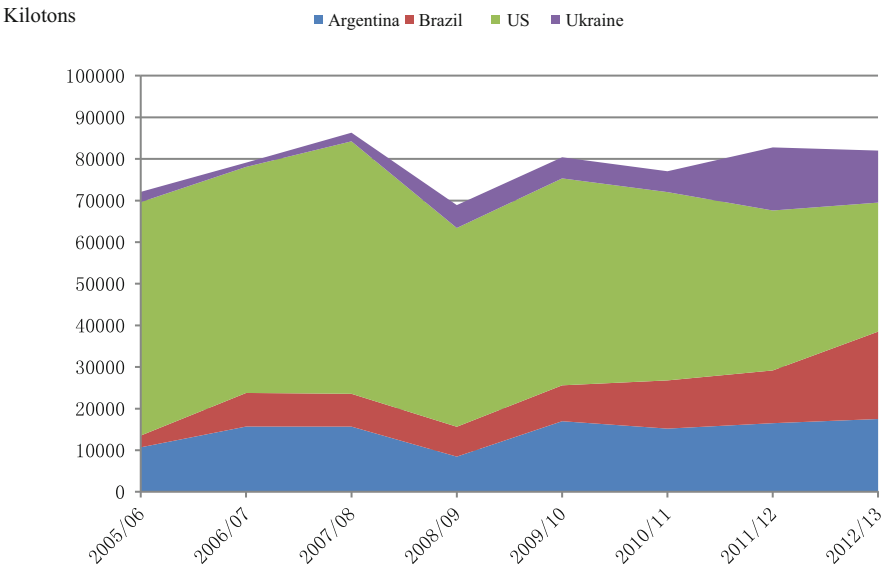

Fig. 9.2 Changes of corn exports of the main exporter of world (Source of data: the United States Department of Agriculture)

trade volume in 2012–2013 is 97.04 million tons, could be declined by 5.9 % over the previous year. The main reason is the reduced production of the United States. World corn export pattern has gradually changed, mainly because the absolute number of the American corn exports and market share have declined, while Brazil and Ukraine corn export volume have quickly grown, and Argentina is relatively stable (Fig. 9.2).

9.2 The Analysis of Chinese Corn Supply and Demand, Market, Trade and Policy in 2012

9.2.1 Analysis of Corn Production in China

Chinese corn yield increased by 8 % in 2012, because the corn planting area and unit yield increased simultaneously. According to the data of National Bureau of Statistics, the national yield of corn is 208.12 million tons, increasing 15.34 million tons, 8 % higher than the yield in 2011. The corn yield is 3.83 million tons more than rice yield, to become the largest food crop for the first time.

Table 9.1 shows the planting area, yield and the unit yield changes of corn in China. By using the average method of factor analysis, it has turned out that the improvement of Chinese corn yields from 2000 to 2012 is a result of both cultivation area and the unit yield. However, the area expansion plays a major role in it. Based on planting areas and the unit yield in 6 respective periods from 2000 to 2012, Table 9.2 shows the contribution volume[1] and rate of these two factors to output growth. According to the calculation, the unit yield provides a bigger contribution than cultivation areas from 2000 to 2002, 2002 to 2004 and 2010 to 2012. During another three periods, it has come to an opposite conclusion. Particularly, the contribution of unit yields was negative from 2008 to 2010 because of their decreased yields. From 2000 to 2012, the expansion of cultivation area is the main reason for the increased yield, providing 61.44 % contribution rate to the increase of production. On the other hand, the contribution rate of unit yield is only 38.56 %.

9.2.2 Analysis of Chinese Corn Consumption in 2012

① In general, corn consumption has maintained rigid growth. The consumption structure, however, has presented a significant change.

In recent years, corn consumption has maintained rigid growth due to the feeding and industrial consumption. The corn consumption has increased by 98.42 million tons from 107 million tons to 205.5 million tons in 2000 and 2012 respectively. The growth rate is 92 % and the average annual growth rate is 7.66 %. Meanwhile, the consumption structure has experienced a significant change, which shows the decline of feeding consumption rate and the increase of industrial consumption rate. The absolute quantity of feeding consumption has increased, but the comparative proportions have decreased. On the contrary, both the absolute quantity and

[1] $\Delta\overline{A_t} = \frac{A_t - A_0}{2!}(B_t + B_0)$, $\Delta\overline{B_t} = \frac{B_t - B_0}{2!}(A_t + A_0)$

A_t, A_0 represent the grain planting areas of the reporting period and base year respectively; B_t, B_0 represent the grain yield of unit area of the reporting period and base year respectively.

Table 9.1 The change of Chinese corn production from 2000 to 2012

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Cultivation area (thousand hectare)	23,056	24,282	24,634	24,068	25,445	26,358	28,463	29,478	29,864	31,183	32,500	33,542	34,949
Yield (ton/ha)	106,001	114,094	121,310	115,830	130,289	139,372	151,603	152,300	165,917	163,974	177,245	192,781	208,130
Unit yield (kiloton)	4.60	4.70	4.92	4.81	5.12	5.29	5.33	5.17	5.56	5.26	5.45	5.75	5.96

Source of data: National Grain and Oils Information Center of China

Table 9.2 The comparison of contribution rate between the change of planting area and unit yield to corn production

	Contribution volume			Contribution rate		
Year	Yield	Area	Unit yield	Yield (%)	Area (%)	Unit yield (%)
2000–2002	15,309	7,513	7,796	100.00	49.07	50.93
2002–2004	8,979	4,073	4,906	100.00	45.36	54.64
2004–2006	21,314	15,764	5,550	100.00	73.96	26.04
2006–2008	14,314	7,623	6,691	100.00	53.25	46.75
2008–2010	11,328	14,510	−3,182	100.00	128.09	−28.09
2010–2012	30,885	13,970	16,915	100.00	45.23	54.77
2000–2012	102,129	62,752	39,377	100.00	61.44	38.56

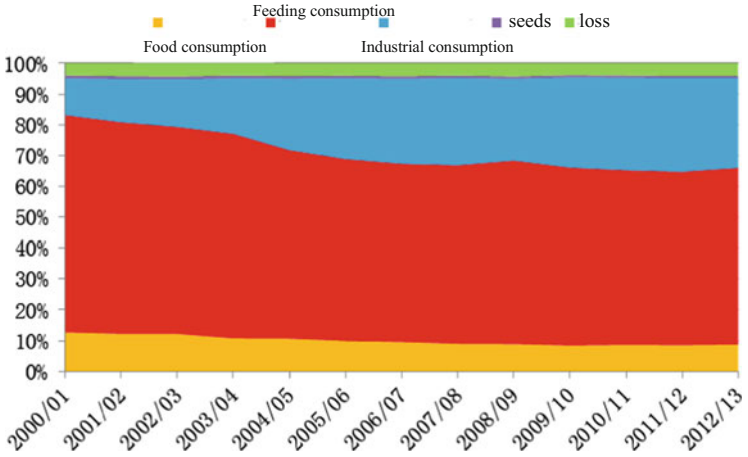

Fig. 9.3 The change of the corn consumption structure in China from 2000 to 2012 (Source of data: National Grain and Oils Information Center of China)

comparative quantity have grown rapidly, which obviously show the competition situation for grains between industry and feeding (Fig. 9.3).

② The situation of supply and demand has improved but still in tight balance

China National Grain and Oils Information Center predicted the consumption of corn would be 20.545 million tons in 2012–2013, and the production of corn would be 268 tons more than consumption. Meanwhile, due to the increase of corn import, the surplus of corn increased in 2012. Thus, the relationship of corn supply-demand had been improved. But the increase of corn consumption is faster than the increase of production, so the supply-demand of corn is still in tight balance.

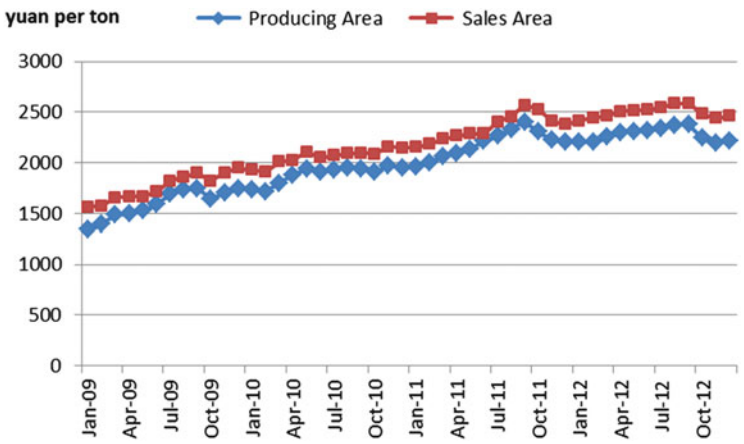

Fig. 9.4 The change of average price between producing area and sales area in China

9.2.3 Analysis of Chinese Corn Market Change in 2012

The change of domestic corn market in 2012 was similar to the change in 2011, and the price of corn went up before September (as the turning point), then it went down. The reasons were as follow: both of the average prices of corn-producing region and selling area had been increasing from January to September. Due to the launch of temporary purchasing of storing by government, the corns of North China couldn't come into the market for their quality problems, and the government corn purchase concentrated on Northeast China, so that the supply of corn was tight and the price of corn increased. However, because of increased corns import and improved quality of corns in North China, the price of domestic corn had been stably decreased from April to June. However, influenced by the decreased production of corns in USA and the sharp increase of international price of corns from June, the domestic corn price recovered to rise. Due to the good harvest of corns and the start of new season corns, the domestic corn price went down from October, and it was lower than wheat price in December (Fig. 9.4).

9.2.4 Analysis of Corn Trade Change in China

① Changes in the pattern of Chinese corn imports and exports

China has changed from a net exporter of corn to a net importer since 2010. The corn import increased significantly in 2012, and the corn imported mainly from the United States. According to the statistic of the Customs of China, Chinese corn import is 5.207 million tons in 2012, 197 % more than the import of 2011. The significant increase of domestic corn import mainly depends on two factors: one is the import of national policy. The purposes of the nation are to replenish stock,

strengthen macro regulation and control ability, and increase imports, which can make the domestic market more stable; the other is the change of the price differences at home and abroad. Since the influence of the fall of American CBOT corn price in later September of 2011, the import corn duty-paid price is lower than Guangdong port price, which shows the imported corn already has a price advantage.

② The influence of corn trade change on the domestic corn industry

The increase in imports of corn as well as the normalization of import will influence the domestic corn industry to some extent. The influences are as follows: Firstly, it increases the domestic supply, so the domestic prices have been pressed down. Secondly, it influences domestic corn circulation pattern. With the increase in the southern port imports of corn, the southern provinces will reduce the amount of corn purchased from the north. Thirdly, it can help to promote the optimization of the domestic feeding industry. Because a certain size corn import is conducive to reduce the purchasing cost for the large-scale feeding industry enterprises, the feeding industry consolidation will be accelerated.

9.2.5 Analysis of Corn Industry Regulation Policy in China

① The corn temporary purchasing and storage policies and its impacts in 2012

In November 2012, the government continues to carry out corn temporary purchasing and storage policy in the three provinces of northeast area. The corn listed prices of temporary purchasing and storage are identified as: 1.07 Yuan per catty in Neimenggu, Liaoning and Jilin, 1.05 Yuan per catty in Heilongjiang, which were increased by 0.07 Yuan per catty than 2011. The temporary purchasing and storage policy forms the bottom support on the market, stabilizing market expectations. At the same time, due to the policy level of corn has more advantages than wheat, soybean and cotton, the corn planting benefit is better than other crops. Thus, the corn planting areas continue to increase in 2012.

② The corn deep processing control policies and its impacts

The State Administration of Taxation issued the *Notice of VAT rate problem on the part of corn products by deep processing* in March 2012. In the notice, corn syrup, corn bran, corn fiber and corn gluten meal are not included in the primary agricultural products, and apply to the VAT rate of 17 %, 4 percentage points higher than the original rate of 13 %. In April, the Ministry of Finance decided to adjust the biofuel ethanol subsidies, reducing subsidies for corn-based fuel ethanol. The corn deep processing control exerted by the government aims at protecting national food security, in order to further inhibit the consumption demand of corn deep processing.

9.3 The Prospect of the Trend of the Global and China Corn Market and Trade in 2013

9.3.1 The Global

In view of international corn market in 2013, as the world largest corn producer and exporter, American corn supply and demand will have important impact on the international corn market. As the top production value of crops in the United States, the corn planting area has continuously grown in recent years, which is expected to reach the historical largest area in 2013. Although the drought decreased the production last year, the improved weather conditions will promote the corn production to resume growth. Therefore, in the short term, the international corn market will remain high and volatile situation affected by the American corn production decrease, insufficient supply and other reasons; in the long term, due to the corn producing benefits are still high, with the expansion of the corn planting area in the U.S. and China, corn production pressure is likely to emerge in advance if the weather disasters do not happen; furthermore, the impact of the European debt crisis is getting worse, the inhibition of the corn industry needs will also be bad for corn market. Therefore, the international corn prices more likely fall from a high position in the second half of 2013.

For corn trade, according to the forecast of the U.S. Department of Agriculture, the International Grains Council and the United Nations Food and Agriculture Organization, the global corn trade volume will continue to decline in 2013, mainly because of the reduction in imports of the major importing countries.

9.3.2 China

China's corn market price will continue to maintain a steady rise, but the range of increase will be limited by state regulation and corn yield harvest. The main factors of affecting the domestic corn market are as follow: firstly, the temporary purchasing and storage policy forms the bottom support on the market. Secondly, the corn yield increase and import increase lead to the increase of domestic supply. Thirdly, the government suppresses corn industrial demand by the regulation policy of corn deep processing.

The imports of domestic corn would be reduced, but the import normalization won't change. This is considered from two main aspects: on one hand, China imported 5.207 million tons of corn in 2012, which has significantly exceeded the total import of the previous year. So the tense of domestic supply and demand alleviated effectively. Therefore under the background of corn production significant increase of our country in 2012, the import of corn won't increase, or will be reduced. On the other hand, a major source of China's corn imports is still the

United States, but the corn price advantage is reducing. According to the data of the U.S. corn market on December 28, the price CIF including taxes of American yellow corn NO. 2 is 2,572 yuan per ton in March of 2013, 72 yuan higher than the quotation of the Northeast corn in Guangdong Port. However, along with the fall of international corn price in the latter half year, China will import a lot of corn as well.

9.4 Policy Recommendations

9.4.1 Improve Maize Yield Relying on Science and Technology Based on Domestic Production

The space of future corn planting area growth is getting smaller and smaller, so it is the main way to increase the yield of maize relying on science and technology. China has great potential for unit corn yield increase. Therefore, we should vigorously promote scientific and technological innovation, cultivate maize seeds with high quality and great yield, and strengthen the popularization and demonstration of cultivation technology of high yield. In order to further increase the corn yield, the concrete ways are to increase the instruction of the planting skills, strengthen the application and popularization of auxiliary technology of improved variety, and increase the technology subsidies of mulching enlargement and formula fertilization by soil testing. In addition, through the improvement of irrigation and water conservancy facilities and the expansion of the effective irrigation area, the yield of maize could be increased. According to the Ministry of Agriculture estimates, the irrigated unit maize yield is 1.47–1.53 times of dry land yield.

9.4.2 Change the Pattern of Import Source Concentration, and Implement the Strategy of Diversified Import Countries

The Chinese corn import country mainly relies on the United States. China imported 1.685 million tons of corn from the United States in 2011, accounting for 96 % of the total imports; and imported 5.113 million tons of corn from the United States in 2012, accounting for 98.2 % of total imports. Because of the American corn production decrease for three consecutive years, American corn export absolute quantity and market share both decreased. Therefore, considering the national food security, we should implement the strategy of diversified import countries. We should try to decentralize import countries as more as possible, and implement the negotiations with Argentina, South Africa and other transgenic corn trade countries as soon as possible to decentralize the market risk.

9.4.3 Improve Corn Temporary Purchasing and Storage Policy to Increase the Growth Rate of the Temporary Purchasing and Storage Price

The increase in production costs reduced the benefits of the grain production, affecting the enthusiasm of farmers to grow grain. In 2012, the corn production cost per catty has increased about 0.05–0.06 yuan in Huang-huai-hai of North China. What's more, the production cost in northeast has increased more than before, which has an increase of about 0.14 yuan per catty. While the national corn temporary storage and purchase price in 2012 is only 0.07 yuan per catty higher than that in 2011. The increased part of the price only can compensate for the rising part of the production cost, and it's even far from the compensation for the cost increase in the northeast. Therefore, adequately considering the farmer's planting benefits, it suggests to appropriately raising the temporary storage and purchase price. Thus, to improve the operation methods, we can take some concrete measures: the first step is to improve the investigation system of corn production cost, reflecting the actual corn production cost of farmers. Second, it is necessary to promote the land transfer. In order to gradually increase the cultivated land area, the comparative benefits can be enhanced on the base of moderate large-scale management. Third, considering the roughly equivalent income between farmers of growing grain and migrant workers, according to the survey, current farmers' income is about 20 % of the income of migrant workers. When the farmers' benefits of planting grain reach 80 % of the income of migrant, the comparative benefits of these two groups are roughly the same.

Chapter 10
Analysis on Current Fruit Market and Late Concerns in China

Junye Zhao and Qiao Zhang

Abstract In this paper, the current fruit market characteristics, import and export status in China were analyzed and predicted. Since 2013, the domestic fruit market has been in the general balance of supply and demand, and mainly the seasonal factors led price changes of varieties of fruits. Later with the newly listing fruits increase, the fruit prices are forecast to decline overall. Compared with the same period of 2012, in the first quarter of 2013, China's fruits export volume reduced whereas the price increased; fruit products exports fell both in volume and price; fruits and products import volume reduced whereas the price improved. It was put forward that special attention should be paid to the influence of abnormal weather on the supply of certain fruits. Also it needs sustained concerns on how to achieve quality, efficiency and coordination of production and marketing under the condition of increased production, and on how to relieve the dual pressure of the shortage of raw material supply and the descending of exporting price of fruit products.

Keywords Fruit • Domestic market • Trade • Trend • Late concerns

10.1 Current Situation and Trend of Domestic Market

10.1.1 The Overall Status of Domestic Market

In 2013 the opening price of fruit is relatively stable for the enough supply due to the fruit yield is forecasted up 6.6 % in 2012 and no serious natural disaster

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_10,

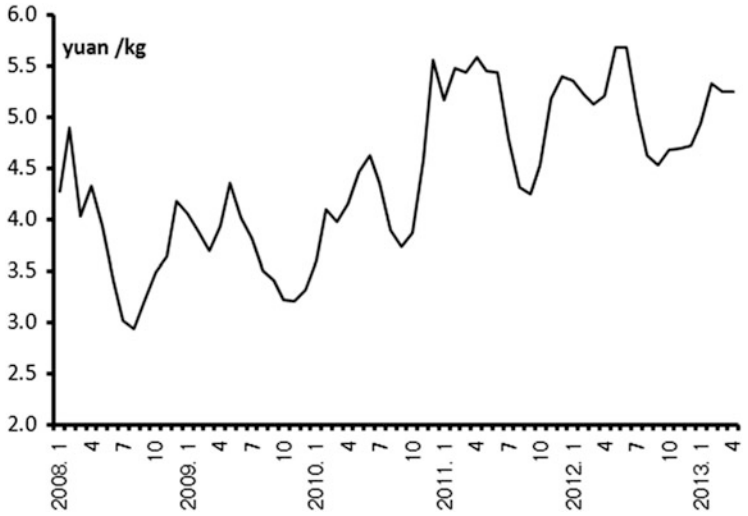

Fig. 10.1 Changes of monthly fruit wholesale price since 2008 (Data resource: The Chinese Ministry of Agriculture)

occurred on fruit production in spring both of Southern tropical fruit and the greenhouse fruits. On the other hand, most of fruit in season appeared later on the market than usual due to low temperature on different regions, and the drought in the north of China decreased the supply of part of fruit, which both resulted in the delay of the price turning to lower as normal years. According to the monitored data of the Ministry of Agriculture, the average wholesale price of the fruit was 4.94 yuan/kg in January, and continued flat at 5.3 yuan/kg during February to April (Fig. 10.1). Compared to the same period of 2012, the price decreased 7.8 % in January and increased slightly during February to April.

The trend of fruit market is thought decided mainly by the seasonal factors, namely, with the temperature increases, large fruit would go into market and the price trends to decline.

10.1.2 Price Changes of Different Fruits

According to the price data monitored by the Ministry of Agriculture and the Ministry of Commerce, the weekly apple wholesale price increased within a narrow range form 6.8 yuan/kg in the beginning of the January to 7.4 yuan/kg in the first 10 days of February, and then decreased slowly to 7.01 yuan/kg, which equal to the same period of the last year. The flat price of the last 4 months was mainly because of the increased production in 2012 accounting for the sufficient supply.

Influenced by the decreased yield, the wholesale price of the pear was flat at 4.5 yuan/kg in the first 3 months in 2013, which was significantly higher than that of the same period of the last year. The price after April kept down, but still higher than 2012.

