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# White Paper on China Dairy

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# WHITE PAPER ON CHINA DAIRY
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**Sponsored by**

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**Supervisory Board:** Ke Bingsheng; Roelof Joosten; Martin Scholten

**Steer Committee:** Toon van Hooijdonk; Kees de Koning

Janine Lutine; Atze Schaap; Gordon Yang

Jeroen Heck; Dong Renjie; Hu Xiaosong

Ren Fazheng

**Written By**

**Editor in Chief:** Li Shengli

**Deputy Editors in Chief:** Liu Kai; Liu Xiao

**Authors:** Alfons Beldman; Bai Junfei; Cao Binbin; Cao Zhijun; Du Wen

Fang Xiangming; Guo Huiyuan; Guo Pei; Han Beizhong

Hu Dinghuan; Jeroen Heck; Kees de Koning; Li Shengli

Lieuwe Montsma; Liu Kai; Liu Xiao; Ren Fazheng

Wang Wenxin; Wang Yajing; Xia Jianmin; Yang Hongjian

Yao Kun

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## DEVELOPMENT OF THE DAIRY FARMING INDUSTRY IN CHINA

# CHAPTER 1
# DAIRY FARMING INDUSTRY IN CHINA

## 1.1 OVERVIEW

### 1.1.1 Changes of Dairy Cattle Number, Yield and Total Milk Output

Over the past 60-odd years, the development of China's dairy farming industry has gone through several distinct phases. Before 1979, the pace of development was relatively low. The dairy cattle numbers and total raw milk output achieved steady growth from 1979 to 1996, respectively expanding from 0.49 million cows by the end of 1978 to 4.47 million in 1996, and from 0.88 million tons of raw milk to 6.29 million. The period from 1997-2005 saw rapid development. The number of dairy cattle grew from 4.43 million in 1997 to 12.16 million in 2005, an increase of 1.7 times. Milk output has also grown rapidly, from over 10 million tons in 2001 and over 20 million tons in 2004. Milk output then rose from 6.01 million tons in 1997 to 27.53 million tons in 2005, an increase of 3.6 times (*see Figure 1.1* and *Figure 1.2*). The yield per cow expanded from 2.3 tons in 1997 to 3.8 tons in 2005. At the beginning of the 21st century, the dairy industry experienced a rapid development period, with the growth rate of raw milk output exceeding 10% from 2000 to 2007 over eight consecutive years. The "melamine" incident came to light in September 2008. Since then, the rapid growth of China’s dairy industry began to cool down. Given the sector’s performance over the last four years, the development of dairy farming industry has entered a period of slow growth.

In 2012, there were 14.5 million dairy cattle in China and 37.44 million tons of milk output, respectively 0.7% and 2.3% higher compared to 2011 (*see Figure 1.1* and *Figure 1.2*). Then in 2013, there was a reduction in the number of dairy cattle, a lower raw milk output and tight supply of raw milk. The milk output was 35.31 million tons, 5.7% lower than 2012, and the number of dairy cattle was down an estimated 10%. These were the largest declines in milk output and dairy cattle numbers in nearly 10 years. As revealed in 2013 survey results on the quantities of raw milk purchases by the 20 largest dairy processing enterprises in China issued by National Dairy Industry and Technology System (NDITS), there was a demand-supply gap of over 6,800 tons on the highest daily records. This represents 20% of raw milk demand per day and means that dairy farming and raw milk production are in a tight spot. This also caused a significant rise in the price of raw milk since April 2013. According to the raw milk data from over 200 large-scale dairy farms monitored by NDITS, the 2013 raw milk price increased by 0.45 yuan/kg, up 12.5% over 2012.

### 1.1.2 Main Breeds of Dairy Cattle in China

The main breeds of dairy cattle in China include Holstein, Jersey, Simmental, and Xinjiang Brown as well as San-he. Chinese Holstein, which first appeared in 1985, is the dominant breed of dairy cattle. At present, over 80% of dairy cattle bred in China are Chinese Holstein cattle and their crossbreeds.