The average price of the citrus was 4.7 yuan/kg in January and up to 5.56 yuan/kg in February then kept flat. The price was up 9.8 % than that of the last year in January, and up 20 % lately. Two reasons accounted for the increased price, one is production decreasing in part citrus belts in 2012, and the other is long-time low temperature and rainfall in the harvest time shorted the storage life of citrus and leading the shortage of stock during March to April.

The price of banana kept steadily increase from 3.88 yuan/kg in the early January to 5.01 yuan/kg in the early May. Compared with the same period of 2012, the price was significantly down in the first quarter, equal in April, but up 8.21 % in May. Hainan banana is dominant in current market. After 2 years of consecutive low prices in 2011 and 2012, the planted area of Hainan banana reduced dramatically and the short supply has pushed the price entering a new round of "up" period (Zhou Yueguang 2013).

Changes of grape price were mainly influenced by holiday factors in the former period. The average price flied from 7.4 yuan/kg in the early January to 8.08 yuan/kg in the middle February, and then decreased slowly to 7.54 yuan/kg at the end of the April. The price flied again at the early May due to short supply. Compared with that of 2012, the prices were down, such as 10 % in the April.

The price of the watermelons changed seasonally, which grown continually to 5.13 yuan/kg from January to the middle March, and then declined slowly to 4.54 yuan/kg in the beginning of May. The price was lower than that of the last year except for the beginning of March to the middle of April.

The price of pineapple was flat at 4.4 yuan/kg before the middle of February, and then down to no more than 3.78 yuan/kg in the later March for increased supply, and up again to 4.2 yuan/kg in April. The price was equal to the last year in the first 2 months but markedly down after March.

The price of strawberry kept down in the first 4 months in 2013, and significantly higher than that of last year. The wholesale price of the peach was 21.4 yuan/kg in the late of April, which was up more than 30 % compared with 2012, because the low temperature delayed the listing time of early-maturing peach.

Looking after May, the prices of the storage fruits such as apple and pear are forecast up for decrease stock. The prices of watermelon and peach are forecast down with increasing supply. The price of the grape is forecast up for shortage of domestic production and the supply depends mainly on import. The price of the banana is forecast kept high because the supply is still mainly depended on the Hainan region and the import.

10.2 The Export Status

10.2.1 The Total Export Was Down and the Price Was Up

In the first quarter of 2013, the export of fruits and fruit products was down 7.6 % to 1.14million tons and the value was down 3.8 % to 1.34 billion dollars. As for the

export product structure, the reduction of the export was mainly due to the decrease of fresh fruit and fruit juice. The export price of fresh fruit increased while the price of fruit juice and the canned fruit decreased markedly. As for the exporting markets, the Asia accounted for 64.8 % of the volume and 61.9 % of the value, the Northern America accounted for 16.61 % and 20.41 %, and Europe accounted for 15.15 % and 13.30 %, respectively.

The exports of fruits and fruit products to the USA, Malaysia and Russia account for 1/3 of the total exports, including the export volume of 161 thousand tons to USA with a value of 233 million US dollars, the export volume of 129 thousand tons to Malaysia with a value of 186 million US dollars and the export volume of 101 thousand tons with a value of 94.12 million US dollars. Compared with that of 2012, the export to America, Malaysia, Thailand, India and Kazakhstan increased, while the export for Russia, Vietnamese, Indonesia, Japan, Canada, and German decreased.

Looking after May, the export is forecast to decline because of the reduced domestic stock of fresh fruit and fruit product, such as fresh apple, the citrus fruit, concentrated apple juice (CAJ, Brix $> 20^{\circ}$), and citrus cans.

10.2.2 The Export of Fresh Fruits Decreased and the Price Increased

In the first quarter, the export of fresh fruits was down 10.5 % to 731 thousand tons, while the value was up 9.9 % to 755 million dollars. In which, the Asia accounted for 86.6 %, the Europe 12.1 %, the Northern America 1.2 %, the other regions less than 1 %. The citrus fruit and fresh apple were the main export components, however, the export of the citrus fruits decreased due to the shortage of domestic supply.

The export of the citrus fruits was down 22.28 % to 332.2 thousand tons, and the value was up 8.94 % to 379 million dollars. Asia was the major market of the citrus, in which 30.6 % exporting to Malaysia, 17.6 % to Vietnamese. Russia is the main market in the Europe, to which the export accounted for 11.06 % as 58.3 thousand tons. Compared to the same period in 2012, the export to Malaysia, Hong Kong, Kazakhstan increased dramatically, and that to Vietnamese, Philippines, Thailand and Indonesia decreased markedly. The export to Russia was down 7.3 % in volume, but was up 22.8 % in the value for the increased price.

The export of fresh apple was 265.7 thousand tons equal to that of the last year, and the value was up 5.6 % to 258 million dollars. India and Russia was the top two export markets, to which the export volume was 39.7 thousand tons and 349 thousand tons separately. Compared to the same period in 2012, the export to India, Thailand and Philippines increased, and that to Russia, Vietnam, Bangladesh, Indonesia decreased.

10.2.3 The Export of Fruit Products Decreased Slightly with the Declined Price

The export of fruit juice was down 5.7 % to 148 thousand tons, and the value was down 24.3 % to 248 million dollars, in which, the export of CAJ was 144 thousand tons. In the major export markets, compared with the same period of 2012, the export to Japan, Russia and Australia declined markedly, the export to South Africa, Germany and Israel increased. India is one another important market in Asia, to which the export of CAJ grown 6.5 % but the value decreased 11.7 %. The decline of CAJ export was mainly due to two reasons. One is the short supply because of the lack of raw material. The other is Poland surpassed USA as the world's second largest AJC producer and expanded the export to Russia and EU.

In the first quarter, the total export of canned fruit was equal to the same period of 2012, but the value was down 15.8 % to 173 million dollars, in which the export to USA was up 9.6 % to 68.7 thousand tons and the value was down 8 % to 77.9 million dollars. Compared with the first quarter of 2012, the export to Thailand, Holland, Canada raised; the export to Japan, Russia, Malaysia decreased slightly, and to German was down 43 %. The value of export declined due to the decreased price.

10.3 The Import Status

10.3.1 The Total Import Declined but the Price Grown

In the first quarter of 2013, the import of fruits and fruit products was down 17.41 % to 809 thousand tons, and the value was up 5.4 % to 1.1 billion dollars. In which, the import of fresh fruit was down 18.9 % to 735 thousand tons, and the value was up 6.8 % to 985 million dollars. The import of fruit juice was flat at 19.3 thousand tons and 43.9 million dollars. The import of canned fruits increased 21.3 % to 7.8 thousand tons and 8.5 million dollars. With the large listing of domestic fruits, the import is forecast down.

Seventy eight percent of the fruits and products imported from Asia, in which 24 %, 20 %, 8.4 % and 7.7 % from Vietnam, Thailand, Philippines and Burma respectively. 14 % imported from Latin American, mainly from Chile, Peru and Brazil. 4.6 % imported from North America, in which 3.5 % from the USA. Compared with the same period of 2012, the import from Thailand, Peru, Penghu, Kinmen and Matsu area increased markedly, but the import from Philippines, Burma, Chile, Brazil, South Africa and the USA was down.

10.3.2 The Import of Banana and Apple Increased but Citrus and Grape Declined

In the first quarter, the import of banana was down 55 % to 100 thousand tons, and the value was down 51.8 % to 58.4 million dollars, most of which imported from the Asia, namely, 71 %, 15 % and 5 % from Philippines, Burma and Thailand, separately. Also, part was from Latin American, in which 4.5 % from Ecuador.

The import of fresh apple was down 69.6 % to 5,859 tons and down 68.4 % to 9.5 million dollars, in which the import from the USA declined to zero, but the import from New Zealand nearly doubled.

The import of the citrus fruits increased 57.1 % to 225.8 million tons and 55.7 % to 31.1 million dollars, in which 88 % from the USA, 6.6 % from Penghu, Kinmen and Matsu area, and 5.1 % from Thailand. Compared with the same period of 2012, the import from the USA increased 64.4 %, driving the total import growing. The import of grape increased 10 % to 50.3 thousand tons, and the value was up 19.3 % to 148 million dollars.

10.4 Late Concerns

10.4.1 Effects of Abnormal Weather on Fruit Supply

Abnormal weather has occurred frequently on a large area since 2013, which may influence the production and supply of fruits. In early January and late February, the Southern regions of China have suffered twice low temperature and sleet processes, also frequent strong convection in March and April. The drought continued in many provinces in Northwest and Southwest of China; and spring floods has been serious in the Northeast; the Northern has suffered from low temperature and freezing disaster (Ministry of Civil Affairs and Office of the National Disaster Reduction Committee 2013a, b). More attention needed to be paid to the production and marketing of many fruits, such as lychee and longan in South regions, or peach and cherry in Northern regions.

10.4.2 The Coordination of Production and Marketing

In recent years, China's fruit industry developed rapidly, and with the expansion of the area and yield, structural oversupply of part varieties has been extended to the overall oversupply. Due to relatively concentrated varieties and time of fruit supplying, the structural unsalable still exists especially under increased-yield. For instance early citrus in Shimen of Hunan and Fuji apple in Mengyin, Yiyuan,

Rizhao, Yantai of Shandong has been slow-moving in late 2012, which damaged the profitability of the farmers dramatically.

Moreover, the production of fruit in China decentralized in small farmers, and marketing companies and farmers are mutually independent interest body, so contradiction highlights between small production and big market. From farmers to consumers, the fruit would go through a number of intermediate links and bring lots of costs, shared mainly by farmers and consumers in the end. The weak ability to resist risks and the general low marketing efficiency has affected the stable development of fruit industry.

In this regard, the coordination of the interests of three parties of production, management and consumption, the moderate production scale, and the diversification of fruit flavors and marketing period is the key to reduce of the abnormal fluctuation, promote the joint of production and sales, and realize long-term stable operation of fruit market.

According to the current situation, the price of Hainan banana continued to rise. To avoid large variation of planted area leading to large fluctuating of price, it should be carried out to statistics and report the banana planting timely and guide the farmers to expand planting area rationally, so to prevent the banana prices once again into the obvious price cycle.

10.4.3 The Dual Pressure of the Shortage of Raw Material Supply and the Descending of Price on Fruit Products Export

In the first quarter of 2013, the export prices of CAJ, and canned fruits were down significantly, which has highlighted the contradictions of increased cost in domestic manufacture and the decline of international selling price of fruit products. The decline of price was mainly due to exchange rate and the quality of the products, and the continued climbing of cost was mainly driven by the price increase of raw material and labor. For instance, Japan is an important export market for Taizhou canned fruits, which accounts for about 1/3 of the total export. Since October 2012, the yen continued to fall and the importer's cost continued to increase, brought adverse impact on Taizhou canned fruit export to Japan (The Entry-Exit Inspection and Quarantine Bureau of Taizhou 2013).

On the other hand, the contradiction continued to exist between tight supply of the raw materials and excess production capacity of processing enterprises, which easily lead to vicious competition on raw materials, so increase both the manufacture cost and the fruit price. Due to the lack of raw fruit, many factories, first of Jiangsu and Ningxia, and lately of Shandong and Liaoning, choose to stop production before December during the 2012 milling season. Chinese enterprises choose to stop rationally the production of CAJ, but not rushing to buy raw materials just as in the past, which is contributed to the balance of supply and demand in

international market and reducing the compact on domestic fruit market. However the lack of specific apple with high acidity and the industrialized production base is far from solved, which made it difficult to coordinate the supply and demand of raw fruit between processing enterprises and farmers, and hinder the promoting of competitiveness in the international market.

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Chapter 11
Rice Policy Reviews in China, Thailand and Vietnam: Policy Instruments, Targets and Impacts

Sina Xie, Orachos Napasintuwong Artachinda, Jun Yang, and Heguang Liu

Abstract This paper reviews the main rice policy reforms in China, Thailand and Vietnam during past five decades, summarize the policy targets and impacts these policies have had on its production, consumption and trade. The policies contents and instruments vary among these three countries, but the common objects of these rice policies are the benefit of consumer and producer as well as the foreign exchange earnings. Government intervention played a central role in early days due to the insufficient food supply, low consumer income and foreign exchange earnings. It was found that rice export taxation and consumption subsidy policies were implemented in the low income and production period and export subsidy and production input subsidy were provided in the high income and production period. But along with the economic development and the participation of FTA or WTO, the government policies move toward to marketing liberalization, rice export subsidy or taxation and rice consumption subsidy were abolished.

Keywords Rice • Policy • China • Thailand • Vietnam

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_11,

11.1 Introduction

Rice is the most important staple food in China, Thailand and Vietnam and the importance of this crop to food security and economic performance is evident. Besides being a good source of calories for consumers, rice is also a source of employment and income for many farmers and a source of foreign exchange earnings for government. At present, China is the largest producer and consumer of rice, while Thailand and Vietnam are the two largest rice exporters. Throughout history these three countries have implemented different policies aimed at promoting self-sufficiency and more exports.

Based on rice policy reviews, this paper aims to explore the similarities and differences of the policy instruments, targets and impacts in China, Thailand and Vietnam. For the purpose of it, in the second section, the description of rice production, consumption and exports trend in these three countries will be given. In the third section, reviews the main policy developments in rice production, consumption and trade, summarize the policy targets and discuss the policy impacts. The final section will be concluded by the result of policy reviews and policy implications about how to promote rice production and exports will be provided.

11.2 Trend in Rice Production, Consumption and Trade

11.2.1 Trend in Rice Production

Due to the significant increasing yield as the result of hybrid rice plantation, rice production in China showed an increasing trend before 1998 although the rice area harvested has been declining since 1977. However, along with decreasing area and yield, China rice production suffered six successive years of declining during 1998–2003. After implementing a series of measures including abolishing agricultural tax and introducing the "Producer Subsidy Program" in 2004, Chinese farmers' burden was greatly reduced and rice production has been increasing for nine consecutive years, reaching 202.7 million tonnes in 2011 which is near the peak level in 1997.

Because of the investment in irrigation system, the adoption of modern rice varieties and increased rice cropping intensity, the rice yield in Thailand has improved since 1970s (Isvilanonda 2001). However, it is still relatively low compared with the China and Vietnam as the traditional high-quality while low-yield rice varieties are grown in most of the rice area. Despite the lower yield, the rice area harvested has been increasing because of the expansion of rice area before 1980s and the widespread adoption of non-sensitive photoperiod variety of rice in 1990s which increase the multiple cropping in irrigated areas. The slowly improved yield and sustainably increased area have contributed the rising rice production in Thailand during the past four decades.

Table 11.1 The average annual growth rate of rice total production, area harvested and yield (%)

	Production			Area harvested			Yield		
	China	Thailand	Vietnam	China	Thailand	Vietnam	China	Thailand	Vietnam
1961–1965	12.70	2.41	1.02	3.11	0.61	0.43	9.30	1.79	0.59
1966–1970	3.54	0.64	4.71	1.42	−1.74	0.23	2.09	2.43	4.47
1971–1975	2.17	2.72	−0.37	0.59	4.17	0.86	1.58	−1.40	−1.22
1976–1980	2.54	3.62	−0.38	−1.73	3.02	1.40	4.34	0.57	−1.76
1981–1985	3.91	3.33	6.34	−0.97	1.94	0.29	4.92	1.36	6.03
1986–1990	2.33	−2.30	4.69	0.55	−1.11	1.46	1.78	−1.20	3.19
1991–1995	0.22	1.92	6.20	−1.48	0.17	1.79	1.72	1.75	4.34
1996–2000	−0.93	3.72	5.36	−1.16	1.64	2.29	0.24	2.04	3.01
2001–2005	0.38	1.96	2.78	−0.02	0.25	−0.55	0.41	1.71	3.35
2006–2010	1.85	4.67	2.78	0.47	4.49	0.56	1.37	0.17	2.21

Source: FAOSTAT (2013)

In Vietnam, the rice yield showed a significant increasing trend since 1980 when the contract production system was built up and farmers' productivity was greatly improved. In addition, the rice harvested area started to increase rapidly since 1986 when the renovation policies which include allocating the agriculture land for households were implemented. The agricultural economic reforms in 1980s, the Government investment in irrigation, and the promotion of hybrid rice in 1990s, have been the main source of the boot in rice production (Table 11.1).

11.2.2 Trend in Rice Consumption

Although the rice consumption per capital per year in China was much lower than that in Vietnam and Thailand, China still maintained the largest rice total consumption in the world as a result of the largest population. The population growth became the main source of the increased total rice consumption as food in China except in the first half of 1980s when per capital food consumption of rice significantly rose as a result of the low consumer prices under the ration system and increased production after implementing the household responsibility system. However, as population growth rate started to slow down and per capital rice consumption remained stable since 1995, China's rice total consumption as food slowly increased with an average annual growth rate of less than 1 %.

In Thailand, the rice total consumption change was mainly contributed by the change of per capital rice consumption. Because of the food shortage and lowered domestic rice price caused by the export taxation policy, per capital rice consumption in Thailand maintained high level before 1980. Along with economic development and increased food availability, consumer shift to consume less rice and more meat, as a result of which, per capital and total rice consumption in Thailand showed a downward trend until 1995. Recently, per capital rice consumption rose again, but it was still lower than the level before 1980.

Table 11.2 The average annual growth rate of rice total, per capital consumption and population (%)

	Total consumption			Per capital consumption			Population		
	China	Thailand	Vietnam	China	Thailand	Vietnam	China	Thailand	Vietnam
1961–1965	13.20	4.20	3.31	11.40	1.07	0.73	1.63	3.09	2.56
1966–1970	3.80	1.41	2.62	0.93	−1.57	0.24	2.86	3.02	2.39
1971–1975	2.57	2.63	2.52	0.31	−0.14	0.43	2.26	2.77	2.08
1976–1980	2.98	−0.28	−0.08	1.56	−2.47	−1.64	1.40	2.24	1.59
1981–1985	4.80	−1.67	5.03	3.29	−3.53	2.69	1.47	1.94	2.28
1986–1990	1.17	−1.05	−1.72	−0.44	−2.71	−3.78	1.61	1.71	2.14
1991–1995	2.31	−1.00	3.48	1.17	−1.80	1.51	1.12	0.83	1.94
1996–2000	0.98	2.77	2.34	0.11	1.57	1.13	0.87	1.18	1.19
2001–2005	0.01	3.17	0.87	−0.56	2.06	−0.22	0.58	1.08	1.09
2006–2009	0.53	4.08	0.79	0.03	3.35	−0.31	0.51	0.70	1.11

Source: FAOSTAT (2013)

Similar with China, the increase in total rice consumption as food in Vietnam was mainly generated by the population growth. But in the early 1980s, due to the boot of rice production under the contract production system, per capital rice consumption in Vietnam increased rapidly and surpassed the amount consumed in Thailand. After 1986, as the per capital consumption showed a downward trend and the population growth slowed down, the growth rate of total rice consumption in Vietnam decreased (Table 11.2).

11.2.3 Trend in Rice Trade

During the past decades, the rice exports in these three countries changed significantly. For example, during 1960s and 1970s, China and Thailand exported almost the same quantity of rice with 28.81 million tonnes for China and 30.05 million tonnes for Thailand. However, in 1980s, Thailand rice exports increased with an average annual growth rate of 6.6 % while China decreased at 3.3 % per year. Finally, China's position in the world rice exports market had slipped to sixth place in 2000s while Thailand maintained the place of the largest rice exporter until 2012. For Vietnam, it changed from a net rice importer to exporter in 1989 and since then the rice exports increased very fast with a high average annual growth rate of 7.8 %. Finally, in 2012, the rice exports quantity in Vietnam exceeded in Thailand.

The rice imports in Thailand were very little during the past decades. For China, most of rice imports are Thai fragrant rice varieties, which are consumed at high-end hotels or restaurants located in affluent coastal cities (FAS 2012). In Vietnam, the rice imports significantly declined after the production achieved drastic increase in the late 1980s. Currently Vietnam imported limited amounts of high-quality rice varieties, also mainly from Thailand (Table 11.3).

Table 11.3 The quantity of rice exports and imports in China, Thailand and Vietnam

	Export quantity (million tonnes)			Import quantity (1,000 tonnes)		
Year	China	Thailand	Vietnam	China	Thailand	Vietnam
1961	0.07	1.57	0.18	118.35	0.00	18.50
1965	1.19	1.90	0.00	122.16	0.00	329.59
1970	1.69	1.06	0.02	5.50	0.00	1,260.00
1975	1.97	0.95	0.02	45.05	0.00	350.00
1980	1.38	2.80	0.03	131.00	0.00	201.40
1985	1.05	4.06	0.06	213.22	0.00	336.10
1990	0.41	4.02	1.62	62.53	0.00	1.90
1995	0.24	6.20	1.99	1,645.84	0.07	11.00
2000	3.07	6.14	3.48	244.74	0.52	0.00
2001	2.01	7.69	3.73	274.59	0.27	2.60
2002	2.07	7.34	3.24	339.70	0.90	40.00
2003	2.60	8.39	3.81	404.66	7.92	2.25
2004	0.89	9.99	4.06	928.21	1.10	0.06
2005	0.67	7.54	5.25	580.81	2.47	0.34
2006	1.23	7.43	4.64	827.34	1.65	0.58
2007	1.32	9.20	4.56	598.69	3.18	2.08
2008	0.97	10.22	4.74	361.94	13.63	0.68
2009	0.78	8.62	5.97	419.73	20.84	0.85
2010	0.62	8.94	6.89	486.05	5.27	0.98

Source: FAOSTAT (2013)

11.3 Rice Policy Reviews

Based on the literature reviews, this section gives a narrative history of government intervention in the rice sector, mainly including the production, consumption and trade policies. Furthermore, based on the comparative analysis, this section discusses the targets and effects of these policies.

11.3.1 Rice Policy in China

11.3.1.1 Rice Production Policy Reforms in China

From 1956 to present, the rice production policies in China mainly include shifting from collective farming system to household responsibility system. It was also characterized by government intervention in the process to market liberalization, such as the provincial governor responsibility system. Investment in irrigation system, adoption of hybrid rice as well as improving farmers' income has been the priorities of the government policies.

People's Communal System and Irrigation Investment

During 1956–1978, China implemented People's Communal System. Government-owned institutions managed the production and circulation of agricultural products from farm gate to consumers (Fang and Beghin 2000). Some research found this system constrained farmers' incentives and productivity (Lin 1992). But during 1960s and 1970s, massive investments in irrigation infrastructure implemented by the government helped improve crop yield by increasing the cultivation intensity (Huang et al. 2006). As a result, rice yield and total production respectively increased 3.6 and 5 % per year and rice exports maintained a high level during 1961–1977.

Household Responsibility System

Since 1979, in order to improve farmers' incentives and productivity, the communal system was abandoned and the "Household Responsibility System" (HRS) was introduced, where farmers were given the land management right and have the freedom in making decisions about crop choices and production. After selling a fixed quantity of rice to the government at a quota price, farmers can in return, obtained subsidized diesel fuel, fertilizers and a cash prepayment for their sales (Yap 1994). In addition, they can sell the surplus production at an "above quota price" or keep it for household consumption. As a result of improved farmers' incentive and subsidized farm inputs, during the period 1979–1984, paddy yields rose by 26 % and paddy output rose by about 23 % despite the sown area diminished.

Hybrid Rice Adoption

Since 1960s, China has put substantial investments in hybrid rice and beginning in the early 1980s, hybrid rice was massively diffused among the small-scale farmers in China. Hybrid rice now accounts for 63 % of all land under rice cultivation in China. It was found that the dissemination of hybrid rice between 1978 and 2008 has contributed to a 67.5 % increase in national rice yields (Spielman et al. 2012) and the increased yields in turn has compensated the decreased total rice land area during this period.

Market Liberalization

During the period of 1985–1993, with an object to increase the role of markets in grain production and distribution, the China Government gradually implemented market liberalization policies. For example, in the early 1985, the mandatory quota procurement system was changed to a contract procurement system, where the

procurement quantity was determined by contracts based on mutual agreements between the government and individual farmers (Lin 1997). In addition, in early 1990s, the State's distribution of subsidized farm inputs declined (Fang and Beghin 2000). These marketed oriented policies led to resources being reallocated from grain production toward other profitable crops, paddy output in China showed the decreased trend in the early 1990s.

Provincial Governor Responsibility System

In 1995, as there were alarmist warnings from outsiders about China's inability to feed itself, and in order to ensure the grain self-sufficient, a new policy "Provincial Governor Responsibility System" (PGRS) was introduced. Under this system, provincial governor was required to be responsible for the balance of grain demand and supply in his/her province, involving providing high procurement prices, and ensuring minimum levels of rice production and reserves required. After implementing the PGRS in 1995, there was a notable rebound in both sown area and output. In 1997, paddy output reached a new record and in 1998, rice exports reached the historical highest level with 3.79 million tonnes. However, this system also created increasingly heavy financial burden of the accumulated stocks and the increasingly poor quality of the procured rice (Nielsen 2002), which induced this system to be abolished in 1998.

Procurement Prices Reform

In the late 1990s, with an aim to reduce the government's financial burden and enhance high-quality rice production, procurement prices reform was introduced. For example, since 1997, government has gradually lowered procurement prices. In addition, differentiated prices for low and high quality cereals are introduced. Low -grade early rice varieties in Southern China had not been eligible for government procurement at all since 2000. As a result of low procurement price and also promotion of planting structure change by local governments, rice farmers replaced their low quality early rice with other more profitable crops and planted area for early rice in Southern China decreased, which brought down the nation's total rice output during 1998–2003. Rice production recorded the lowest level in 2003 over the past two decades at 162 million tonnes, and rice exports sharply decreased in 2004.

Producer Subsidy Program and Land Reserve Policy

For the purpose of encouraging grain production and maintain profit margins for grain farmers, China implemented a series of policies, effective since 2004, including the elimination of taxes on agricultural land, providing direct payments to grain

farmers, and adjustments to price support programs.[1] In 2005, the Government provided a subsidy for the purchase of farm machinery, and in 2006, added a direct subsidy for fuel and fertilizers (FAS 2010, 2012, China). In spite of producer subsidy program, the government released the land policy requiring retain basic farmlands for grain production with no less than 1.56 billion Mu. The increasing producer subsidies, floor price and harvested area, stimulated the rice production, which increased by 40.4 million hectares between 2003 and 2011, or equivalently, a 25 % increase for the period.

11.3.1.2 Rice Consumption Policy Reforms in China

Until 1993, the domestic marketing system was almost entirely centrally controlled and managed by the ration system, where the rice was distributed by the grain bureau at a fixed subsidized or ration price to the urban dwellers. The ration prices for rice, which were about one-quarter of the free market price, had remained unchanged during 1966–1991(Yap 1994). As a result, per capital food consumption of rice increased significantly in the first half of the 1980s.

In May I991, in order to reduce the massive cost of consumption subsidies, the government raised the ration prices of staple foods, including those for rice. In1993, the grain ration system was abolished.

11.3.1.3 Rice Trade Policy Reforms in China

Both import and export of rice in China are monopolized by state grain trade agencies.[2] Before 2002, rice exporter in China was levied by 13 % value-added tax (VAT) and refunded by 5 % after exports; in addition to export refund, government provided export subsidies, of which the standard was different in each province.

However, after become a member of WTO, the Government started to implement a total VAT exemption on rice exports since 2002, and by 2004 export subsidy under any types was abolished. Fang (2007) found export companies didn't get benefit from zero tax rate policy and the elimination of export subsidies make them lost some advantages. Partly as the removal of export subsidy and decreased production, rice exports showed a decreasing trend since 2003. In 2008, as the international market price of rice increased sharply and in order to maintain stable

[1] If domestic grain market prices fall below the floor price, state grain companies will purchase the grain at the floor price from farmers (FAS 2012). The 13 Provinces covered by the floor price program are located in the grain-surplus regions that produce about 80 % of nation's commercial grains to meet the demand in other grain-deficit provinces (FAS 2008).

[2] International trade of rice in China is administered jointly by the Ministry of Foreign Economic Relations and Trade (MOFRT), the Ministry of Commerce and the Cereals, Oils and Foodstuffs Import and Export Corporation (CEROIL).

price domestic market, Chinese government decided to impose a temporary tax of 5 % on rice exports, which resulted that the rice exports decreased by 27 % compared with that in 2007.

11.3.2 Rice Policy in Thailand

11.3.2.1 Rice Production Policy Reforms in Thailand

The rice market intervention policies in Thailand mainly included price support program (1975–1983) and rice pledging program (Since 1981) and the non-price policies mainly include the investment in irrigation, the offer of agricultural credit policy and the adoption of modern variety rice.

Price Support Program

Due to the concern over the low paddy price in early 1970s, the government launched the farm support program to intervene the paddy market through purchasing rice at prices higher than market levels. This program, however, has not had a significant impact, because the amount of paddy purchased by the government was very small and the support price to be paid to farmers was frequently inadequate due to the lack of budget (Yap 1982).

Rice Pledging Program

In order to make farmers withhold the products from the market in the early harvesting season and delay sale until prices rose up, since 1981, the Bank for Agriculture and Agricultural Cooperatives (BAAC) has operated a rice pledging program to provide a loan at low interest rate for farmers.[3]

As the government needed to subsidize the 5 % interest to the BAAC to make up for a total loan rate of 8 % per annum, this program firstly created a huge burden for the state. In addition, the rice pledging scheme caused a decline in shipments and consequently a current substantial buildup in stocks (Wailes and Chavez 2012). From historical data, it can be seen that rice ending stock quickly rose from 0.186 million tonnes in 1994 to 1.2 million tonnes in 2012.

[3] Under this program, farmers could mortgage their rice at the price of 80–95 % of the target price and received the loan at the net interest cost of 3 % per annum. If famers could not redeem their pledged rice at the given period of 5–7 months, the mortgaged rice would go to the government.

Agricultural Credit Policy

Since 1975, the Bank of Thailand (BOT) instructed all commercial banks to allocate 5 % of all commercial loans for agriculture at an interest rate lower than the market. The credit policy has significantly impacted on the farmers' adoption of modern technologies as well as crop diversification (Isvilanonda and Bunyasiri 2009).

Irrigation Investment

Thailand government has made massive large and medium scale irrigation projects during the period from the first to the fifth economic and social development plans and rice irrigated area increased from 1.56 million ha in 1961 to 3.91 million ha in 1986. However, large investment and long, slow-return has shifted the investment priority to small scale projects or improving water distribution system rather than constructing new projects during 1990s and 2000s, which lead to a slower growth in irrigated area since sixth plan. Currently, the irrigated area is about 23.9 % of the total cultivated area (Isvilanonda and Bunyasiri 2009).

Adoption of Modern Rice Varieties

Modern rice varieties, which are mainly defined to be non-photo period sensitive and early maturing varieties, has been introduced in Thailand since early 1970s and quickly adopted in 1980s. The modern varieties generally produced higher yield than local varieties and help to improve the rice cropping intensity especially in irrigated areas. However, as the modern rice varieties were constrained by the degree of water control, the adoption rate of modern rice varieties was low in most of the rice land area except irrigated area.

11.3.2.2 Rice Consumption Policy Reforms in Thailand

During the period of 1962–1982, all rice exporters are required to sell a percentage of their rice exports to the government at below-market prices and then the part of reserved rice was sold to Bangkok residents at subsidized prices. This kind of rice reserve requirement has been used as a consumption subsidy as well as export taxation device. Its impact in Bangkok was quite substantial, represented by the bulk of rice consumed within the city (Siamwalla and Setboonsarng 1989).

11.3.2.3 Rice Trade Policy Reforms in Thailand

Before 1986, Thai government adopted several instruments to tax rice exports, including export premium, exports duty and rice reserve requirement. It means that, private traders need to pay a premium for obtaining an export license and all rice exporters were levied by a 5 % ad valorem exports duty. By calculating the nominal protection rate (NPR),[4] it was estimated that (Kajisa and Akiyama 2004; Choeun et al. 2006) tax rates were very high during 1960–1970s and then were reduced appreciably in the 1980s. As result of taxation, the world rice price rose while the domestic price declined (Choeun et al. 2006; Lam 2002), which finally lead to a high level of per capital rice consumption and stagnated rice exports until 1980.

Since 1986, the rice exports tax policies were abolished and a provision of discounted credit rates or a packing credit has been available for exporters to subsidize their export cost. In 1995, government provided subsidies of $10 per ton for low and medium grade rice exports and offer private rice exporters cost subsidy of 250 baht per ton for rice storage and rice quality improvement. As result of the elimination of export taxation and the offer of export subsidies, rice exports in Thailand kept increasing since 1980s.

11.3.3 Rice Policy in Vietnam

11.3.3.1 Rice Production Policy Reforms in Vietnam

The rice production policy reforms in Vietnam mainly include shifting from collective production system to individual-oriented contract system, allocating the land to farmers, providing input subsidy and credit assistance, investing in irrigation system and protecting the agricultural land.

Contract System of Production

In order to improve producer incentives and thereby increase productivity, Vietnam switched from the collectivized agricultural production system to individual-oriented contract system in 1981, which was similar to China's policy reform of shifting from people's communal system to household responsibility system. Under the new contract system, individual rice farmer was allowed to take responsibility for fulfilling their own production quotas rather than the collective (Ghosh and Whalley 2004). The contracted output had to be sold to the state at a fixed price

[4] NPR = (RDP-RBP)/RBP, NPR, defined as the percentage difference between the real domestic price (RDP) and the real border price (RBP), to measure the rice export taxation rate, is negative when rice is taxed and is positive when it is protected.

while above quota surplus could be sold on free market. Upon the introduction of contract system of production, rice production in the period 1981–1986 was marked by a sharp increase with an average annual growth rate of 5 %, most of which was attributed to the increased yields rather than the expansion of cultivated area.

Renovation Policy

In 1986, the government announced its intention to move toward a more market-oriented economy, a policy known as renovation. Therefore in 1988, private ownership of farm assets was legalized and cooperative land was allocated to individual farmers, since then farmers were no longer required to sell a large part of their output to the state at a low price. The Renovation Policy has been widely recognized as the underlying factors behind the boost in rice production and exports in the 1990s (Pingali and Xuan 1992; Young et al. 2002). Along with the improved producer incentives, rice production increased 4.4 % per year during 1987–2011 and rice exports increased 8 % per year during 1989–2010.

Programs Supporting Farmers

Followed by renovation policy, other policies of reducing production cost and improving farmers' income were implemented. For example, in 1990s, the Vietnamese Government has started the input subsidy policy for farmers and set a minimum purchase price on paddy; in 2003, land use tax waiver and reduction were introduced; in addition, started in 2009, farmers can access loans at favorable interest, longer terms and larger amounts to buy equipment and materials.

Land Reserve Policy

Land is the decisive factor for rice production. The Vietnamese government has followed a strict policy of maintaining a certain proportion of agricultural land for rice cultivation. The area of land under irrigated paddy was targeted at 4.2 million hectares in 1999. However, due to the process of industrialization and urbanization as well as the concern of diversifying the country's agricultural production, some paddy fields has been converted into alternative uses, which resulted the total rice land gradually declined from 4.47 million hectares in 2000 to 4.09 million hectares in 2009. Faced with the pressure to transfer more rice land for other agricultural and non-agricultural uses, in 2009, the Vietnamese government has set the goals to keep rice land at 3.8 million hectare by 2020.

Irrigation Investment

Even though total rice land area decreased, the irrigated rice area and the harvested rice area have been increasing since 1976 as the Vietnam Government attached great attention to irrigation systems, particularly in the main paddy production regions. Currently 85 % of rice areas in Vietnam are irrigated (Bo and Buu 2010). The improvements in irrigation bring about the increased cropping intensification and rice planted area. For example, in 1980s, the improvements in irrigation and drainage in the Mekong River Delta have allowed single rice cropping system during the rainy season to be converted to double rice cropping system.

11.3.3.2 Rice Consumption Policy Reforms in Vietnam

The rice surplus region of Vietnam is in the southern Mekong Delta whereas the rice deficit regions are in the north. Before 1997, the government regulated the movement of rice within the country, particularly between the North and South. The regulation has generated differences in rice prices between North and South.

11.3.3.3 Rice Trade Policy Reforms in Vietnam

During 1989–2000, rice exports in Vietnam were strictly controlled by export quotas which have been allocated to two regional, state-owned trading enterprises[5] and to a number of provincial, state-owned trading enterprises.[6] Except export quota, tax was also imposed, but it has been managed flexibly in the sense that it has not always been levied, particularly in times of low world market prices (Son 2010). Previous studies (Minot and Goletti 1998; Nielsen 2002) showed that the biding export quota result in domestic prices below the relevant border price and has kept the exports well below potential, which have similar effects as an export tax.

As Vietnam already became a member of ASEAN in 1995 and engaged in tax-cut commitments, on May 1, 2001, the export quota has been abolished. Along with the removing of the export quota, the government applied export promotion through export subsidies[7] and losses compensation. In addition, with export promotion fund, rice exporters were given credit assistance with the interest rate between 0 and 50 % of the prevailing rate (FAS 2006, Vietnam). As a result of

[5] VINAFOOD I (also known as the Northern Food Company) in Hanoi and VINAFOOD II (Southern Food Company) in Ho Chi Minh City.

[6] Although since 1997 and 1998, private trading companies was allowed to export rice but they accounted for just 4 % of total rice exports in 1999 (Minot and Goletti 2000).

[7] Rice exporters will receive a subsidy of VND 180 (about USD 0.012) per export dollar (Son 2010).

export subsidy and credit assistance, rice exports in 2005 reached highest level since Vietnam came back into the international market in 1989.

With the commitment to WTO principles, all export subsidies under any type in Vietnam were terminated in 2005. The only incentive that can be applied is providing a favorable loan interest for the export companies to buy rice for temporary stock at the peak of harvest season. But in 2008, as worried about the fast increasing food price in the domestic market affected by global food crisis, the Prime Minister stop the signing of new rice exports contracts for 3 months and lowering the rice exports volume to 2.5–4.0 million tons. In addition, On July the 21st, 2008, Government imposed an absolute tax on rice exports with the price taxable limit of US$800. As a result of the removal of export subsidies and the implement of temporary tax, rice exports decreased during 2006–2008, but afterwards increased very fast.

From the above policy review, we discuss the characteristic of policy targets, instruments and impacts in these three countries.

11.3.3.4 Policy Instruments

The instruments for promoting rice production were similar in these three countries, mainly including production system reform, input subsidies, agricultural credit assistance, government purchase at guaranteed price, direct payments for farmers, irrigation investment and land reserve policy.

Different policies have different targets. For example, in order to improve farmer's initiative and productivity, both China and Vietnam changed from collective production system to individual production system. With the objective to make up for the rising cost of production, all these three countries provided input subsidies. For the purpose of encouraging famers to adopt modern technology and equipment, both Vietnam and Thailand provided favorable loan to farmers. Furthermore, in order to ensure farmers' income, government purchase of rice at floor price was provided in China and Vietnam. For the sake of protecting agricultural land and limiting to be transferred into non-agricultural land, both China and Vietnam have released land reserve policy to ensure the grain or rice production.

The instruments for provide consumption at affordable price for urban residents were different among these three countries. It was managed by ration system in China, rice reservation requirement in Thailand, and interregional movement regulation in Vietnam.

The instruments for rice exports policies mainly include export taxes, export quotas, export subsidies, and credit assistance. It can be seen that, the rice exports policy in these countries can be summarized to three stages: from the beginning, in order to maintain sufficient domestic supply, all these three countries implemented consumer-oriented food policy including taxing rice exports, but after reaching a large surplus of domestic rice supply, government switch to the producer-led food policy which include provide subsidies rice exports, and finally after joining the ASEAN and WTO, subsidy policy was abolished and replaced by credit assistance.

11.3.3.5 Policy Targets

Although the policies contents varies among these three countries, but the rice policies objects generally include at least the following: providing adequate supplies at low and stable prices for consumers; promoting producer's incentives to increase domestic supplies; generating government revenue or foreign exchange earnings.

Furthermore, based on the particular national conditions, each country has different emphasis on the rice policies. As there is a large population in China, the main goals of Chinese rice policy are to sustain high levels of self-sufficiency, to secure higher farmer incomes and to ensure price stability, which can explain why China implemented the "PGRS" policy in 1995, introduced Grain Support Programs in 2004, and imposed a temporary export tax in 2008 when the international rice price sharply rose; For Thailand, because of the large surplus during the past decades, the overriding goals of rice policy are to ensure the international competitiveness and sustain the high level of rice exports, thus the government provided export subsidies and credit assistance to support rice exports since 1986. In Vietnam, after the boost in rice production as a result of economic reforms in 1980s, the primary rice policy objects not only include achieving food security for its population, but also raising foreign exchange earnings by encouraging the export.

11.3.3.6 Policy Impacts

Production policy that had a positive impact on rice production didn't necessarily have the same impact on rice exports, for example, the similar production system reform in China and Vietnam both stimulated the rice production. But as the different conditions of the population and consumption, the production system reform in Vietnam created more domestic surplus for rice exports while in China didn't.

The investments in irrigation system and the adoption of modern rice variety or hybrid rice in these three countries bring about a common benefit that is improving the rice yield as well as cultivated area by increasing the cropping intensification, which finally has contributed significantly to the improving production. Both the proportion of irrigated area and hybrid cultivated area of the total rice area in China are much higher than Vietnam and Thailand and maybe can explain why China has a relatively higher rice yield.

Export tax and quota produced a negative effect on rice exports while export subsidy and credit assistance had the positive impact. With the advantage of the removal of export taxation policies and providing the export subsidies, Thailand since 1980s and Vietnam since 1990s significantly increased rice exports under the large domestic surplus.

11.4 Conclusion

The policies contents and instruments vary among these three countries, but there're some common objects of these rice policies, which could be summarized by three aspects: protecting consumer by lower domestic price, promoting production by increasing the income of producer, generating government revenue or foreign exchange earnings by taxing exports.

In spite of the common objects, based on the particular national conditions, each country has different emphasis of policies: with a largest population, the self-sufficient policy has always been highlighted by China government while in Thailand and Vietnam, sustaining the high level of rice exports has been their primary target since there're large amount of domestic surplus.