### 1.1.3 Distribution of Advantageous Regions for Dairy Farming in China

In 2003, during the rapid development of the dairy industry in China, the Ministry of Agriculture (MOA) formulated and implemented a Planning for Development of Advantageous Regions for Dairy farming in China (2003-2007). After several years of development, the basic regional layout of the dairy farming industry took shape. Geographically, the country’s raw milk production is mainly concentrated in "Three North" regions (Northeast China, North China, Northwest China) such as Inner Mongolia, Heilongjiang, Hebei, Xinjiang, Shandong, Henan, etc. of the total number of dairy cattle in China in 2012, 72.5% came from these provinces, including Inner Mongolia (2.7 million), Heilongjiang (1.94 million), Hebei (2.04 million), Xinjiang (1.6 million), Shandong (1.24 million) and Henan (1 million). All the top 10 provinces and autonomous regions in terms of the dairy cattle numbers and milk output are in "Three North", which is where 82.3% of total number of dairy cattle are found and the origin of 83.4% of total milk output across China (*see Figure 1.3* and *Figure 1.4*).

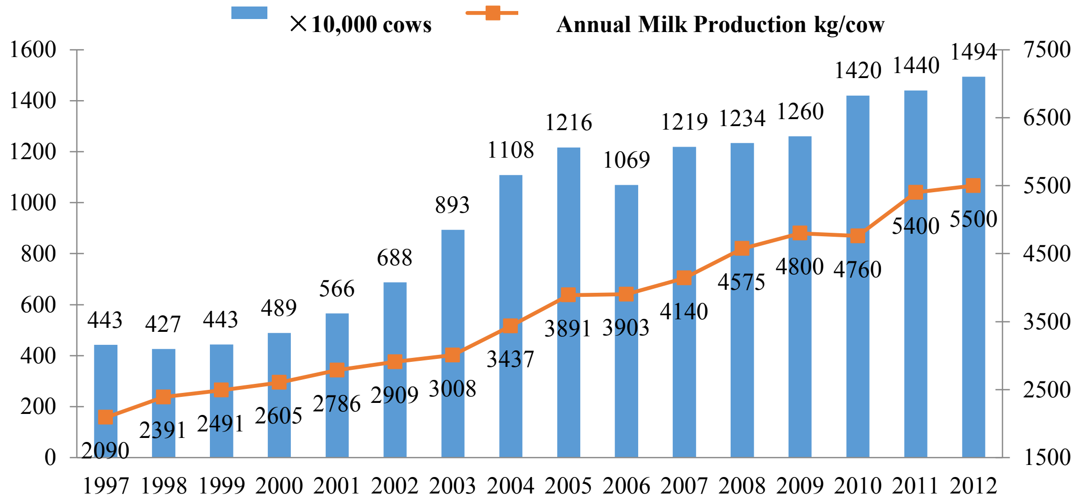



**Figure 1.1 Changes in dairy cattle numbers and yield per cow in China (1997-2012)**
**Source: "China Dairy Yearbook 2012" and "2013 Dairy farming Industry Statistics in China"**

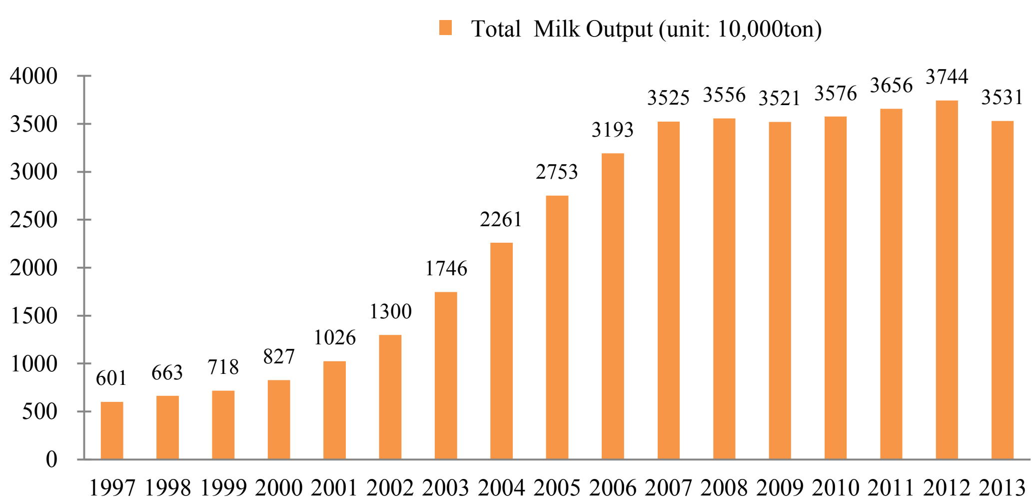



**Figure 1.2 Changes in total milk output from 1997 to 2013 in China**
**Source: "China Dairy Yearbook 2012" and "2013 Dairy farming Industry Statistics in China", among others.**