Government intervention played a central role in rice production, consumption as well as the trade in the early days due to the insufficient food supply, low consumer income and foreign exchange earnings. Along with the economic development and the joining of WTO, the government policies move toward to marketing liberalization characterized by building up the individual production system, removing the consumption subsidies and abolishing the export taxation.

The policy development in these three countries generally changed from protecting the benefit of consumers to producers. In the trade policy side: export taxation policies usually are firstly implemented when consumer income is low and government commit to provide sufficient domestic supplies at low and stable prices; and then the taxation policies were replaced by export subsidies when domestic surplus increased and government pay more attention to protect the benefit of producers.

As the rice exports also depend on the consumption side, policy that could have a positive impact on rice production, does not necessarily have a promoting effect on rice exports, such as the similar production reform in China and Vietnam. In addition, as export taxation policy has a negative effect on rice exports while export subsidies have a positive impact, the country that abolish export tax and provided export subsidy earlier would have the advantage of promoting more rice exports, for example, Thailand has removed export taxation and provided export subsidies earlier than China, which was the part of the reason why there was a growing gap of the rice exports between Thailand and China since 1980s although before these two countries export almost the same quantity of rice.

In order to ensure the self-sufficient and provide a basement for rice exports, promoting the production is primary goal for these countries. The production depends on the harvested area and yield. Both Vietnam and China has already introduce the policy to prevent land from being switched out of rice cultivation to other more profitable uses, but there are still few possibilities exist for further expansion of the country's rice growing area. The increased rice production in China proved that higher yield can compensated the decreased area, so for Vietnam and Thailand whose yield is still low, it is advisable to take a series of action to

improve rice yield such as adopting the high yielding rice and improving the investment in irrigation.

Acknowledgements This paper is financed by the Capacity Building Program for KU students on Internationalization, Fiscal Year B.E. 2556 and Department of Agricultural and Resource Economics, Kasetsart University. The author gratefully acknowledges the helpful comments from Professor Somporn Isvilanonda, Nguyen Tri Khiem as well as the assistance from: Ms. Tran Hoai Thao Trang, Mr. Ho Trong Phuc, Mr. Ukris Apivattananon, Ms. Ceresil Paule-Erika, but remains solely responsible for any errors or omissions.

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Chapter 12
A Study on Model Design of Tropical Agricultural Products Closed-Loop Supply Chain in Hainan

Meng Meng and Enping Liu

Abstract This paper, based on the analysis of the existing models and problems of tropical agricultural products supply chain in Hainan, combined with the closed-loop supply chain theory, elaborated tropical agricultural products closed-loop supply chain design ideas in Hainan, put forward produce agricultural products closed-loop supply chain design element, and accordingly designed four kinds of agricultural products closed-loop supply chain mode of different types of core enterprise leading, namely the production, distribution, processing and retail as the core enterprise closed-loop supply chain mode. The research results will provide a useful reference for tropical agricultural products closed-loop supply chain theory research in Hainan, mode design and practice development.

Keywords Hainan Province • Tropical agricultural products • Closed-loop supply chain • Model design

12.1 Introduction

In recent years, the development of export-oriented tropical agriculture has strong advantages in Hainan Province, Tropical agricultural products accounted for only 1/4 in the sales every year, Outside Hainan Island is the main direction of the market for sales (Feng Zeng and Wubo Fan 2009). Along with the external consumption demand increasing of the tropical agricultural products of Hainan province, Consumers have become increasingly demanding about agricultural diversity, quality and safety, reliability, and logistics timely accuracy. However,

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_12,

because of geographical location, historical basis, policy environment and other factors of Hainan province, the development level of agricultural products supply chain compared to the mainland lags behind, for the agricultural product sales to the island to bring serious effect, even slow-moving, and causes a series of problems of quality and safety of agricultural products. We, according to the characteristics of Hainan Province, Starting from the situation of Hainan Province, combined with the research on the agricultural product closed supply chain connotation, design tropical Agricultural Products Closed-loop Supply Chain model in Hainan Province. The study is of great significance to ensure tropical agricultural products quality and safety of Hainan province and promote the development of tropical agricultural products circulation, and provide a useful reference for the theory research and the practical development of tropical agricultural products supply chain.

12.2 The Existing Mode and Problems of Tropical Agricultural Products Supply Chain of Hainan Province

The agricultural products supply chain refers to a series of links of the agricultural products from production to consumers, and these include the production supply link, the production link, the processing link, the retail link and so on. But the economic backwardness, weak economic foundation, development of low starting point, traffic infrastructure backward, and the lag of logistics development, in Hainan province, have hindered the development of tropical agricultural products supply chain, but also formed the existing tropical agricultural products supply chain models. These models include primarily self-produced self-marketing model (Fig. 12.1), tropical agricultural products wholesale market model (Fig. 12.2), the company leading model (Fig. 12.3) and so on.

By our research and analysis of the existing models of Hainan Province tropical agricultural products supply chain, we find the following problems: Firstly, self-produced self-marketing model problems are mainly large number of farmers, small scales, weak competitiveness, lack of effective management, high cost of logistics, low agricultural products value-added, and no guarantee of the quality of agricultural products; Secondly, tropical agricultural products wholesale market model (North and South tropical fruit wholesale market in Hainan) problems are mainly tropical agricultural products wholesale market is the link between the links of production and sales, information asymmetry of producers and retailers, wholesalers grasping more market information, low bargaining power of farmers in disadvantaged areas, farmer's interests infringed, wholesalers tropical agricultural products shared a lot of profit, but have serious problems and defects in tropical agricultural products quality and safety; Thirdly, the company leading mode is accompanied by the formation of the development of agricultural industrialization

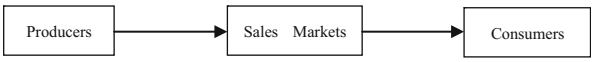

Fig. 12.1 Self-produced self-marketing model

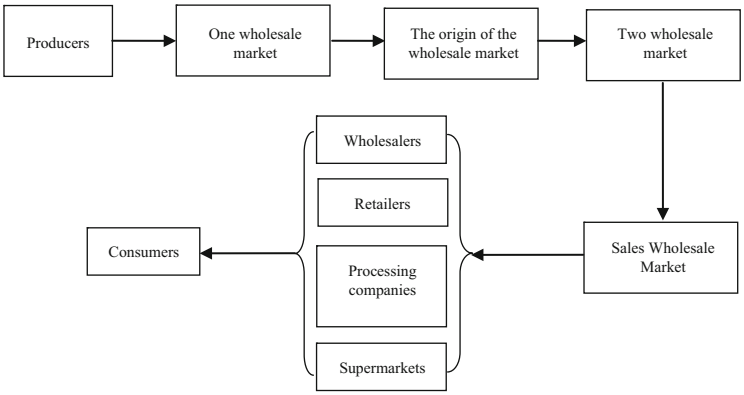

Fig. 12.2 Tropical agricultural products wholesale market model

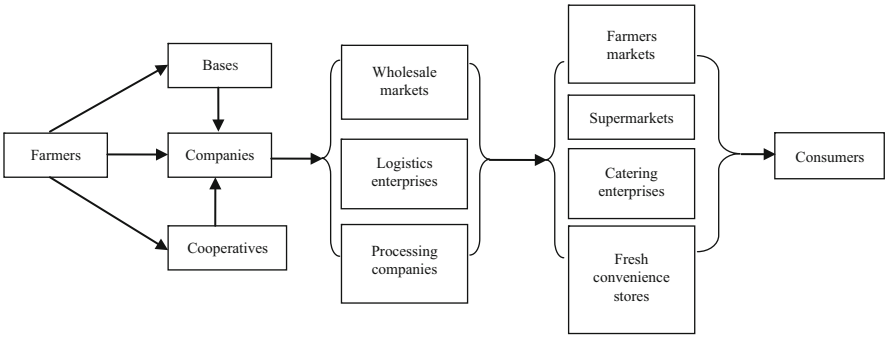

Fig. 12.3 The company leading model

in China, and it is a contract contractual relationship between farmers, cooperatives, base, the company. These relations include: (a) farmers + company, its problems are a loose contract relation between farmers and companies, differential binding contract, difficult to estimate the market price, unequal strength of both sides, the price usually by enterprises, the passive recipients of price the farmers, the majority of farmers away from the market, information occlusion, not knowing market level, Often the company to keep the prices down acquisition, damaging the interests of farmers and so on; (b) farmers + base + company, the existing problems is the low cultural quality of farmers. Some farmers often resale the agricultural provided or sell them at high prices, at the same time, buy the inferior agricultural production from the market price, result in tropical agricultural products failed and low yield,

but say that the company provides agricultural failure, lacks of technical guidance and so on, and farmers are relatively loose and it is very difficult to manage them and supervise them through the legal means; (c) farmers + cooperative + company, its problem is that the cooperative is a link between the companies and farmers. The cooperatives are set up unclearly, just in order to solve the difficult problem of farmer selling, and cooperative members have mostly low cultural quality, not understand the operation and management, and difficult to carry out business activities because of lacking of activities funds.

12.3 Definition and Characteristics of Agricultural Products Closed-Loop Supply Chain

12.3.1 Definition of Agricultural Products Closed-Loop Supply Chain

The concept of Closed-loop Supply Chain which is first proposed by Nankai University modern logistics research center in 2006, is that the member enterprises to join the supply chain carry out strict access management system, have a unified operating norms and technical standards, can carry out real-time monitoring and dynamic tracking, and the supply chain system have traceability (Zhilun Jiao 2011).

12.3.2 Characteristics of Agricultural Products Closed-Loop Supply Chain

According to the definition of agricultural products closed-loop supply chain, we can get the basic characteristics of agricultural products closed-loop supply chain: strict access management system of member enterprises of supply chain; uniform operation procedures and technical standards; integration of advanced agricultural technology, logistics technology, information technology and management technology; third-party authority of supervision based on multi-level node detection and tracing system; stable strategic partner alliances between Closed-loop Supply Chain members.

12.4 Tropical Agricultural Products Closed-Loop Supply Chain Model to Build in Hainan

By analyzing the existing models of tropical agricultural supply chain in Hainan, combining with the definition and characteristics of agricultural products closed-loop supply chain, the author try to design four kinds of agricultural products

closed-loop supply chain mode of core enterprise leading in Hainan, and namely the production, distribution, processing and retail as the core enterprise closed-loop supply chain mode. The closed-loop supply chain design patterns can be expressed as follows:

12.4.1 The Production as the Core Enterprise Closed-Loop Supply Chain Model

The production as the core enterprise is mostly to point the large-size tropical agricultural products bases or the agricultural cooperatives, which manage the whole closed-loop supply chain, make flow standard and profession permission system of closed-loop supply chain, and develop more strict enterprise product quantity standards than trade standards of the third party inspection. The production as the core enterprise and the partner often discussed supply chain cooperation, and the applications of advanced technology are used. The production as the core enterprise has some responsibilities for the quality and safety of tropical agricultural products of the supply chain, and the basic information of the enterprise in outer package correlative tropical agricultural products can be sure to recorded for quality and safety traceability (Nidi Zhou 2011; Zhilun Jiao 2009).

In the supply chain structural design, the production as the core enterprise not only manages their tropical agricultural production base, but also makes technical guidance to dispersed farmers or agricultural professional cooperatives, provides relevant production data, and buys their primary tropical agricultural products which are then inspected. The primary tropical agricultural products will sort to package, keep in cold storage and so on, and then sell to the agricultural products wholesale market, the agricultural products processing enterprises and terminal retailers. Sale terminals products will not be regularly inspected by the third-party inspection, if these products are qualified, they can continue to be sold, or information tracing and notifies the production as the core enterprise, and releases information to consumers. The production as the core enterprise will recall substandard tropical agricultural products and take relevant measures to deal with the problem of the whole supply chain. The third-party inspection participates information backward and cancels the unqualified tropical agricultural products into market. Figure 12.4 shows the specific model design of the production as the core enterprise closed-loop supply chain mode in Hainan.

12.4.2 The Distribution as the Core Enterprise Closed-Loop Supply Chain Model

The distribution as the core enterprise closed-loop supply chain mode is mostly to point the large-scale agricultural product wholesale markets, which is similar the

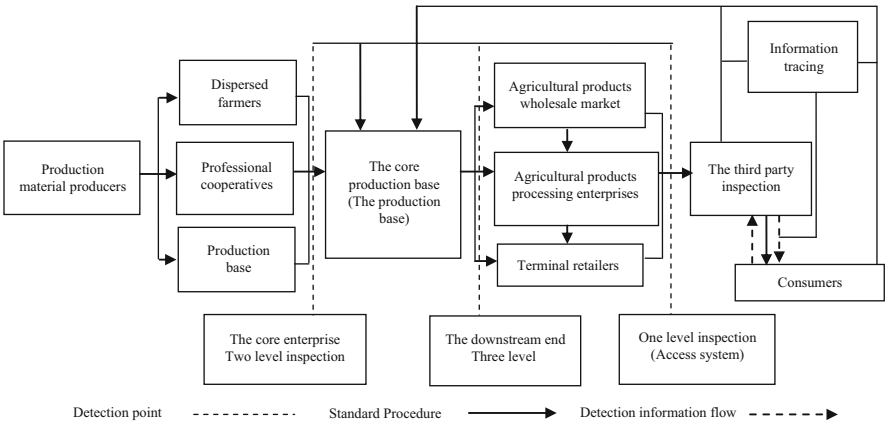

Fig. 12.4 The specific model design of the production as the core enterprise closed-loop supply chain mode in Hainan

production as the core enterprise closed-loop supply chain mode. It needs to display core enterprise functions, and take the corresponding responsibilities too. There is no expatiated.

In the supply chain structural design, agricultural product wholesale markets' operators purchase tropical agricultural products from dispersed farmers, agricultural professional cooperatives and production base, and inspect those tropical agricultural products. The core enterprise will often simply preprocessed to tropical agricultural products by fresh-keeping treatment and packaging, and then the products are sold to the small wholesale markets, agricultural product processing enterprises and terminal retailers. Of course, these partners will be corresponding detection. The follow process and the supply chain mode design are basically agreed with the production as the core enterprise. The closure and the inspection setting nodes of the distribution as the core enterprise are basically agreed with the production as the core enterprise. Figure 12.5 shows the specific model design of the distribution as the core enterprise closed-loop supply chain mode in Hainan.

12.4.3 The Processing as the Core Enterprise Closed-Loop Supply Chain Model

The processing as the core enterprise is mostly to point the large-size agricultural products processing enterprises, which needs to play the production as the core enterprise functions, and to take similar responsibilities.

In the supply chain structural design, the processing as the core enterprise purchase products from dispersed farmers, agricultural professional cooperatives, production base, wholesale market and supporting the processing enterprises, and

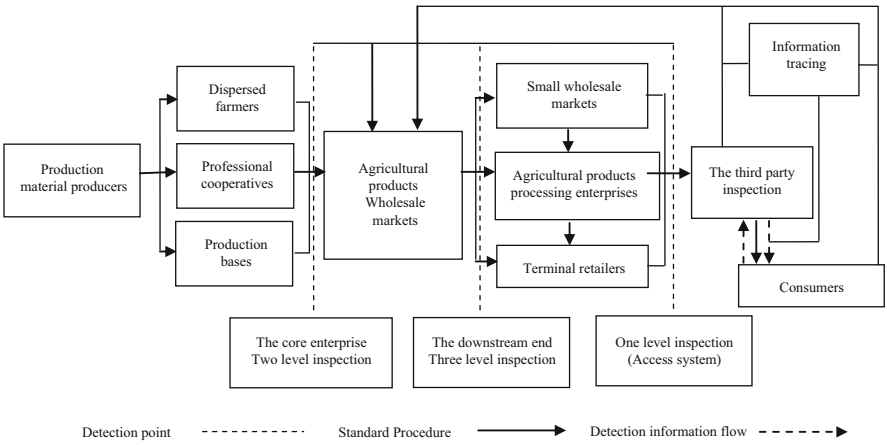

Fig. 12.5 The specific model design of the distribution as the core enterprise closed-loop supply chain mode in Hainan

inspect those tropical agricultural products. The processing enterprise will often simply preprocessed to tropical agricultural products by fresh-keeping treatment and packaging, and then the products are sold to retail terminal. Unlike the other core enterprises, the processing as the core enterprise needs to set up the three detection nodes. The follow process and the supply chain mode design are basically agreed with the production as the core enterprise. The closure and the inspection setting nodes of the processing as the core enterprise are basically agreed with the other as the core enterprise. Figure 12.6 shows the specific model design of the processing as the core enterprise closed-loop supply chain mode in Hainan.

12.4.4 The Retail as the Core Enterprise Closed-Loop Supply Chain Model

The retail as the core enterprise closed-loop supply chain model is mostly to point the large-size ordinary supermarkets or farmer's markets, which also need to play a similar function and take a similar responsibility.

In the supply chain structure design, Core retailers purchase products from the supply chain upstream dispersed farmers, agriculture professional cooperation organizations, production bases, the agricultural products processing enterprises and consumer and wholesaler markets, and inspect these products.

Core enterprise or contracted logistics service providers carry out effective preservation, packaging and other primary treatment on these products and then sell consumers. Other processes and schemes of supply chain design are similar with other models. The closure and the inspection setting node are also consistent

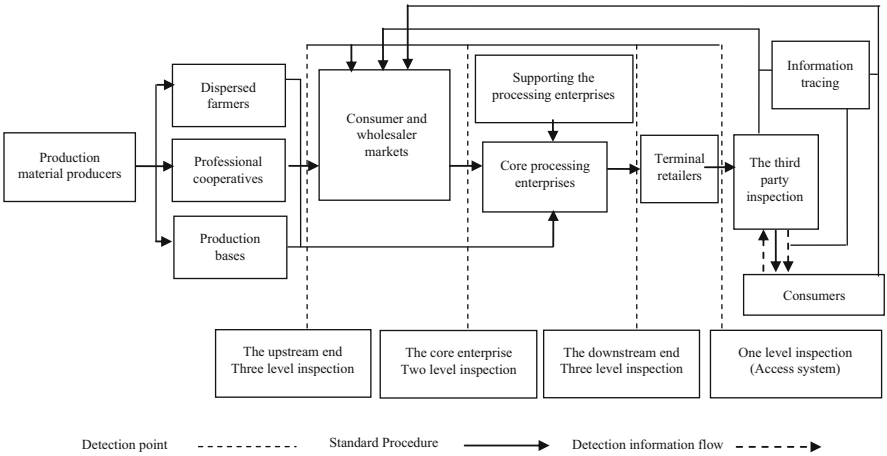

Fig. 12.6 The specific model design of the processing as the core enterprise closed-loop supply chain mode in Hainan

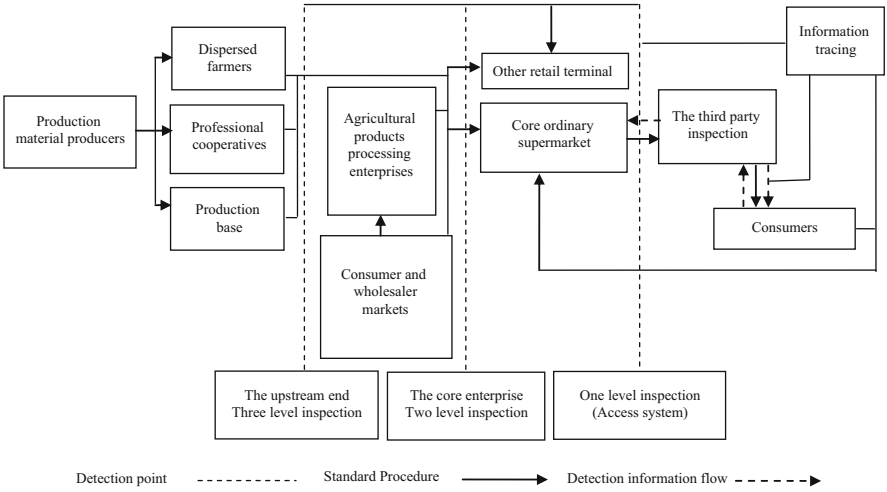

Fig. 12.7 The specific model design of the retail as the core enterprise closed-loop supply chain mode in Hainan

with other models. Figure 12.7 shows the specific model design of the retail as the core enterprise closed-loop supply chain mode in Hainan.

12.5 Conclusion

Hainan has excellent natural environment and climatic conditions, has unique advantages in resources and regional characteristics, and has become China's inland "vegetable basket" and "fruit plate". Although the corresponding supply

chain and logistics system has obtained a certain degree development, but Some realistic problems are facing, such as supply chain system and tropical agricultural products and circulation models being incompatible, Imperfect operating mechanism, low efficiency of the logistics system and so on.

In view of this, this paper, based on the analysis of the existing models and problems of tropical agricultural products supply chain in Hainan, combined with the closed-loop supply chain theory, elaborated tropical agricultural products closed-loop supply chain design ideas in Hainan, put forward produce agricultural products closed-loop supply chain design element, and accordingly designed four kinds of agricultural products closed-loop supply chain mode of different types of core enterprise leading, namely the production, distribution, processing and retail as the core enterprise closed-loop supply chain mode. The research results will provide a useful reference for tropical agricultural products closed-loop supply chain theory research in Hainan, mode design and practice development. At the same time it is of great significance for ensuring the quality and safety of agricultural products and promoting the development of agricultural products circulation.