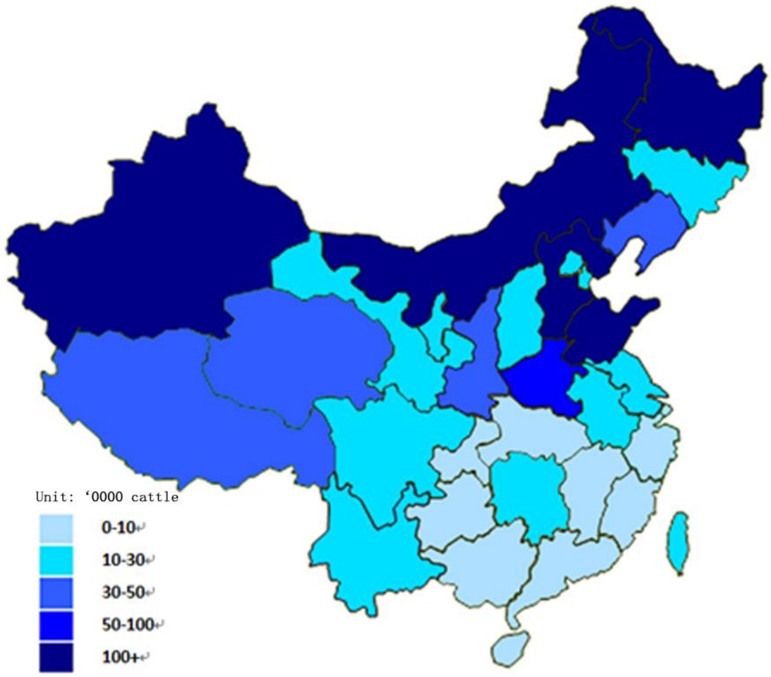



**Figure 1.3 Distribution of numbers of dairy cattle in China**
**Source: "2013 Dairy farming Industry Statistics in China"**

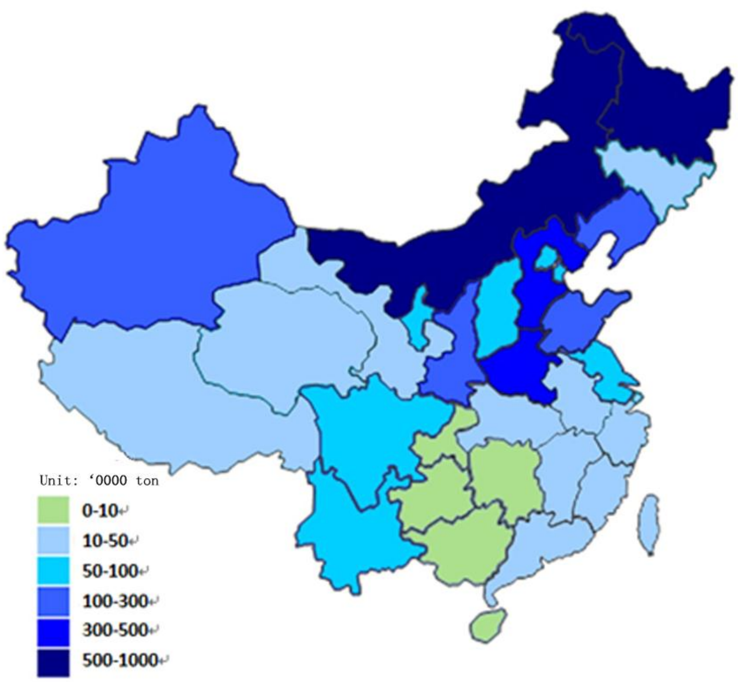



**Figure 1.4 Distribution of milk output across China**
**Source: "2013 Dairy farming Industry Statistics in China"**

Therefore, raw milk production is geographically mainly concentrated in North China. However, there was a slight change after 2000, when the number of dairy cattle began to increase in southern provinces. The position of North China as the main dairy cattle breeder (especially Holstein) will not change much, due to ideal climate and husbandry conditions as well as cost constraints.