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Chapter 13
Research of Construction of Australia Agriculture Information System

Xiaochan Hu, Huijian Zhang, Wei Luo, and Xiongjun Mai

Abstract This article studies the current construction situation of Australia agriculture information system, it first makes an overview of Australia agriculture and development of its information technology, then, studies the characteristics of Australia agriculture information system from the building of information networks and application of information technology. The study shows that Australia has constructed a complete and standardized agriculture information system.

Keywords Australia • Agriculture information system • Information networks • Information technology

13.1 Introduction

Australia is one of major producers and exporters of food, livestock and natural fibers in the world, Australian agriculture is based on farming and animal husbandry. Currently, the Australian Department of Agriculture, Fisheries and Forestry (DAFF) and its affiliated institutions are the main body to Formulate and implement policies and programs of Agricultural information technology To ensure that Australian agriculture, fisheries, food and forestry industries remain competitive, profitable and sustainable (DAFF 2013). Many technologies have been used in research of agriculture, resources, environment and disaster in Australia, such as Systems engineering, database and information systems, expert systems, decision support systems, remote sensing (RS), geographic information system (GIS) and Global Positioning System (GPS) technology, etc (The revelation of Agricultural

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_13,

Information Development of the tropical countries 2013). In addition, computer, internet and electronic technology and other technologies are widely used in Australia, Australia Per capita computer ownership ranked sixth in the world and ranked first in the Asia-Pacific region. Australia per capita Internet access ranked ninth in the world and ranked second in the Asia-Pacific region; since Australia has high-quality culture Farmers, good network infrastructure and many sharing sites in the country, its has rapidly developed agricultural information with a high level (Overview of Australian Agriculture and Agri-Information Technology 2013).

13.2 Building of Information Networks

Australia is more successful in agricultural information resources sharing, it has many national sharing sites, such as ChemCert, Animal Health Australia.

ChemCert is a non-profit industry training organization established in 1999 as the peak body for the training, up-skilling and industry accreditation for users of herbicides and pesticides. It concern about potential adverse consequences of the use of farm chemicals and the need to protect the health and safety of rural workers, ensure the security of food and fibre production and maintain the viability of our domestic and export products. ChemCert has been enthusiastically embraced by a wide range of herbicide and pesticide users including farmers, graziers, horticulturists, viticulturists, forestry workers, community organizations, volunteers and employees of local governments and the National Parks and Wildlife Service (ChemCert 2013).

Animal Health Australia is an innovative partnership involving the Australian Government, state and territory governments, major livestock industries and other stakeholders, it work to strengthen animal health in Australia and maximise confidence in the safety and quality of Australia's livestock products in domestic and overseas markets (Animal Health 2013).

Weed Information provides environmental and agricultural weed identification, management and control of information, it Provide services for Weed management personnel in Australia and overseas by mail and other Ways (Weed Information 2013).

The Australian Centre for International Agricultural Research (ACIAR) is a statutory authority that operates as part of the Australian Government's development cooperation programs. The Centre encourages Australia's agricultural scientists to use their skills for the benefit of developing countries and Australia (Australian Centre for International Agricultural Research 2013).

In addition, the famous Australian web portal Agrigate link hundreds of the world's important authority sites, with characteristics of sharing resources, text connected, Smooth flow and others, Agrigate is jointly set up by University of Melbourne, Ontario University, Queensland University, etc. Australia CISC agricultural information network Provides a convenient information and services for farmers, CISC contains all the functions of agricultural sector and information of

market dynamics, agricultural science and technology, nature and meteorological information, agricultural policies and regulations, relevant information, etc. Which associated with the functions (Zhang Zhihui 2008).

In addition, almost all large research institutions in Australia has its own extension network, which Diffuses information to the user, all research institutions provide useful information to the users regularly on site (Arumapperuma 2013).

13.3 Application of Information Technology

Currently, information technology has been widely used in agricultural production in Australia, such as Internet, electronic technology, precision agriculture technology, computer systems technology, etc.

13.3.1 Technology of Internet and Electronic

It shows that more than 50 % of Australian farmers had already adopted IT facilities for their farming business by 2005–2006, nearly 90 % Annual turnover of more than one million dollar farm used computers and Internet, Internet activities for farm business operations in Australian states and territories farm business includes obtain weather information, obtain market information, availability or cost of goods and services, purchased or ordered goods or services, accessed government websites, paid bills via the internet, email and others. The survey also reveals that the most common internet activities undertaken by Australian farms in 2003–2004 were email (39 %), obtaining weather information (35 %) and checking the availability or cost of goods or services (29 %) (Arumapperuma 2013).

The mobile communications market in Australia, as in other developed economies, is continuing to see a further shift in emphasis from voice to more data-orientated services, driven by more new handsets and applications. Penetration has outstripped the size of the market, which indicates that people are increasingly using multiple services and multiple devices. Mobile broadband has steadily become more popular, spurred on by the advent of smartphones from vendors like Apple, HTC and RIM. By mid-2011 close to half of the population owned a smartphone (Paul-Budde-Communication-Pty-Ltd 2013).

Australian e-business environment ranked sixth in the world and ranked second in Asia-Pacific region, global business network giant MRI in Australia is building a global commodity and agricultural trading market, the United States, Canada, Britain, France, Germany, Japan, Australia, and China are included. It help farmers access to international information and technology. It also as Agents of domestic agricultural products in international market transactions and develop international trade of agricultural e-commerce (Ling 2005).

13.3.2 Precision Agriculture Technology

The technology application of GPS positioning guide, biomass maps, yield monitors and variable application has been more than a decade in Australian .in August 2004, Pam Watson founds that 34 % of respondents used precision agriculture technology in South Australia, north Australia, and west Australia, Currently, GPS positioning and guidance systems are the most widely used precision agriculture technology, mainly used in the control of crop spraying; More advanced precision agriculture technology are yield mapping with GPS and compile map production software, etc. (An Economic Analysis of Investment in Precision Agriculture Variable Rate Technology (VRT) 2013).

Other major precision agriculture equipment including automatic steering with GPS, harvester protein sensors, variable rate fertilizer, soil electromagnetic conductivity, etc. Australia precision agriculture technology is mainly used in the production, soil type, soil and crop nutrient status, soil electrical conductivity, soil pH, crops marginal, soil depth, etc. Yield and Soil type are the highest application rate (An Economic Analysis of Investment in Precision Agriculture Variable Rate Technology (VRT) 2013; A Glimpse of Precision Agriculture in Australia 2013).

13.3.3 Computer Systems

Currently, expert system has been applied in farm management in Australia, the application of technologies achieved many important results in agriculture, some results have already reached international advanced level. Such as systems engineering, database and information systems, expert systems, decision support systems, remote sensing (RS), geographic information system (GIS) and global positioning system (GPS) (The revelation of Agricultural Information Development of the tropical countries 2013).

Thirty-nine agricultural expert system have been Developed and 15 have been applied, such as expert system of main crop fertilization and irrigation and plant protection and cultivation and management, expert system of aquatic animal feeding and management, rural economic decision support system. Australia has applied geographic information systems (GIS), remote sensing (RS), global positioning system (GPS), mapping system, monitoring system and management systems in crop yield estimation, Growth Monitoring of plants and animals, meteorological and pest forecasting, agricultural storage and preservation and processing and transportation, etc. (Ling 2005). The precise rate of Application of satellite remote sensing for crop yield estimation in Australia is 90 %, and GIS technology has been applied in many aspects, such as soil management in agricultural production and forestry management.

13.4 Conclusion

Today, Australia agriculture information system is very advanced, Australian Department of Agriculture, Fisheries and Forestry (DAFF) and its affiliated information agencies have make an important contribution in the construction of the system, Australia government attaches great importance to the construction of agricultural information network and agricultural information infrastructure.

Since Australia government promote precision agriculture, Technology of Internet and electronic, Computer systems to develop for a long time, it has achieve a great result.

So, Australia agriculture information system promoted the development of its agriculture, and Australia became the most important agricultural country in the world.

Acknowledgement 1. Development and application of Hainan Nongbo platform for rural information service of Hainan Province major scientific and technological project

2. Regional development Basic Research of subtropical features of fundamental research funds of 2013 central-level public welfare for research institutes, project No.: 1630012013013

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Chapter 14
An Analysis on the Trend of International Biomass Energy Technology

Yanyan Du, Xiaofen Wen, and Binmei Guo

Abstract In this paper, the technology trends of solid, liquid and gas biofuels were analyzed by using a combination of qualitative and quantitative analysis methods. Then, based on patents collected from Derwent Innovation Index (DII), the trends on market expansion, technology development, patent assignee and inventor of international biomass energy technology were elaborated. Results showed that, in the international biomass energy technology market, there was a weakened market expansion ability, steadily increased technology and constantly expanding R&D teams.

Keywords Biomass • Energy technology • Development trend

Recent years, all countries in the world especially developed countries have been committed to the development and application of high heating value and relatively pollution-free biomass energy technology. Under this circumstance, by using a combination of qualitative and quantitative analysis methods, the technology trends of solid, liquid and gas biofuels were analyzed; Also elaborated were the trends on market expansion, technology development, patent assignee and inventor of international biomass energy technology based on patents collected from DII. Analysis results showed some valuable intelligence information in international biomass energy technology market, and can provide references for government decision-making, business innovation and researcher study.

Key project of national soft science-New energy research and development trend and its impact to China's energy strategies (project number: 2010GXS1K087)

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_14,

14.1 Development Trend of Solid Biofuels Technologies

Solid biofuels technologies are widely used and fully ripe technologies, which include biomass molding technologies, biomass direct combustion technologies and biomass-coal combined combustion technologies. Research and development on biomass direct combustion and solidification & molding technologies focuses mainly on design of special burning equipment and application of biomass molding material. On international biomass solidification & molding technologies and equipments there are three types of R&D: first, screw extrusion production of rod-like molding technology with Japan as representative, second, piston extrusion of strip molding technology with European countries as representative, third, Internal pressure roller of granular molding technology and equipment with America as representative. The Chinese government started to attach importance to research and development on biomass compression molding technology in 1980s and made great progress on screw extrusion and hydraulic pressure roller molding technology in the last few years. Key problems facing China at this time are how to reduce energy consumption per unit product of compression molding machine, improve productivity and lower production cost. The technology of briquette making under normal temperature is the trend of solid biofuels technologies (Liu Songbo 2010).

14.2 Development Trend of Liquid Biofuels Technologies

By far the technology of grain-based liquid biofuels production is ripe, but this poses great threat to food security in the world. So the development of second-generation biofuels technology with cellulose as law material is a way out for liquid biofuels. Although second-generation biofuels market is now facing many obstacles and its scale is not yet big, with the gradual progress and maturity of second-generation biofuels technology, it will soon have a prosperous future.

The second-generation biofuels refer to bioethanol and biodiesel produced through fermentation by using cellulase or other methods with agricultural and forestry waste like straw and sawdust, algae and pulp waste as the main raw materials. The significant difference between second-generation and first-generation biofuels is that grain is no longer used as raw materials, which minimizes the threat to food security. The use of second-generation biofuels can not only get rid of reliance on traditional fossil energy, but also contribute to reduction of greenhouse gas emissions to achieve global sustainable development (Xiang Wen 2012).

To stimulate the development of second-generation biofuels, many countries have made or being implementing related programs. Cellulose-based fuel ethanol production still has some problems to make through: (1) The development of clean and green technology to effectively remove lignin and reduce energy consumption

at the same time; (2) Breeding of high yield cellulose and lignin enzymes by using technology of genetic engineering to reduce production cost and improve the efficiency of enzymatic hydrolysis; (3) Acquisition of genetically engineered enzyme and bacterial strain to improve the efficiency of pentose fermentation and co-fermentation of pentose and heroes; (4) Development of combined process to integrate procedures from cellulose to ethanol to further simplify production process and reduce production cost. R&D teams from companies and scientific institutions related advance research into preprocessing and hydrolytic enzyme and yeast, making second-generation biofules technology full of opportunities. Global industrial revolution is now developing toward a carbohydrate-based economy.

The third-generation biofuels are made from algae. Research in algae biofuels is growing rapidly for algae is widespread and high in oil yield and has strong adaptive capacity to environment and short growing cycle among many kinds of non-grain biomasses. By far, algae biofuels are in a fledging period, but government policies and regulations will greatly boost the industrialization of algae biofuels. Algae biofuels may become one of the most important renewable energy sources in the future.

14.3 Development Trend of Gas Biofuels Technologies

Gas biofuels technologies mainly include biogas technology, biomass gasification technology and biological hydrogen production technology. Industrialized production of biogas and biogas used as transportation fuel GTL (Gas to Liquid Fuel) after purification are feasible technologies in developing gas biofuels recently.

Biogas technology is one of the ripe technologies. Main problems facing biogas industry at present are as follows: there is no mature technology to make full use of straw when producing biogas; Low conversion efficiency in biogas fermentation and feed concentration, high feed quantity and unstable running, resulting in low economic benefit; The lack of uniform standards and regulations in design and construction of large and medium-sized biogas projects. Currently, main production technology in biogas industry is anaerobic and dry fermentation technology, with features of no sewage produced in processing, low energy consumption in running and biogas fermentation residue is used as solid organic fertilizer. The main types of Europe anaerobic and dry fermentation technology are garage type, air bag type and dry & wet joint type.

Technologies of gasification and microbial catalytic dehydrogenation are used to produce hydrogen from biomass. Based on current research results home and abroad, biological hydrogen production technology is not yet mature and the research level is still in its elementary and foundation stage. Many researches focused on immobilized cells technology and immobilized enzyme technology and there are problems left to be settled: (1) For the activity of immobilized cells decreased rapidly and have to be replaced regularly, production of matched strains and processing technologies of immobilized materials are needed, thus adding

greatly to hydrogen production costs; (2) Metabolites of immobilized cells accumulate inside of granules increase mass transfer resistance, reducing biological hydrogen production; (3) Bacterium embedding is complicated processing technique and there is no suitable embedding medium; (4) Employment of embedding medium or other cell fixing materials impose limitation on improvement of hydrogen production rate and total output. The key issue in hydrogen production is to reduce production cost to provide cheap hydrogen. At present, large scale production of hydrogen is to produce hydrogen from fossil fuels such as coal, oil and natural gas, but it is not a sustainable method in the long run. Hydrogen production from water electrolysis is a good way to produce hydrogen from non-fossil fuels and has realized large scale production, reducing power consumption is the most important issue to spread water electrolysis technique. Hydrogen production by solar energy is a very promising hydrogen production method for its power is solar energy and its law material can be sea water or fresh water. Biological hydrogen production technology has become a hotspot in domestic and international research for it is produced in normal temperature and atmospheric pressure and it is low in power consumption and environmental friendly (Hu et al. 2011).

14.4 Development Trend of Biomass Energy Technology from a Patent-Based Perspective

From a patent-based perspective, trends on market expansion, technology development, patent assignee and inventor of international biomass energy technology in 1980–2009 were analyzed.

14.4.1 Trend Analysis on Market Expansion

The number of patent member countries can reflects the market distribution and expansion of biomass energy technology. Figure 14.1 is the yearly number of patent member countries from 1980 to 2009 with blue part represents the existing patent member countries, while red part represents the added patent member countries in the current year. It indicates that in the years between 1980 and 2006 technology market of biomass energy was expanding rapidly with the rising number of member countries; Then the biomass technology market was nearly saturated from 1996 to 2006 with no new opened markets and a stable number of member countries of about 33; While market expansion weakened with a decreased member countries science 2007, maybe it was because of the so called technical bottlenecks in research and development in some member countries.

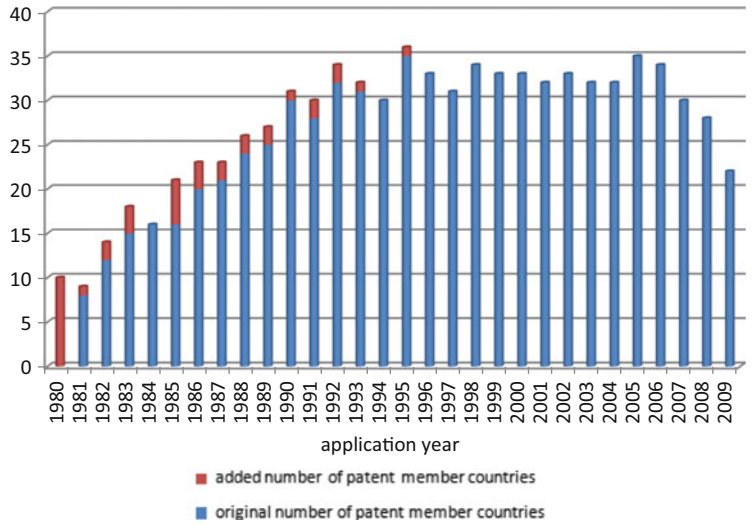

Fig. 14.1 Yearly numbers of patent member countries from 1980 to 2009

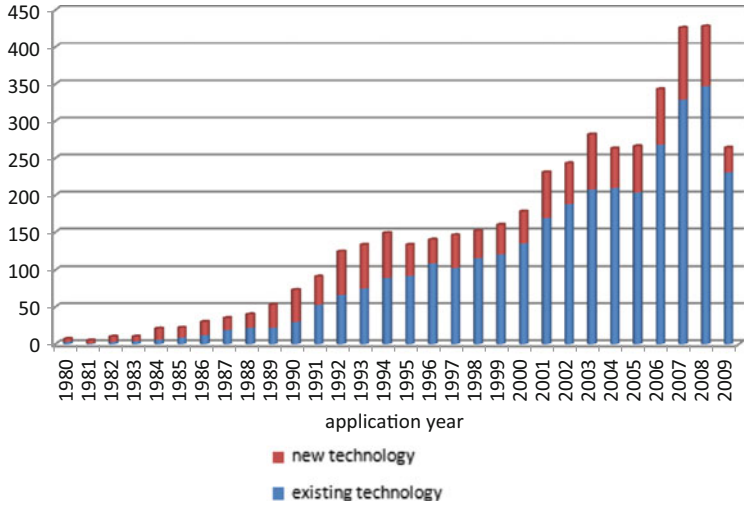

Fig. 14.2 Yearly numbers of IPC main groups from 1980 to 2009

14.4.2 Trend Analysis on Technology Development

Figure 14.2 is the yearly number of patent categories (IPC main groups) of biomass energy technology with blue part and red part represent respectively the existing patent categories and newly added categories in the current year. The figure manifests that biomass energy technology developed rapidly since 1980s with the

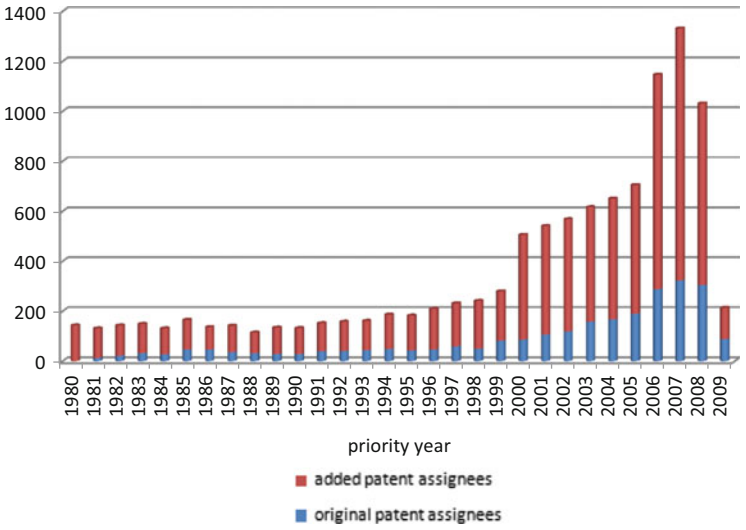

Fig. 14.3 Yearly numbers of patent assignees from 1980 to 2009

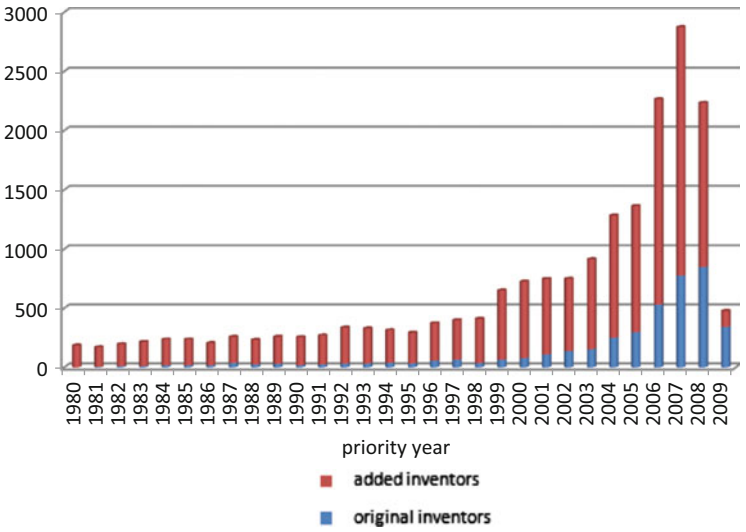

Fig. 14.4 Yearly numbers of inventors from 1980 to 2009

continuous growing number of IPC main groups, although the growth rate slowed down between 1995 and 2000, it returned to rise extraordinarily from then on. At the same time, newly added technology categories (IPC main groups) increased steadily. All these above demonstrate that all countries are bullish on biomass energy industry and enterprises and research centers constantly increase investment on new biomass technologies to obtain a larger market share in the future.