### 1.1.4 Major Types of Dairy Farming in China

The dairy cattle farming patterns can be classified into three types (according to their scale and organization), including small household farmers, farming communities (cooperative dairy farms) and large-scale dairy farms. A comparison of the three types is detailed in *Table 1.1*. Besides these three types above, a new pattern called *family farm* is emerging in China.

**Table 1.1 Scale and organization of three major types of dairy farming in China**

| | Small Household Farmer | Farming communities (cooperative dairy farms) | Large-scale dairy farms |
|---|---|---|---|
| Cow numbers | 5-30 | >100 | >200 |
| Average annual milk production (t/cow) | 4-5 | >5.5 | >6.5 |
| Ratio(%) | 40 | 30 | 30 |
| Method of feeding management | Cows raised in backyard | Small household farmers bring their cows together to raise in an area with a milking parlor | Cows belong to one owner and are grouped, raised by laborers |
| Main roughage | Primarily low-quality forage Corn Stalk with no silage | Forage quality better than household farmers, corn stalk, corn stalk silage, sheep grass | Corn silage, imported or domestic alfalfa and sheep grass |
| Milking | Milk in milk collection station | Milk in milking parlor | Milking parlor |
| Manure treatment | Compost | Compost | Compost, biogas |

*SMALL HOUSEHOLD FARMERS* are an important group of dairy farmers in China and face severe challenges. Individual farmers refer to those who have less than 20 dairy cattle, which are not grouped and are kept in the backyard. The scale depends on the land owned. The manure is used as a natural fertilizer after simple collection and fermentation. The dairy cattle are vaccinated every year and milked at adjacent milk collection stations. This dairy farming type is relatively simple and the milk yield is low.

*DAIRY COMMUNITY* is a transitional form between the small household farmer and the large-scale dairy farm; in some regions it is known as the "cooperative dairy farm". Farming communities are co-funded by governments, enterprises or individuals under unified planning, management and construction structures. Different farming communities have different dairy cattle. The dairy cattle are raised in different barns owned by the farmers and separated according to ownership rather than grouped and raised according to age and physiological cycle. Although “unified breeding, unified milking, unified management and unified vaccination” can be theoretically achieved in farming communities, there are a lot of related problems. For example, the extent of unity needs improvement. These communities need to transform into real dairy farming cooperatives in terms of production and ownership. Currently, some farmers working in the farming communities are trying to establish dairy cattle cooperative companies. They have developed a new model, in which dairy cattle are evaluated as a capital share. The household doesn’t have management rights, but can work as a laborer in the reformed cooperative company. Inner Mongolia Dairy Cooperative (Dairy United) provides a new model like this, whereby the individual farmers, or the farmers working in the farming communities, can join the cooperative using their dairy cattle as shares. The farmers can then shift from owners of dairy cattle into industrial workers, or plantation workers in the dairy farm silages, and finally earn money depending on their number of shares and work they perform.

*LARGE-SCALE DAIRY FARMS* refer to dairy farms with over 200 dairy cattle, where the cattle are grouped, bred and managed according to their ages and physiological cycles. Unified scientific management methods are applied in terms of farm design, planning, breeding, feeding, milking and vaccination. As a result, “unified breeding, unified milking, unified management and unified vaccination” is achieved. The degree of mechanization is high, raw milk quality is good, and average yield per dairy cattle is higher than cooperative dairy farms.

There are currently two development directions for large-scale dairies. The first is the dairy operation and management model as a company. In this model, the same legal entity will own both the dairy farms and the company, and this entity can implement a centralized and unified production management system, vaccination and disinfection system, file management system, and scientific and rational breeding management specifications. This helps promote the application of new technologies and new equipment, and accelerates the improvement of productivity and production levels. In addition, it helps control and improve the dairy product quality and safety of the grass. And it can also effectively improve disease prevention and control capacities, reduce disease risks and ensure human and animal safety. Financially solid state-owned enterprises, such as Modern Farming, Tianjin Jialihe and Shanghai Bright Holstein Co., Ltd., have adopted this model.

The second direction is the integrated dairy chain development model. Here, dairy enterprises build up large-scale dairies, raise the dairy cattle like factories, lease land or sign a contract with farmers for planting forages, and the forage processing plants are built to process and mix high-quality forages in the dairy farms, which can integrate dairy farming with dairy product processing.

Product quality and safety can be ensured through the effective control of the entire processes, including forage production and processing, dairy farming, milk processing, product research and development, logistics, packaging, terminal sales and other aspects. The integrated dairy chain mode means the raw milk quality can be traced to the level of the dairy farm and the dairy product safety can be ensured, while the traditional dairy farming enterprises don't need to rely on the dairy enterprises or struggle with marketing. Companies like Heilongjiang Firmus, Beijing Sanyuan Lvhe Dairy Cattle Breeding Center, Shenyang Huishan and Beijing Guiyuan have adopted this farming model.

Besides the three types of dairy farming mentioned above, a new pattern is emerging in China called *FAMILY FARMS.* In early 2014, the Ministry of Agriculture issued "*The Guiding Opinions on Promoting the Development of Family Farms*" to encourage the development of family farms. There are no strict definitions of the family farms currently in China, but it is generally agreed that they will be operated by the families of farmers (rural households) who work in dairy farming villages. Family dairies are different from the feeding models involving individual farmers, and the dairy cattle meet a certain scale, namely 20-200 dairy cattle. Family farms have two distinct characteristics: the first is that they involve a combination of crop farming and dairy farming and the second is that workers are mainly family members (1-2 laborers can be employed). The residential areas are naturally separated from the dairy barns, and some modern feeding facilities and equipment are available, such as barns, milking machines, manure treatment facilities, silage silos and feeding equipment. Forage production agreements are signed with the neighboring growers and ensure the supply of fodder and the removal of manure.

## 1.2 CONSTRUCTION OF RAW MILK PRODUCTION LOCATIONS AND IMPROVEMENT OF RAW MILK QUALITY IN CHINA

### 1.2.1 Construction of Raw Milk Production Locations in China

Recent data reveals that in terms of the total number of dairy cattle in China, the proportion of cattle in dairy farms owning less than 20 cows has been declining since 2002, namely from 74.1% in 2002 to 48.9% in 2011 (*see Figure 1.5*). Meanwhile, the proportion of dairy cattle in dairy farms owning 20-99 cows basically remained the same, ranging from 14% to 18%. And the dairy cattle in dairy farms owning over 100 cows has been clearly increasing since 2006, reaching 32.9% in 2011. This number grew to 37% in the first half of 2013 according to data issued by the Ministry of Agriculture, and the proportion of large-scale dairies and feeding communities will likely reach 40% this year.

In 2011, of the top ten provinces and autonomous regions in terms of dairy cattle, Xinjiang had the highest proportion of dairy farms with less than 100 dairy cattle at 91.8%, followed by Heilongjiang and Inner Mongolia, at 88.3% and 71.5%, respectively. This indicates that the dairy farms here are much smaller scale than those in other regions. Three provinces – Hebei, Henan and Shandong – have a higher proportion of larger scale farming, where the proportions of dairy farms owning over 100 dairy cattle are 67.6%, 55.5% and 51.7%, respectively (*Figure 1.6*).