14.4.3 Trend Analysis on Patent Assignee and Inventor

Figures 14.3 and 14.4 show the annual trends of patent assignees and inventors with blue part represents existing patent assignees and inventors and red part represents newly added patent assignees and inventors in the current year. The change trends of patent assignees and inventors are almost same with a slow and steady growth between 1980s and 1990s and since then increased rapidly and continuously, indicating that R&D teams and researches of biomass energy technology have a continuous and rapid growth. More and more enterprises and research centers have joined the R&D member of biomass energy technology and invest more human resources to pursue a promising future.

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Chapter 15
Analysis of Major Factors Influencing Crop Yield of Shandong Province

Xiaoyan Zhang, Lili Wang, Lei Wang, Bingfu Liu, Jiye Zheng, Jia Zhao, and Huaijun Ruan

Abstract Based on the evaluation on overall grain production capacity, the major factors influencing grain production in every decade were analyzed using the grain yield statistics in over 60 years of Shandong Province. The factors included crop varieties and related production techniques, applying amount of chemical fertilizers, total investment of agricultural machinery, natural hazards, agriculture policies and market. Their relations with grain production were also analyzed. The results showed that the first factor leading to the increase of interannual volatility of grain yield was the applying amount of chemical fertilizers; the second one was effective irrigation area, and the third one was grain cultivation area. Drought hazard was the main factor decreasing grain yield. Per unit yield was the first factor influencing total grain yield of Shandong Province. The hazard rate of farmlands had obvious effects on total grain yield, and they showed apparently negative correlativity.

Keywords Shandong Province • Grain yield • Influencing factor • Natural hazards • Food security

Fund Project: Sponsored by Shandong Province agricultural application techniques innovation subject "Intelligent analysis on wheat production risk and study on key technology of early warning" and Shandong Province science and technology development plan (2012GNC11019) "study and application of key technology of winter wheat early warning of drought in Shandong"

Introduction of Author: Zhang Xiaoyan (1974–), female, doctor, associate researcher, comes from Tongliao of Inner Mongolia. Her study direction is monitoring and early warning of agricultural products and precision farming.

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_15,

There are lots of external factors influencing grain production, technically, economically as well as environmentally. In view of the major study of this research center, we consider the climate factor as the main external impact variable to grain yield. It is the characteristic of natural reproduction that makes climate changes have strong impact on grain production, thus become the most influencing factor (especially the abnormal change) of fluctuation of grain yield. For the fact that climate change is random and has a contemporary influence on grain production, China's interannual random yield fluctuation mainly results from climate impact.

After a whole study on China's development history of grain production, it can be concluded that meteorological factors directly result in those great bumper or serious lean years. Over last 20 or more years, areas covered by natural hazards become larger and larger with more and more severe damage to agriculture and grain yield. Natural hazards have become the most important and irresistible influencing factor of fluctuation of grain production. According to its origin, natural hazards can be divided into six categories- geological disasters, meteorological disasters, hazards of environmental pollution, fire, marine disasters, and biological disasters. Flood and drought have the biggest influence on China's agriculture and grain production, generally accounting for over 80 % of damage areas with a highest rate of 89 % (Mei Fangquan et al. 2006). In Shandong Province, major agricultural natural hazards include food and drought, hail, gale, dry-hot wind, low temperature and frost, tide, and crop pests, etc.

This text, according to statistical material of Shandong agriculture and based on assessment and evaluation on comprehensive grain production capacity of Shandong Province, makes a discussion on all kinds of influencing factors of grain production in Shandong and analyzes our current production condition as well as relations between farmland hazard rates with gross yield to determine the principal factor influencing Shandong grain production.

15.1 Regional Overview

Shandong Province is located in the eastern coast of China, downstream of Yellow River, between 114°36′–122°43′ east longitude and 34°25′–38°23′ north latitude. In summer, southerly wind prevails here resulting in hot and rainy weather; in winter northerly wind prevails bringing cold and dry weather while weather in spring is changeable, dry, rainless with frequent sand-wind; in autumn it is shiny and moderate. Annually average temperature is 11–14 °C, with annually accumulated temperature $\geq$0 °C of 4,137–5,283 °C, $\geq$10 °C of 3,592–4,760 °C as well as frost-free season of 173–250 days annually.

Annual sunshine duration is 2,300–2,900 h with percentage sunshine of 52–65 % and total solar radiation of 481–540 kJ/cm^2. The annual average rainfall here reaches 550–950 mm with a trend of decreasing by degrees from southeast to northwest. At costal region, frost-free season have 180–220 days at hinterland. In general, during the whole year 140–150 days are in winter, 72–108 days in summer

while spring and autumn have 50–70 days respectively (http://www.stats-sd.gov.cn/2007/sdgk/sdgk.asp). Shandong Province is one of the major grain production areas with principal crop of winter wheat in summer and corn, potato, soybean, and rice etc. in autumn. Wheat and corn are the two major grains in Shandong.

15.2 Analysis of Factors Influencing Grain Yield in Shandong Province

Factors influencing China's grain yield include: (1) crop varieties improvement and cultivation techniques; (2) the applying amount of chemical fertilizers; (3) agricultural machinery; (4) change in grain cultivation area; (5) agricultural meteorological disaster; (6) grain price (Li Maosong et al. 2005).

15.2.1 Varieties Improvement and Cultivation Techniques

It can increase grain yield largely to improve fine varieties, optimizing and standardizing grain seeds together with related techniques, such as fertilizing techniques of scientific formula, water-saving irrigation technology, mulching film and comprehensive prevention and control of insects and rodents, etc. In the long term, it is also the only way to settle China's food problem.

15.2.2 The Applying Amount of Chemical Fertilizers

The grain yield will increase obviously after applying defined amount of fertilizer. Figure 15.1 shows annual applying amount of fertilizer of Shandong Province over last 33 years. It can be concluded from this figure that amount of fertilizer before 2010 rose upward generally with an obvious increase. From then on, it increases slowly and has downward trend.

Xu Lang and Jia Jing (2003) hold that contribution rate of fertilizer amount to grain yield goes along a parabolic trajectory, rising first (i.e. increase grain yield at beginning) and then going downward gradually when it reaches zenith, (i.e. yield-increasing effect of fertilizer becomes weaker and weaker with time going by, taking on the law of diminishing marginal utility in economy).

Great amount of fertilizers applied will not only contaminate soil and underground water but also worsen the soil crust and erosion problems, etc., indirectly influencing per unit and gross yield in future, which can be seen in Fig. 15.1 from the value of last corresponding point of 2011. Therefore, in condition that farmlands

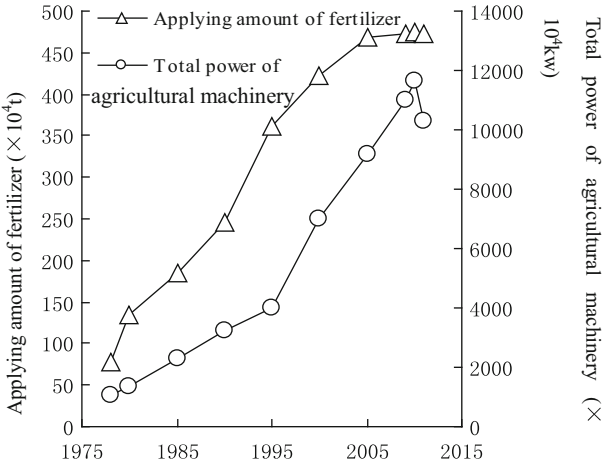

Fig 15.1 Investment of chemical fertilizers and farm machinery power per year in decades

decrease gradually, we cannot assure a sustainable grain development by solely applying fertilizers to promote yield increase.

15.2.3 Total Power of Agricultural Machinery

China has a large population and rich labor force in rural areas, with traditional ideology of intensive farming. For a long period, man and animal power are principal plowing powers in agriculture. With development of our economy and improvement of production level, input of total agricultural machinery power also increases a lot. After implementing the "tenth five-year plan", we have always persisted strategic guiding principle of "basing on big agriculture and developing big agriculture machinery", considering and evaluate agricultural mechanization in under the whole development of agriculture and rural economy and projecting it in the overall context of coordinating urban and rural development, in order to meet requirements of agricultural strategic structure adjustment and development of big culture. It can be seen from Fig. 15.1 that from 1978 our input into total power of agricultural machinery has rose directly upward in line with guiding thought in developing agricultural machinery. However, owing to changeable international resource market, China has met a tough period in energy consumption, resulting into frequent shortage of power, oil, and power cuts which restricts the input of energy-consuming machinery seriously.

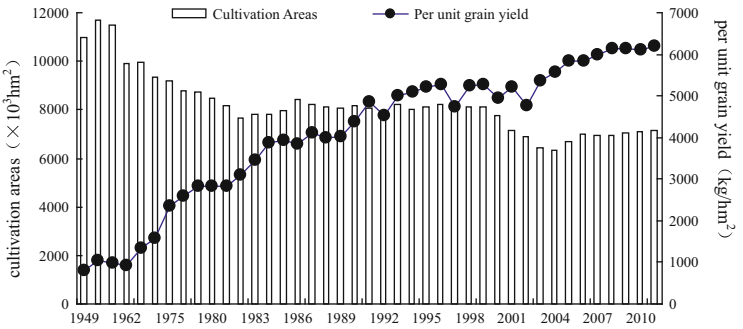

Fig 15.2 Change of per unit grain yield and cultivation areas in Shandong province

15.2.4 Grain Cultivation Areas and per Unit Yield in Shandong Province

Figure 15.2 shows changes of grain cultivation areas and per unit yield in Shandong Province. From this figure we can directly find that the per unit yield keep a gradual increasing trend except years of 1962, 1986, 1992, 1997, 2000, and 2002 when the per unit yield was a little low. Increasing trend keeps steady after 2003. Grain cultivation areas decreased from 1952 to 1982 and changed steadily without big fluctuation from 1983 to 2000. Another round of decrease occurred in 2000–2004 and from 2005, cultivation areas keep increasing $6.7–7.0 \times 10^6 \text{hm}^2$ annually. In 1949 cultivation areas are $10.98 \times 10^6 \text{hm}^2$ and $7.685 \times 10^6 \text{hm}^2$ in 1982, with a decreasing rate of 29.98 %. Simultaneously, per unit yield of grain in Shandong increased from 795 $\text{kg} \cdot \text{hm}^{-2}$ to 3090 $\text{kg} \cdot \text{hm}^{-2}$, with 2.88 increasing times and gross yield increased from 8.7×10^6 t to 3.75×10^8 t, with a 1.73-fold increase. Compared with 1982, cultivation areas in 2011 decreased 7 %, per unit yield doubled and gross yield had a 0.86-fold increase. From the above analysis, we can conclude that while the proportion of grain cultivation areas in total sown areas decreases gradually, the gross yield increase annually in Shandong Province. Therefore, per unit yield is the principal factor having an influencing on gross yield changes in Shandong.

From Figs. 15.2 and 15.5 we also can see that change trend of gross yield and per unit yield keep in same pace generally. In 1962,1986,1992,1997 and 2002, low per unit yield resulted into low gross yield. We have made a great transformation from merely relying on expanding areas into increasing per unit yield by keeping cultivation areas and applying science and technology in order to increase gross yield. It can promote comprehensive production capacity to improve production techniques and technical service ability and enhance withstanding ability to natural hazards with the condition that current farmland decrease no more.

15.2.5 Areas Covered by Hazards, Area Affected by Hazards and Areas Influenced by Drought in Shandong Province

Natural hazard is a principal affecting risk factor to grain in Shandong having an obvious influence to comprehensive production capacity here. In Shandong Province, drought has a large affecting range and problem of imbalance in water supply and demand becomes more and more serious. With a large population, Shandong has relatively small farmland of low quality. Under those situations as well as environment of national single market, to further protect and improve comprehensive grain production capacity and rationally utilize and protect agricultural resources, we must make a new systematic evaluation on whole province of its comprehensive grain production capacity in order to guarantee the fundamental position agriculture and strategic position of grain production (Zhang Xiaoyan et al. 2010).

Shandong Province locates at warm temperature of monsoon climate zoon and has four distinctive seasons, concentrated rainfall, largely changed temperature and frequent drought and flood. Average fresh water resource of the whole province only accounts for 1.09 % of whole nation for many years and per capita water volume is 344 m^3 only accounting for 14.7 % of per capita of whole country and 4.0 % of world per capita. Per acre water resource is 307 m^3 accounting for 16.7 % of whole country. Shandong Province suffers a lot from resource-type water shortage and the shortage has brought a severe threat to economic development and livelihood. Shandong province locates in northern areas of China and rainfall distributes unevenly whole year; in summer rainfall can account for 60–70 % sometimes even reaches 80 % of the whole year while in other season it rains rarely. In addition, rainfall distribution among regions is also unevenly. As a result, most of the province lies in arid and semi-arid areas as well as humid and semi-humid areas; thus drought occurs easily in the year with low rainfall, leading Shandong into a province frequently suffering from drought (Ma Peiyuan 2004).

Form 1990s in twentieth century, the drought becomes more and more severe resulted from decreasing rainfall and drying up of Yellow River. During 1989–2004, areas covered by hazards are 2,097,300 hm^2 yearly of the whole province; drought affected areas in 1991, 1997, 1999, 2000, 2001 and 2002 are all above 3,500,000 hm^2 yearly exceeding the average value obviously. Especially during 1999–2002, 4-year's drought brought about agricultural reduction, shutting down of industrial and mineral industry and enterprises as well as water supply shortage in urban and rural areas. Hazard of drought influences all kinds of aspects including industry, agriculture, service industry and people's livelihood, thus bringing serious affect to economic and social development Annual average areas covered of Shandong Province cover 26.77 % of total cultivation areas and rate of areas affected is 14.80 %; areas affected by drought cover 11.44 % of total cultivation, accounting for 42.75 % of total areas covered. It shows that drought ranks first among those natural hazards (Figs. 15.3 and 15.4).

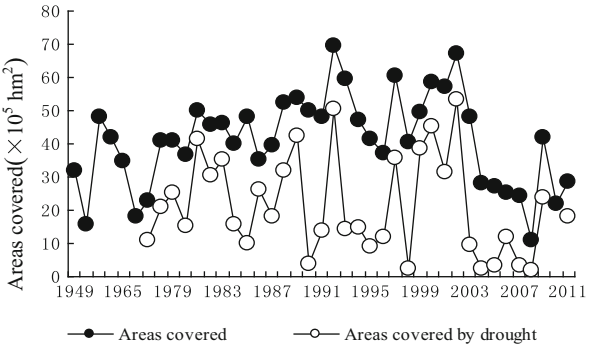

Fig 15.3 Comparison of areas covered by hazards and areas covered by drought over the years in Shandong province

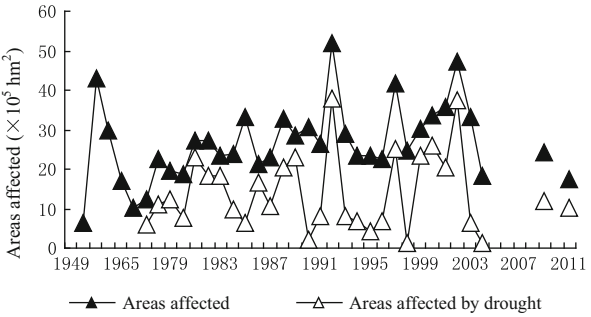

Fig 15.4 Comparison of areas affected by hazards and areas affected by drought over the years in Shandong province

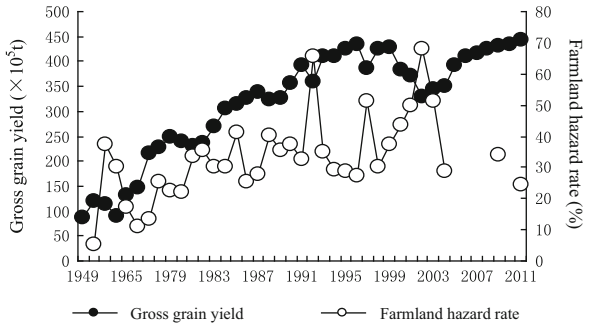

Fig 15.5 Relation between farmland hazard rate and gross grain yield

15.2.6 Hazard Rate of Farmland vs. Gross Grain Yield

Shandong Province, with complex terrain and influence from atmospheric circulation and monsoon, suffers from natural disaster frequently which bringing serious influence to grain production and becoming one of important factors restricting economic development (Encyclopedia Editor Committee of China's Agriculture 1994; Shao Xiaomei 2001). It can be seen from Fig. 15.4 that hazard rate of farmland has an apparently influence on gross grain yield. They have a negative correlation which reflects in following two aspects:

① Decreasing year of gross grain yield is just the year when hazard rate of farmland increased; typical years are 1997, 2000, 2001 and 2002; hazard rates are 38 %, 43.2 %, 48.3 % and 67.7 % respectively while the gross grain yield decreased 11.1 %, 10.1 %, 3.05 % and 11.5 % respectively compared with previous year. ② At the year of low hazard rate, gross grain yield increased obviously; typical years are 1990, 1993, 1995 and 2004; hazard rates are 32.1 %, 28.1 %, 26.4 % and 30.1 %; gross grain yield increased 9.8 %, 21.3 %, 3.8 % and 2.4 % respectively compared with last year. This follows that agricultural natural hazard is the major factor that decreases gross grain yield.

15.2.7 Agriculture Policy and Influence of Market on Grain Yield

Agriculture policy and market have great influence on China's grain yield: when grain price rises, farmers have high initiative and when grain price drops, farmers will plant other commercial crop or let farmland lie idle decreasing grain acreage directly and thus decreasing grain yield. Market can cause fluctuation of grain yield while agriculture policy can keep it steady if make and implement well. For instance, government functional departments can provide strong support in disaster prevention and reduction to minimize direct grain losses caused by natural disasters.

15.3 Contributions to Grain Yield of Those Factors

Based on above analysis, this text makes other related discussion of those influencing factors and grain yield. The biggest correlation coefficient between gross grain yield and amount of fertilizer is 0.937, correlation coefficient between gross grain yield and effective irrigation area, total power of agricultural machinery, and cultivation areas are 0.872, 0.837, and 0.790 respectively. It shows that these four factors all have big influence on gross grain yield. According to related analysis of areas covered and affected by natural hazards and gross grain yield, they have a negative correlation (i.e. when areas covered and affected increase, gross grain yield will decrease). Although relationship between areas covered and affected is not obvious, we cannot ignore its importance considering the big calculation unit and complex knock-on influence of hazards.

The above analysis shows that the first factor leads to the increase of interannual volatility of grain yield is the applying amount of chemical fertilizer; the second one is effective irrigation area; and the third one was grain cultivation area with potential connotation of influence water supply or drought have on China's grain yield; the third one is cultivation areas with potential connotation of influence

decrease of total cultivation areas or food policy and price have on China's grain yield. Major factor that causing grain yield a fluctuant decrease is drought.

15.4 Summary

This text clears the positive and negative factors influencing grain yield of Shandong Province through analyzing influencing factors from 1949 in this area, pointing out that in situation of farmland and water shortage and decreasing, to stabilizing grain yield of Shandong Province and guarantee China's food security, it is not enough just relying on adding input of fertilizer and agricultural machinery. We should further increase capital and technology input in agriculture, select and breed new varieties with high production and quality, and do works of disaster prevention and reduction well at the same time to reduce grain losses caused by natural hazards, especially by drought.

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Chapter 16
Study on Creative Agriculture Mode in Community

Haiyan Sun, Jianwei Feng, Dashun Zhai, Shubo Wan, and Lin Li

Abstract This paper based on the theory of community agricultural development, from the community agriculture mode presents the background, orientation, business system, key resources ability, profit model, the risk of existence and solving methods of different aspects of the depth. With the city of Haikou gold trade community as the research object, to the design of Hainan black pig, Hainan rice, Hainan tropical vegetable & fruit and Hainan Wenchang chicken investment operation platform for practice as the starting point, for the international tourist island of Hainan "green rise", for the establishment of new high-end creative leisure agriculture builds character to make suggestions.

Keywords Mode • Creative agriculture • Case study • JinMao community • Haikou city

16.1 Background of Agricultural Mode in Community

"Hunger breeds discontentment", "food safety first". Food is the basic material conditions of human survival and development, agriculture is an important source of food. Our country agriculture in the rapid development over the past few decades, the number of people's basic need for food security, with the development

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_16,

of economy and the improvement of living standards, the sustainable use of food quality safety and food resources has been put on the schedule of national.