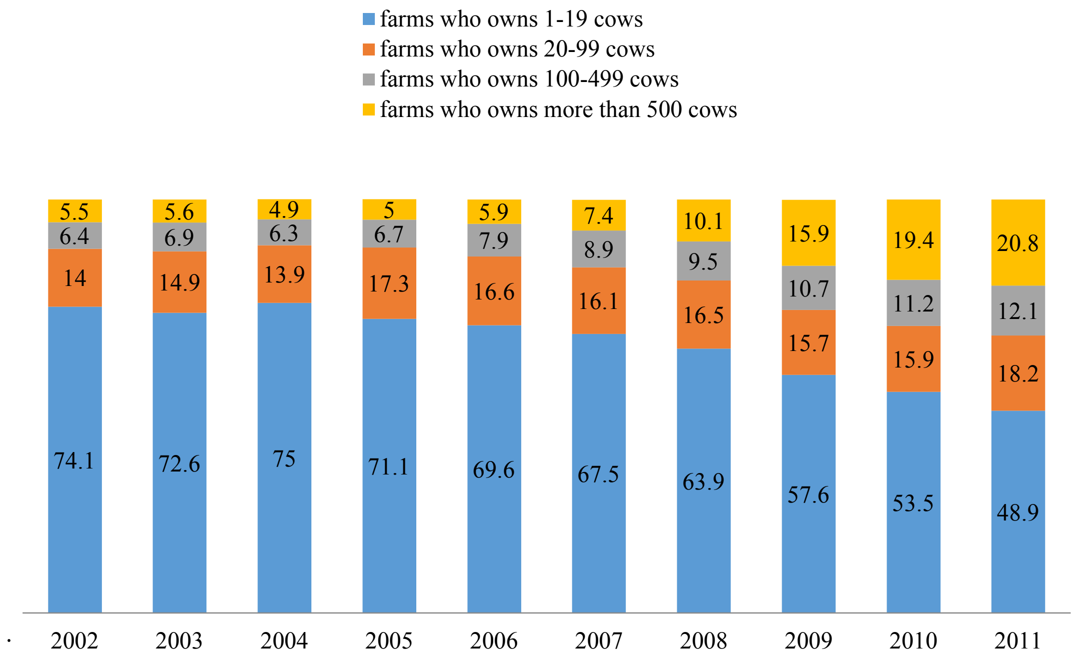



**Figure 1.5 Proportional changes in dairy farming among different dairy farms in China from 2002 to 2011**
**Source: "China Dairy Yearbook" over the years**

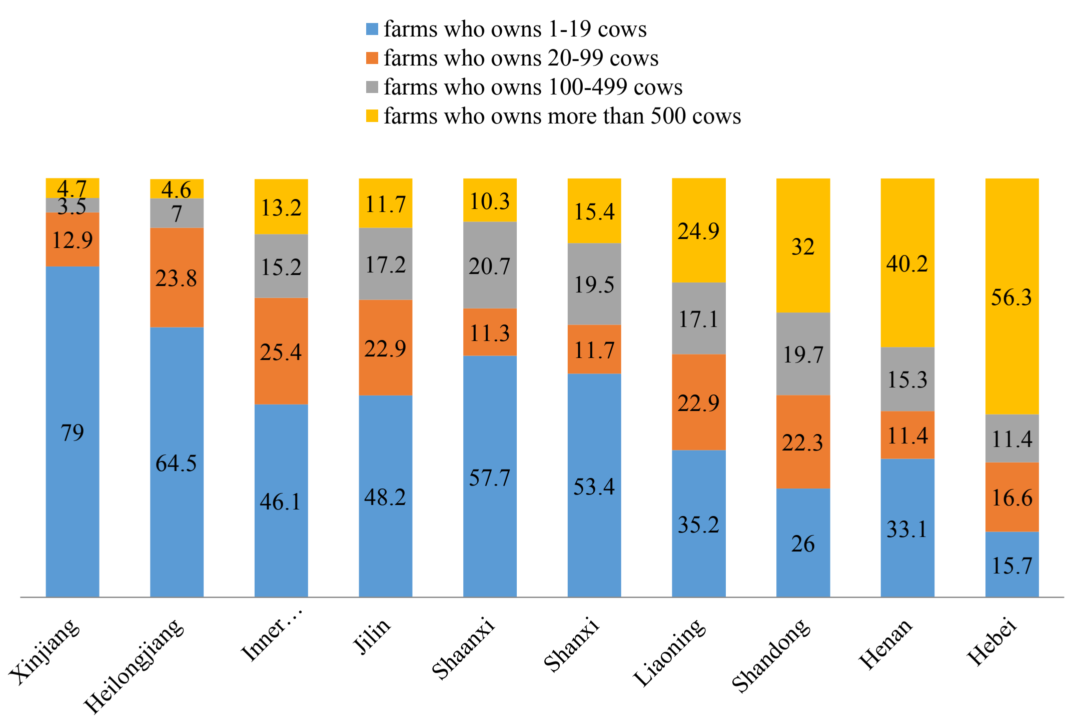



**Figure 1.6 Proportions of different dairy farming scales in the top ten provinces and autonomous regions in terms of dairy cattle**
**Source: "China Dairy Yearbook" over the years**

### 1.2.2 Gradual Improvement in Raw Milk Quality

Thanks to improvements in dairy farming scale and technology, the quality of raw milk has also gradually improved. According to the raw milk safety monitoring program launched by the Chinese government, all the detected levels of melamine comply with national regulatory requirements and no leather hydrolyzed protein, alkali or other substances have been detected in recent years. The raw milk quality is therefore much better than in the period prior to 2008.