Different people of different social economic status, the demand for food is actually not the same, the different demand level, lower needs are met, will develop to the higher level. Today, the vast number of consumers of food is in order to seek the security of spare no effort; there are many "producers directly related to sales of agricultural products – the consumer" form of society. Such as: Community Supported Agriculture (CSA, Community Supported Agriculture), white-collar farm etc.. . .

But this form of marketing is not fundamentally solving the integration of investors, consumers, producers, managers and use of resources. Consumers have no incentive to return on investment for the production of agricultural products, resulting in the development of these sales forms are relatively small scale, and low profitability.

Therefore, based on in-depth research on market demand, Hainan community of creative agricultural operators to subvert the agriculture industry in the traditional sense and sales terminals to fight the enemy separately model presents – new mode of community agriculture.

16.2 Agricultural Mode in Community

16.2.1 The Positioning

Location of community agriculture lies in the organic combination of investors and consumers, the integration; for consumers/investors to provide safe, cheap agricultural products at the same time, providing a return on investment for investors/consumer spending. Double guarantee is for the realization of investment and consumption.

Item company through community agriculture this platform, system integration of related resources of agricultural products, agricultural products become provide total solution service provider – to provide customers with safe, cheap, convenient agricultural integration services for customers. In order to achieve sales of agricultural products, double profit agricultural products cultivation management and sales of agricultural products.

16.2.1.1 Safety

Operation of the project is strict quality control system, guarantee the agricultural product variety; breeding technology and standards; the agricultural product quality, production date, product specifications. To this end, the company promised 3 days no reason to return, a full range to ensure customer relaxed worry-free purchase health and safety of agricultural products.

16.2.1.2 Cheap

Community agriculture powerful ability to integrate resources, farm management scientific, professional, not only to effectively guarantee the quality of agricultural products, but also realize the farm direct, reduce intermediate links, saving the cost of purchasing agricultural products, to meet the investors and consumers to buy cheap agricultural products demand.

16.2.1.3 Convenient

Agricultural mode of community has completely changed the traditional concept of agricultural products sales. The customer as a dual role of investors and consumers access to them, only need to provide the necessary requirements of agricultural products, the company by virtue of the agricultural system of community and professional services, can provide choice, from farm land varieties selection, cultivation management, to produce home delivery services for the integration of the managed type.

16.2.2 The Service System

To construct a community agriculture as the hub, with service outlets, enterprise engaging in production of agricultural products and logistics company as a collaborative network of agricultural products total solution and operation mechanism; **forming a light assets, the liquidity of commercial pattern**.

In the entire sales process, operation control of the information flow of the key, which will include the production of agricultural products, part of the sales terminal, logistics business outsourcing. The mode of operation will enable him to focus on the center construction, marketing, supply chain operation and brand management; at the same time, by the high quality of outsourcing and derivative services provide a range of value-added content for the customer, the customer to complete in this platform is not only the purchase of agricultural products, is solved from the farm to the kitchen scientific scheme, personalized.

The core community agriculture business model is to continuously meet customer personalization demand for agricultural products to promote sales of agricultural products, achieve win-win situation investors, consumers and the community of creative agricultural operators, partner.

16.2.3 Key Resources

The core operation of the project company is the agricultural system of community, so everything revolves around the core of business model, and to maximize the

value. The company's business system to run well cannot do without the support of key resource capacity.

16.2.3.1 Investors/Consumer

Community agriculture by attracting society of consumption of agricultural products have higher requirements for the project development group. The spirit of "helping investors to make money, to help consumers" and "to provide safe and healthy food" to 1 % people's ideas, seeking their reasonable profit space at the same time, fully guaranteed returns for investors, this is the key to building a stable of the cooperation system.

16.2.3.2 Outsourcing Strategy

The company for the construction of farm, feed, warehouse, service outlets to spend a lot of money, but with the agricultural enterprises, logistics companies and service outlets to carry out close cooperation, adopt outsourcing strategy. In the concept of win-win cooperation to fully guarantee the interests of partners, build cooperative system, stable to provide a high level, high consistency service for customers.

16.2.3.3 Brand Strategy

In the market of agricultural products, reputation is very important factor of consumer, the brand strategy is especially important. This project provides safe, cheap, convenient services, which have very high visibility, customer trust and loyalty, and thus obtain extra profit.

16.2.3.4 Strong Supplier Relationships

Traditional retailers and manufacturers are generally based on the relationship between trade relationship, its core strategy is based on the supplier continuous extrusion, obtain higher profits. While the location relationship between the company and the enterprise are strategic partners, will ensure a reasonable profit enterprises into production to the value net operating company, so as to further stimulate production enterprise loyalty to the company. Large, complete and mutually beneficial supplier relationships are creating a leading edge is not easy to copy.

16.2.3.5 The Ultra Low Price

The company through the integration of resources, reduce intermediate links, reduce the cost of operation and circulation, but also solve the backflow

phenomenon of the current sales of agricultural products, in order to ensure the production enterprises and agricultural products supermarket profits against erosion at the same time, save at least 15 % of the cost for the customer.

16.3 Profit Model

The community of creative agricultural neither from the manufacturers of products in the process of producing a profit, nor from the direct product sales profit, but through the integration of resources to produce supermarket enterprises, logistics companies and to join, to profit by investors, consumers, manufacturers, join supermarket service.

16.3.1 Franchise Fee

The 90 % chain store is the development through joining form, for the supermarket to terminal services platform of community agricultural system, and give the operation, technology, marketing, human resources training, logistics support. Each join supermarket charge at least $50,000.

16.3.2 Principal Order Management Fee

Due to the large number of potential customers on the network, project operating company product entrusts the order quantity will be maintained a high growth rate, which is an important source of income. According to the agreement, a certain proportion of company according to the service network client orders the charge management fees, in the benefit at the same time, fully guarantee the service profit space.

16.3.3 Manufacturers

Operators and value net of the agricultural product supplier project has established close cooperative relations, order quantity, the steady growth of the timely payment settlement established a good reputation in the suppliers. As the high value customer's manufacturers, production enterprises according to the amount ordered to give the company a 3–6 %. With the development of value net mode and logistics order quantity rapid growth, manufacturers rebate income has become one of the most important sources of community of creative agriculture. Therefore,

continuously improve the supermarket customer service level and service quality, expand the supermarket marketing channels, improve the quantity of agricultural products, is the development direction of community of creative agriculture.

16.3.4 The Straight Camp Shop Management

In order to better combine line, line, gets the most potential market returns, will be phased construction in the city of Beijing, Guangzhou, Shenzhen economy developed 30–35 home center stores, and in each area to the center of the straight camp shop opened 120–160 two grade center straight camp shop as the foundation. The operator will use the pulling effect of the straight camp shop good operating condition to franchise in the form of land, city, county region laying service outlets, expand customer catching surface. Through the straight camp shop business, can be a more direct understanding of customer needs, continuously improve the value net model to meet customer demand for agricultural products as the leading, in order to obtain proper logistics income at the same time, the company also will obtain from the straight camp shop sales of agricultural products operating income.

16.4 The Establishment Costs of Agricultural Mode in Community – Taking JinMao Community as an Example

With the Haikou JinMao community construction and the continuous improvement of facilities, as one of the emerging residential areas in Haikou City, has attracted more and more people came to their investment in the high-end.

JinMao community resident households to 10,000 households calculation, we intend to develop key customers is $10{,}000 \times 1\ \% = 100$ households. According to 50,000 yuan of each investment, total investment of JinMao community agricultural households for $100 \times 50{,}000$ yuan $= 500$ yuan.

According to the conventional method to avoid the risk of the project investment, item company plans were put into the following agricultural project:

(Source: Community creative agriculture project operation time: 2012 June)

A. Hainan Black Pig

Hainan black pig is expected to invest 2,000,000 yuan.

One Hainan black pigs from the purchase of piglet to marketing the whole process a total of 1,000 yuan, profit of 200 yuan for each unit of account.

Planning culture: 2,000,000 yuan/1,000 =2,000

Profit: $2{,}000 \times 200$ yuan =400,000 yuan

Household income: 400,000 yuan/100 yuan/households households =4,000

B. Hainan Shanlan Rice

Hainan rice is expected to invest 1,500,000 yuan.
In Hainan the purchase of seeds per hectare of rice to the entire sales process a total of 16,500 yuan, per hectare yield of 7,500 Jin, sales price of 3.5 yuan, profit of 9,750 yuan as the calculating unit.
Planting: 1,500,000 yuan/16,500 yuan =91 ha
Profit: 91 ha by 9,750 yuan =887,250 yuan
Household income: 887,250 yuan/100 yuan/households households =8872.5

C. Hainan Tropical Vegetable & Fruit

Hainan tropical vegetable & fruit is expected to invest 500,000 yuan.
The per hectare tropical vegetable & fruit from the purchase of seeds and seedlings to the entire sales process a total of 37,500 yuan, per hectare yield of 75,000 Jin, sales price of 2 yuan, profit of 112,500 yuan as the calculating unit.
Planting: 500,000 yuan/37,500 yuan =13 ha
Profit: 13 ha by 112,500 yuan =1,462,500 yuan
Household income: 1,462,500 yuan/100 yuan/households households =14,625

D. Hainan Wenchang Chicken

Hainan Wenchang chicken is expected to invest 1,000,000 yuan.
One Wenchang chicken from the purchase of seeds and seedlings to the entire sales process a total of 25 yuan, sales price 14 yuan per catty, each only 3 jins, profit of 17 yuan as the calculating unit.
Planning culture: 1,000,000 yuan/25 yuan =40,000 only
Profit: 40,000 × 17 yuan =680,000 yuan
Household income: 680,000 yuan/100 yuan/households households =6,800

16.5 Economic Accounting

1. 50,000 yuan of investment in household income:

Hainan black pig household income + Hainan + Hainan tropical vegetable & fruit fragrant household income household income and household income of Hainan Wenchang chicken
=4,000 yuan/household +8872.5 yuan/household +14,625 yuan/household +6,800 yuan/household =34297.5 yuan/households

2. Household consumption is expected to:

(Source: National Bureau of Statistics Survey Office in Hainan, release date: 2011 December)

A. Pork: according to the per capita consumption of 40 kg, every four people, is expected to household consumption of Hainan black pig 160 kg, 160 kg × 2 kg × 12 yuan =3,840 yuan
B. Rice: according to the per capita consumption of 200 kg, every four people, is expected to household consumption in Hainan rice 800 kg, 800 kg × 2 kg × 3.5 yuan =5,600 yuan
C. Vegetable & fruit: according to the per capita consumption of 120 kg, every four people, is expected to household consumption vegetable & fruit 480 kg, 480 kg × 2 kg × 1.5 yuan =1,440 yuan
D. Wenchang chicken: according to the per capita consumption of 5 kg, every four people per household consumption calculation, is expected to Hainan Wenchang chicken 20 kg, 20 kg × 2 kg × 14 yuan = 560 yuan

Investment of 50,000 yuan per household consumption:

Hainan black pig household consumption and household consumption in Hainan rice + Hainan tropical vegetable & fruit household consumption + Hainan Wenchang chicken household consumption

=3,840 yuan/household +5,600 yuan/household +1,440 yuan/household +560 yuan/household =11,440 yuan/households

3. The average net profit:

(Hainan black pig household income + Hainan + Hainan tropical vegetable & fruit fragrant household income household income + Hainan Wenchang chicken household income)

−(Hainan black pig household consumption and household consumption in Hainan rice + Hainan tropical vegetable & fruit household consumption + Hainan Wenchang chicken household consumption)

=34,297.5 yuan/household − (3,840 yuan +5,600 yuan + 1,440 yuan + 560 yuan = 22857.5 yuan/household)

4. The average rate of return on investment:

22,857.5 yuan/50,000 yuan = 45.7 %

Through the above analysis we can see that, if a family living in Haikou JinMao community family invested 50,000 yuan in agricultural communities of the project, not only can enjoy the fresh, safe, cheap meat, rice, vegetables, fruit, poultry per day, and in 3 years, will be to recover the full investment.

16.6 Existing Risks and Solutions of Agriculture Mode in Community

Under normal circumstances, agricultural projects exist several risks: natural risk, market risk, system risk, credit risk, technology risk. Agricultural mode of community can solve these problems well.

First of all, community agriculture achieves the whole process from farm to table the personalized solutions. In the case of the Haikou trade community, we can find all the product of agricultural production, community, 40 % of the products are directly into the investor's home. We need to solve the problem of market sales is only the remaining 60 % of agricultural products. Because our products are safe, healthy, cheap, and established a wide sales network, the development of the non – investment of consumer groups large, surplus agricultural products will quickly enter the community families. Market risk, system risk can be avoided.

Secondly, the ability integrates resources, extensive, Hainan province famous agricultural experts, scholars as a technical consultant, production enterprise guiding communities in different categories of agriculture. This will solve the technical risk.

Finally, through the establishment of agricultural Guarantee Corporation and insurance company's cooperation, can be avoided to the largest extent of natural risk, market risk and credit risk.

16.7 Conclusion

JinMao community agriculture business model, the full integration of investors, consumers, agricultural production enterprises, logistics companies and franchise business resources, production, terminal sales, logistics business to outsourcing. Therefore, companies do not need to invest in the construction of sales terminals, through the franchise transfer lever, this part of the cost to the franchise and body; does not need to take expensive inventory costs, this part of the cost of agricultural product manufacturers to assume (Jiang Xiangdong 2005). Community of creative agricultural companies will form a unique to zero investment in the development of franchise network, light assets financial model negative operating funds management, capital efficiency, and with minimal capital investment, rapid expansion, and the formation of profitability and capital value.

Because of the fixed assets basically does not need to increase, with the expansion of the market, a rapid increase in logistics commissioned order quantity and characteristics of the franchise fee, asset concentration will be further reduced, the rate of return on capital will be further improved.

Acknowledgement The work is supported by the Doctoral Science and Technology Innovation Fund of Hunan province.

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Chapter 17
The Application Study of Electronic Farming in the New Countryside Construction in Hainan

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Abstract In this paper, which takes Hainan as an example, analyze the application of Electronic agriculture affairs in the process of building a new countryside, and aims at proposing the application strategy of Electronic agriculture affairs. The paper points out the advantages of applying electronic agriculture affairs in building a new countryside and the ways to carry it out. It takes the application of electronic agriculture affairs of Hainan as the focal point and analyzes its application mode. Together with the analysis of the application situation in other areas, it summarizes the problems in the process of applying electronic agriculture affairs. At last, it proposes the countermeasures and solutions in application of electronic agriculture affairs.

Keywords New countryside construction • Electronic farming • Agricultural informatization

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_17,

17.1 Introduction

Information technology has greatly changed the mode of agricultural development and reform, in particular, had a huge impact on the interaction between the markets for agricultural products and agricultural production.

The core to build a new socialist countryside is to develop the agricultural economy and increase rural incomes. It is undoubtedly an effective way to reform the traditional management of agriculture for building new countryside. Electronic agriculture affairs, as an advanced commercial pattern, has great advantages in improving the industrialization degree of agriculture, adjusting agriculture structure, reducing the transaction cost, and expanding the market of the sale of agricultural products.

As the country's largest special economic zone and international tourism island, Hainan is an agricultural province; agricultural information degree of market determines the level of results and to play the role of bridgehead of the new socialist countryside construction in Hainan. Although the province's agricultural information market in recent years has made great progress, especially 1-year term of Hainan Winter Fair, rural economic development of Hainan and the surrounding provinces and cities of the more advanced market demand, technology and industrial development agricultural information. Hainan agricultural market development status, the market is not mature, the trading behavior is not standardized, even the existence of low-quality information, false information events.

The Hainan is a major agricultural province; therefore, to the establishment of a sound, comprehensive agricultural information system to promote rural economic development of Hainan is the urgent task of the agricultural province.

17.2 New Socialist Countryside Farm Applications Countermeasures

To become boosters of the socialist new socialist countryside construction, the implementation of e-agriculture is very complex system engineering. E-agriculture in the new socialist countryside construction applications may encounter a variety of problems, for the problems that may arise, as well as the construction of a new socialist countryside in the case of successful application of e-agriculture, domestic socialist new countryside building applications for electronic farm to make some suggestions.

17.2.1 The Establishment of Agricultural Information Service System

The establishment of agricultural information service system and gradually establish agricultural means of production and supply system; processing of agricultural

products, sales system; agricultural research, teaching, technology extension system; crop seeds, poultry livestock cultivation, breeding, processing, marketing system and agricultural quality inspection and supervision system, a series of agricultural information service system.

17.2.2 Government Supports

To guide the development of the advanced countries of agricultural products e-commerce demonstration system experience shows that without government involvement and support in e-commerce of agricultural products is difficult to smooth progress. The construction of e-agriculture as the main government departments, and deregulation operating services, promote the diversification of service model, and the promotion of e-agriculture targeted. Government to the grassroots agricultural sites, below the county grass-roots promotion of agricultural technology organizations, rural information service enterprises, farmers, professional and technical associations and intermediary organizations to provide support in all aspects, so that they can on the joint network, the second line people. To strengthen the Government's efforts to support the provision of public information products and services to the majority of farmers, the provision of fiscal and monetary policy support, standardize the order of the information services market.

17.2.3 Train a New Generation of "Electrical Farmers"

To take various measures to train a new generation of "electrical farmers" the quality of farmers is the key to China's agricultural modernization, but also an important factor in the development of e-commerce of agricultural products. The long-term goal of the departure from the modernization of agriculture, to develop detailed planning to take concrete measures to step-by-step phases, get down to improve farmers' cultural knowledge and agricultural technology.

17.2.4 Establish the Appropriate Supply Chain and Logistics Systems

To establish the appropriate supply chain and logistics systems agriculture has obvious regional and seasonal characteristics of the different regions, different seasons of the agricultural products to be linked between agriculture and e-commerce platform, which requires the establishment of effective supply chain

system, as well as agricultural database. Establish the agricultural supply chain of agricultural logistics system.

17.2.5 Determine the E-farm Demonstration Sites to Comprehensively Promote Information Technology in Rural Areas Provide a Demonstration Effect

The limited local finance, promote e-agriculture construction impossible to carry out large-scale. Therefore, local governments in promoting informatization construction, make sure that the construction of demonstration sites, building on a small scale. Leading enterprises, agricultural cooperative organizations, large breeding, as the focus of information construction. In the demonstration sites should be taken to the idea of rapid application of high standards of quality, low-input, and to adopt a unified program, unified standards, unified integrated, hierarchical implementation approach, the accumulation of experience in the construction. This information construction in rural areas is very important, and helps to reduce the blind investment and resource conservation, and can find the information on the real needs of rural residents.

17.2.6 Market-Oriented Operation Mechanism for E-agriculture Construction Refueling

E-agriculture has a strong public interest, and to highlight the social benefits is a long-term task, you must combine government promotion, guidance and market mechanisms. In addition to government departments, various social or business organizations can become direct information service principal, the Government can play an organization to promote and oversee the manager's role, and insisted that the government-led emphasis on the basic role of the market, accelerating the development of the information technology market players, play to their enthusiasm; the role of government to gradually Go to actively create a favorable policy environment for up to encourage and support all kinds of social forces to carry out the socialization of information services for the majority of farmers, to promote e-agriculture.

As long as the governmental organizations, to co-ordinate the planning, funds, technical support. Development of low-cost, high-tech, systems-oriented integrated innovation, e-agriculture will be able to achieve brilliant results. Which is conducive to narrow the urban-rural digital divide, break the urban-rural dual structure; conducive to the promotion of farmers to change their ideas and improve quality; conducive to modern technology and the combination of agriculture, strengthen the comprehensive agricultural production capacity-building, the construction of these

e-agriculture, promote rural economic and social development played an important role of government is a way of building a new socialist countryside.

17.3 A New Socialist Countryside E-farm Application of Innovative Solutions

17.3.1 Overall Program Architecture

After a large number of requirements analysis, in-depth study on the construction of agricultural information, a comprehensive plan to provide a set of agricultural information technology solutions, mainly from three aspects:

First offers a range of hardware and software products for the agricultural production information to meet the agricultural prenatal, delivery, postpartum and other aspects of the high-tech needs, enhance scientific and technological content of agricultural production, enhance the market competitiveness of agricultural products.

Followed by agriculture-related enterprises to provide information technology solutions, from simple to complex embodiment, a comprehensive plan for the gradual implementation of agriculture-related enterprises gradually increase the level of information, meet agricultural production, operation in science and technology, market, management, personnel and other information needs.

Again to provide information services for the government, enterprises, scientific research institutions, farmers, build modern rural information service system. Vast amounts of technology and market data sources as the basis of all the modern means of communication, build a convenient, fast, intelligent, high-speed two-way information channel and trading platform to meet all aspects of the information needs of all levels.

17.3.2 Agricultural Production Information – Precision Agriculture System Solutions

Precision agriculture by 10 system, namely, global positioning systems, field information collection system, agricultural remote sensing monitoring system, irrigation and geographic information systems, agricultural expert systems, intelligent farm machinery systems, environmental monitoring systems, system integration, network management systems and training system, its core is a perfect farmland geographic information system (GIS), can be said that the full integration of a new type of agricultural information technology and agricultural production. Precision agriculture is not too much emphasis on high-yield, and the main

emphasis on effectiveness. It agriculture into the digital information age is an important direction of development of agriculture in the twenty-first century.

Precision agriculture is based on information technology support, based on the spatial variability, positioning, timing, quantitative implementation of a set of modern farming operations technology and management system, a new type of agriculture is fully integrated information technology and agricultural production. Precision agriculture technology system, including the different levels of the system, based on the application software.

System Software: Average common Windows operating system software;

Basic software: can be used for secondary development of GIS software such as MapInfo, Arc/Info; application programming software, such as VB, VC, the underlying database software;

Applications: spatial information management and analysis software; farmland GIS precision agriculture as the foundation of the database; software and data exchange software, software and hardware interface software; GPS and GIS interface software, GPS, GIS and intelligent agricultural interface software, field information collection and GIS interface software; analysis and decision software and agricultural expert systems, crop growth and numerical simulation, farm management decision-making software.

17.3.2.1 Agricultural Production Management Program

Analog agricultural experts ponder the reasoning process to solve the farmers' problems in the production process a set of utility software. Can also be run separately to run on a computer to solve due to the usual fertilization irrigation, pest and disease control, information understanding timely grasp inaccurate not the right response to the losses caused by integration with the local agricultural site. Agricultural expert system to guide scientific farming, science and sprinkle the medicine, scientific fertilization, scientific pest control, reduce the dangers of instability and improve the economic efficiency of the agricultural industry. Agricultural expert system has a unique intelligent reasoning, the use of multimedia information technology, graphic audio and Mao popularization of agricultural production technology guidance of scientific farming.

The main features of the system:

Fool: the color of the man-machine interface, style design with the current mainstream WINDOWS XP interface style; method of operation, the choice of the list (such as a drop-down list, combined list), greatly reducing the user manual input operation; the form of a Windows Explorer on the system to use interface enables users to easily get started operation; tree structure in the form of knowledge representation, knowledge system a clear at a glance.

Intelligent: the system according to the relevant parameters of the user-selected pest and disease onset of symptoms, body characteristics, automatic judgment,

analysis, results given by the inference engine, such as the name of the pest and disease control methods.

Interactivity: agriculture and animal husbandry expert professional interaction through the system with the user, with a professional online conversation function module, the user of the problem and reply to the experts in this line docking.

Simple: the system comes with a data management system that provides a simple maintenance platform, according to the instructions to fill in the data, the system can automatically and immediately to knowledge extraction and interpretation, the required knowledge stored in the underlying database maintenance The process is very simple.

17.3.2.2 Pest Control Forecasting System

Solve local plant protection departments pest forecast forecasts of information technology, it is a combination of software technology, network technology and plant protection technology intelligence software, specifically designed for plant protection forecasting, for all aspects of the plant protection work process design, effectively reduce the workload of the plant protection of forecasting, improve work efficiency.

This system is fully functional, related to all aspects of plant protection, the system consists of ten subsystems, namely: pest data upload and release system, the pest database management system, integrated pest and disease information inquiry system, reporting and management systems, pest and disease forecasting Statistical Analysis System, pest and disease forecast data mining system, pest prediction visual modeling system, pest multimedia data management systems, pest and disease forecasting model simulation system and disaster fuzzy evaluation system. The function of each system are described as follows:

1. Under the network environment pest data upload and release system

   The system through the Internet site of data to collect, collate, publish, upload and issued. Around the state, counties and cities statistics and other materials to document form on the aggregated upload. The provincial stations under the local cities and counties can also be down directly send text notifications.

2. Pest and disease information query system

   The data management module embedded in a strong data query functions. Query objects include: data table fields, data sheet describes the information, data sheet classification, data tables, fields, field descriptions. You can query data tables, fields, and records. Comparison include: equal, not equal, fuzzy comparison, equal to the null value is not equal to a null value.

3. Reporting and management system

   Report Manager free report table-like design to achieve a good header of the freedom to customize, easy to use and powerful. Users according to the actual need to design a report header, select the matching data sheet and select the corresponding field for each column, then a simple parameter settings to the preview of the report, print.

4. Pest forecasting Statistical Analysis System

   The statistical analysis of regression prediction method is the prediction of agricultural pests and diseases has important practical significance. System and multiple linear regression modeling and prediction function, intuitive modeling guide makes the model easy to use, standardized and rigorous. Save the establishment of a good model, forecasts, select the data table corresponding to the model library model input argument value, you can calculate the predicted value and the predictive value of interval estimation.

17.3.3 Agricultural Enterprise Information Solutions– Supply and Demand of Agricultural Products Information Intelligent Service System

Based on fully research the current agricultural enterprises informatization construction features of the core of enterprise resource plan (ERP) agricultural enterprises informatization construction program, including the construction of network infrastructure, enterprise Internet (LAN and wide-area network), Enterprise Resource Management and e-commerce in order to achieve full sharing and utilization of information resources. Using Internet resources to establish an online order service platform, logistics and distribution system, to achieve the full range, removable, integrated centralized management and real-time process control; fully tap the business information resources, and provide an important basis for management decisions.

Agricultural supply and demand information intelligent service system integration with local rural network to forecast the trend of prices of agricultural products through intelligent analysis, analysis of market conditions, to automatically search market supply and demand information, analysis and retrieval, automatic matching of supply and demand of agricultural products. Agricultural supply and demand information intelligent service system is a data acquisition, data cleansing, data mining analysis, intelligent prediction, visualization, display and other subsystems organic whole, mining analysis and intelligent prediction from each other, complement each other to form a comprehensive smart trends predictive analysis methods, and ultimately the formation of an integrated system.

Agricultural supply and demand information intelligent service system main function is to: show the prices of major agricultural spatial distribution, the timing

variation trends of the market price, supply and demand information intelligent docking; market-oriented agricultural structure adjustment for government departments; agriculture and animal husbandry enterprises, large, Association, and even ordinary farmers show the dynamic and intelligent analysis.

1. The prices of agricultural data mining method

   Based on the prices of agricultural data warehouse, variety, price, quality, production, origin, property, classification, clustering, association, timing and other mining analysis, reveal price trends influencing factors and reasons, such as: the impact of high prices,, low distribution area characteristics, population characteristics, the analysis of the seasonal characteristics of inter-city price fluctuation relationship between varieties prices ebb and flow, and the industrial structure, price and agro-meteorological relationship analysis.

2. Commodity price trends analysis and forecasting methods

   Price data and spatial distribution of the data according to the timing of agricultural products, the establishment of a data mart, through statistical analysis, support vector machines, neural network and wavelet chaotic prediction method for trend analysis, timing analysis and cycle analysis, forecast the trend of prices of agricultural products.

3. Agricultural supply and demand information intelligent docking method

   The use of Ontology-based Web information mining, extraction, semantic analysis technology, combined with the price, quantity, quality, location and other attributes intelligent docking of supply and demand information for the user or request information, the priority of the request or for competitiveness automatic docking to the user. Information is available through the means of transmission, such as: voice systems, portals, SMS platform, customization and broadcast push.

17.3.4 Rural Information Technology Solutions – The Rural Market Service System

Existing agricultural market information collection channels and collection points, unified and standardized information collection system of various types of agricultural products, as well as market supply and demand and prices of agricultural commodities (including fertilizers, pesticides, plastic sheeting and other agricultural markets, food, vegetables, livestock, aquatic products and other agricultural products market information). In the data acquisition system based on the integration of existing information media, real-time information released by e-mail, pager, SMS, etc. In addition to real-time information on the Internet, information is

automatically released. Processing, sorting and analysis of information resources, analysis and forecast the agricultural main varieties of domestic and international market conditions, production and marketing situation. Use the web to provide the means of communication in the online transaction an exchange of information between the two sides, trading contact stylized system; take online auction as the main mode of trading Contact by e-mail, mobile phone text messages and paging intelligent an exchange of information. Create an online agricultural trade information service platform, to achieve real-time online deliberation trading conditions.

17.4 Conclusion

In this paper, some of the problems of e-farm applications in the construction of new socialist countryside, some countermeasures, and launched on the basis of the application of innovative solutions for e-agriculture, including agricultural information technology, the agriculture enterprise information and rural information of the solution.

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Chapter 18
Low Carbon Economy and Sustainable Development of Tropical Agriculture in Hainan Province

Dashun Zhai, Dongsheng Zou, Han-yan Sun, and Xiaofei Zheng

Abstract This paper starts from the origin and meaning of Low carbon economy, describes the possibility and necessarily for Hainan province to practice Low carbon economy. Then studies the current situation of Low carbon agriculture in Haikou city, makes the decision that practicing low carbon economy is the necessary way for Sustainable Development of Tropical Agriculture in Hainan Province.

Keywords Low carbon economy • Tropical agriculture in Hainan Province • Sustainable development • Haikou City

18.1 The Origin for Low Carbon Economy

With the continuous growth of the global population and economic scale, energy use and cause environmental problems are constantly recognized, not only harm the smoke, photochemical smog and acid rain and other, atmospheric carbon dioxide concentration of global climate change has been recognized as an indisputable fact. by the, it is the background for "Low carbon economy" put forward, that challenge of global warming to human survival and development.

"Low carbon economy" first appeared in the government documents in the UK energy white paper "the 2003 our energy future: creating a low carbon economy". As a pioneer of the first industrial revolution and the resources are not abundant

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S. Xu (ed.), *Proceedings of Selected Articles of 2013 World Agricultural Outlook Conference*, DOI 10.1007/978-3-642-54356-2_18,

islands, United Kingdom is fully aware of the threat of energy security and climate change, it is from the energy supply to provide for one relies mainly on imports of age. According to the current consumption patterns, is expected in 2020 80 % of the British energy must be imported. Therefore, the British government proposed the "low carbon economy according to the research results of experts" (Low carbon economy) concept, and quickly became popular in the world. Especially the world climate conference in Copenhagen, let the "low carbon economy" to the end of 2009 hot words, low carbon means of environmental protection, energy-saving emission reduction, means the transformation of production, life style and concept of value.

18.2 The Connotation of Low Carbon Economy

The so-called low carbon economy, refers to the concept of sustainable development under the guidance, through technological innovation, system innovation, the industrial transformation, new energy development and other means, as far as possible to reduce energy consumption high carbon coal oil, reduce greenhouse gas emissions, a form of economic development to achieve economic and social development and ecological environmental protection win-win.

The development of low carbon economy on the one hand's to actively take responsibility to protect the environment, complete the country's energy consumption indicators requirements; on the other hand, is to adjust the economic structure, improving energy efficiency, development of new industries, and the construction of ecological civilization. This is the real way to abandon the development pattern of intensive treatment after pollution, the first low after the high-end, after the first extensive, is an inevitable choice to realize economic development and resources and environmental protection win-win.

Low carbon economy based on low energy consumption, low pollution, low emission based economic model, is a great progress of human society after the agricultural civilization, industrial civilization. The essence of low carbon economy is the efficient use of energy, clean energy development, the pursuit of green GDP, the core is a fundamental change of energy and emission reduction technology innovation, industrial structure and system innovation and the concept of human survival and development.

In this context, the "carbon footprint" of "low carbon economy" and "low-carbon technologies" "low carbon development" "low carbon life" to "low carbon society" and "low carbon city" "low carbon world" and a series of new concepts, new policy emerge as the times require. Energy and economic values and results of the implementation of major changes, will be gradually moving towards ecological civilization out of a new road, namely: abandon the traditional growth pattern in twentieth Century, innovative technology and mechanism of the direct application of the new century, through the low-carbon economy and low-carbon lifestyle, to achieve the sustainable development of society.

As the forefront of a broad social economic philosophy, the definition of a low carbon economy is not common. Low carbon economy also relates to the field of a wide range of industries and management.

18.3 The Concept and Characteristics of Low Carbon Agriculture

"Low carbon economy" is based on low energy consumption, low pollution based on green economy, is the inevitable choice to deal with climate change. Agricultures the foundation of the national economy should respond to low carbon economy to control climate warming. But now people spoke of a low carbon economy, is the industry more, say less about city agriculture, the country, speak less. In fact, the United Nations Food and Agriculture Organization recently pointed out, land releases large amounts of greenhouse gases, global anthropogenic greenhouse gas emissions more than 30 % of the total, equivalent to 150 tons of carbon dioxide. At the same time, the United Nations Food and Agriculture Organization estimates, ecological agriculture system could be offset by80% of global greenhouse gas emissions farming causes, without the production of industrial chemical fertilizer per year can save 1 % of the energy for the world, not to the fertilizer used in the land, but also reduce the 30 % of agricultural emissions. So, in the development of low carbon economy, agriculture has great potential.

Low carbon agriculture is agricultural biodiversity. The development of agriculture has experienced slash-and-burn cultivation agriculture stage, the stage of traditional agriculture and agricultural industrialization stage. The process of industrialization of agricultural threat to biodiversity: farming and planting of natural vegetation and caused reduced, reducing natural species and their natural enemies; pesticide use destruction of species diversity; fertilizer caused the pollution of the environment, and also caused biodiversity reduction; genetic background of single and major cultivar breeding process, caused the other varieties of rejection. If measured by the concept of low-carbon economy, that agriculture can be said to be "high carbon agriculture". Method to change the high carbon agriculture is the development of biological diversity in agricultural. Biodiversity, agriculture because it can avoid the use of pesticides, fertilizers and so on, in a sense it belongs to low carbon agriculture.

Low carbon agriculture is a concept of ecological agriculture than generalized also broader concept, should not only be efficient agricultural production to promote less use of chemical fertilizer and pesticide, such as ecological agriculture, but also consume more and more energy in agriculture, planting, transportation, processing process, the use of electricity, oil and gas and other energy sources are on the increase, decrease and pay more attention to the overall agricultural energy consumption and emissions. But this is it right? It means low carbon agriculture is a relatively distant from our empty concept? Absolutely not, the simplest, the most

effective example is a forestation, because according to the determination of science, a mu of forests, generally every day can absorb carbon dioxide 67 kg 49 kg, release oxygen, need for 65 people a day.

Without the production of industrial chemical fertilizer per year can save 1 % of the energy for the world, not to the fertilizer used in the land, but also reduce the 30 % of agricultural emissions, to offset the other agricultural emissions – such as livestock enteric fermentation, rice, biomass burning and manure handling requirements – land carbon sequestration rate of 400 kg/ha/year, need to reach 200 kg/ha/year, organic agriculture system can achieve this level, namely offset 80% of global greenhouse gas emissions in agriculture.

18.4 The Development Advantage of Low Carbon Economy in Hainan

1. Hainan is China's largest provincial special economic zone, with the construction of low carbon economy demonstration province innovation advantage, the relevant policies and regulations and research institutions continue to emerge, such as:

   Haikou city in February 25, 2010 fourteenth session of the National People's Congress fifth conference, Haikou building "green city" low carbon target was first written into the government work report, means that Haikou will stand-in the low carbon economy construction tide.

   In March 28, 2010, Hainan University, Qinghua University joined the China Renewable Energy Association jointly established Hainan low carbon economic policy and industrial technology research institute.

   In April 15, 2010, Haikou Gas Group Company, Hainan petroleum Shennan Petroleum Technology Development Limited Company, held at Chang'an University, Hainan province low-carbon energy research center cooperation agreement signing ceremony in Haikou.

2. Hainan construction of ecological demonstration province has a history of 10 years, with the construction of low carbon economy demonstration province of ecological environment; Hainan as a tropical island, has always been to the ecology province construction leading, the forest coverage rate reached more than 50 %, the air quality excellent rate of 100 %, better than other area based. Compared with other proposed the "low carbon" provinces have very low carbon.
3. The formation characteristics of Hainan industrial structure, with the construction of low carbon economy demonstration Province industrial advantage; the development of low carbon economy to suit one's measures to local conditions, Hainan to develop a low carbon economy, we must combine the local features to their own resources fully utilized. Because Hainan does not have too many

industry, coupled with better foundation, to develop a low carbon, can from proceed with of the existing economic structure. Agriculture is a source of carbon dioxide emissions is relatively large. To the development of organic agriculture, reduce pesticide use; control the emission of carbon dioxide.

4. Hainan is rich in renewable energy, with the construction of low carbon economy demonstration material advantage; Hainan in solar and wind energy construction, there are many inherent advantages.
5. Hainan environmental protection legal system environment is perfect, with the construction of low carbon economy demonstration province policy advantage. Hainan is building an international tourism island, in the relevant planning, the Hainan to build "national ecological demonstration zone civilization. Adhere to eco Li Province, environmental priority, development in protection, protection in the process of development, promote resource-saving and environment-friendly society construction, to explore the harmony between man and nature of the civilization development path, so that the people of Hainan become the country's four seasons garden. This is equivalent to Hainan one to ensure the "ecological, environmental protection" development policy.

18.5 Low Carbon Economic Development of Tropical Agriculture, in Haikou City

The relevant departments in Haikou city is preparing a "low carbon agriculture development proposal" in Haikou City, according to the plan, Haikou will be in 2010–2012 to develop ecological breeding and biogas projects, this program will bring 50,200 tons raw material results saving firewood to agriculture in Haikou, equivalent to 93000acres of fuel wood annual growth.

Haikou through vigorously implement the "seven development mode", "four simultaneous" management services such as the three major measures, modern ecological circular agriculture demonstration area construction, has been affirmed by the Ministry of agriculture, has received all over the country to visit 86 batches. Efforts will be in Haikou ecological cycle agricultural demonstration zone building low carbon agriculture demonstration area of the provinces.

"Seven in one" model of development, introducing a village to build a ecological breeding community, supporting the construction of a biogas project and a gas service station, founded a biogas fertilizer use planting base, a leading enterprises, farmers professional cooperatives Cheng Liyi link management.

The ecological circular agriculture project special fund included in the annual budget, last year the city ecological cycle agricultural construction in striving for national, provincial investment of about 30,000,000 yuan, city level and investment of about 30,000,000 yuan, to the "government support, multi inputs" way, stimulate social investment 150,000,000 yuan. In the cycle of eco agriculture construction, the city adhere to the animal husbandry as the main line, to the village of biogas as a

link, to recycling as the features, explore in practice to form a more perfect "seven in one" model of development.

For example: in the Dao Mei Zhen Sanjiang Cun Tao beautiful ecological breeding community, farmers here are just off the small cucumber packing up, ready to transport live inland sales. The farming area not only the development of pig – methane – Food ecological circular agriculture mode, but also the development of greenhouse vegetables, welcomed by the market is pollution-free vegetables to the mainland. According to the demonstration base of comprehensive the farming community of large-scale biogas responsible person introduced, farming community set of pig breeding, waste utilization, new energy development, and effective pollution control, recycling of resources, reduction of forest protection and many other advantages as a whole. Last May put into production, planning, population 5,500 pigs, slaughter 11,000 pigs, and the development of the 100acres of greenhouse vegetables, not only solved the problem of employment of the villagers, but also increased the income of the farmers.

At present, Haikou city in the "pig biogas plants" ecological circular agriculture base of more than 9 acres, facilities for agricultural demonstration base set of biogas fertilizer, drip irrigation in one of the many 6,000 mu, agricultural economic benefit significantly.

In the vast rural areas, are all over the "low carbon" agriculture in it. The implementation of the "a pool of three changes" in the ecological construction, the marsh gas construction and change kitchen, lavatories, changing circle together, into biogas fermentation garbage, livestock manure, crop straw, biogas slurry, residue can replace pesticide, residue can replace chemical fertilizer, both turning waste into treasure, beautify the environment, but also save expenses, increase revenue, this is typical of low carbon agriculture.

18.6 The Conclusion

Through the above analysis, we can see that in the agricultural production and life, both saving and water saving, fertilizer saving, electricity saving, section, or the fuel, firewood saving (coal), grain, as long as can reduce the cost of agricultural production, protect agricultural ecological environment, enhance soil organic carbon sequestration, reduce greenhouse gas emissions, all belong to the agricultural risk, the development of circular agriculture, low carbon agriculture the most effective form of reality.

Of course, from the current mode of production, low carbon agriculture although the prospect, but the distance is still a huge gap between low carbon agriculture standard. First of all, the development of low carbon agriculture labor force is the main part of the cost of investment, especially the knowledge labor force; secondly, we present the characteristics of agricultural production scale development of low carbon agriculture difficult. For example, a farmer or a plantation to implement low carbon agriculture mode, while cultivated land is still the chemical agriculture

around, the ecological patterns of soil, air and water are affected and pollution, which requires a change in the form of organizations, such as the establishment of ecological farmer cooperatives. In addition, the development of low carbon agriculture, need to be part of the technology, the big area use eco agriculture production technology and the corresponding matching, the need for government and the social organization of professional guidance and training, especially the market join. At the same time, to encourage low carbon agriculture policies and preferential measures should be more complete, the mechanism can be more flexible.

In view of this, the concept of "the development of low carbon agriculture" is not playing fashion, but continued support emphasis on technology and increase of all kinds of resources input, fan out from point to area, eventually forming mode of sustainable development to increase farmers' income, agricultural efficiency.

To sum up, low carbon economy is the route one must take the sustainable agriculture development in tropical Hainan.

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