According to a research report in 2008 prior to the melamine incident, the milk fat and milk protein levels of raw milk from large-scale dairies in China were 3.62% and 2.94%, respectively. The values were much lower in raw milk from farming communities and individual farmers, namely about 4% to 9% lower in terms of milk fat and about 1% lower in terms of milk protein. According to the monitoring data from 200 large-scale demonstration dairy farms issued by the National Dairy Industry and Technology System, the milk fat and milk protein content in 2013 were 3.81% and 3.13%, respectively, meaning that levels had increased 2.4% and 0.6% compared to 2010. Meanwhile, the number of bacteria and the SCC reached 208,000 cfu/mL and 345,000 cells/mL, or 26.5% and 5.1% lower compared to 2010. It can be concluded from this data that the milk fat and milk protein content at large-scale dairies has increased by 5.3 % and 6.5%, respectively, within 5-6 years. Thus the raw milk quality in China has improved as a whole.

## 1.3 PROBLEMS REMAIN IN CHINA'S DAIRY FARMING INDUSTRY

Although significant progress has been made in the development of China's dairy industry, there is still much room for improvement in the quality of the dairy cattle resources, development of feed resources, application of feeding and management technologies, research and development related to disease prevention and manure treatment technologies. Another distinct issue is the low output per dairy cow and the milk quality, which requires improvement. The average output per cow is only 5.4 tons per year (in 2011) in most dairy farming regions in China, which is much lower than the level in developed countries. In addition to problems of lower quality breeds, there are other factors causing low output per cow, such as a lack of whole plant corn silage, alfalfa and other high quality forages. The dairy cattle feed efficiency is low, and the efficiency of conversion from feed to milk is about 0.8 to 1.1 – also lower than in developed countries. Still, this value can reach over 1.5 on some dairy farms, which is the advanced level seen internationally. Due to the lack of alfalfa hay and other high-quality forages and improper feeding management technologies, the raw milk has a low milk protein ratio – lower than 2.95% in some dairy farms in summer – and high SCC. Lower quality breeds and a low output from adult dairy cattle inevitably lead to high costs and low yields on most of dairy farms.

Dairy cattle disease control is also problematic. As the vaccination system is out of date, FMD outbreaks occasionally occur in Northeast China and, recently, in Northwest China. The positive rate of dairy cattle brucellosis, tuberculosis and other zoonosis is high while the positive rate of viral diarrhea is more than 25% in some areas. Therefore, a lot of long-term work still needs to be done to prevent epidemic diseases. China has invested a great deal in efforts to prevent and control FMD, tuberculosis and brucellosis, and research and development efforts are ongoing while strict prevention and control measures are being adopted.

Both the shortage of commercial diagnostic kits and the absence of corresponding vaccines result in a high incidence of related diseases. Common diseases such as mastitis, nutritional and metabolic diseases, hoof diseases, etc. have constrained the development of the dairy farming industry in China. Rapid development of cattle disease diagnostic techniques and vaccines is an important direction for future disease prevention.

## 1.4 DEVELOPMENT TREND OF DAIRY FARMING INDUSTRY IN CHINA

Since 2010, the dairy farming industry has experienced three years of slow-paced development. Some structural adjustments were implemented between 2011 and 2013 and the number of individual farmers decreased quickly while large-scale farms dramatically increased. Due to the impact of rising feed costs, ineffective feeding and rising beef prices, the number of dairy cows and milk output declined, to varying degrees, along with the exit of a number of individual farmers. The next several years will be crucial for China's dairy farming industry, as its development pattern is set to change. It will show steady and rapid growth, while significant developments will be realized in large-scale farming, combining crop farming and dairy farming as well as environmentally friendly practices after restructuring efforts have been completed.

### 1.4.1 Growth trends in dairy cattle

China's GDP and income growth rates will remain above 7% in the next five years and, based on the relationship between GDP growth and per capita milk consumption, it is estimated that per capita milk consumption will reach 38 kilograms in 2020. This will require an annual production of 52.4 million tons of milk. Therefore, calculated based on the average yield of 6.5 tons per dairy cow, 8.06 million adult dairy cows will need to be available, which theoretically requires a total of 16.12 million dairy cattle. Considering income levels, population, urbanization and consumer preferences, it is estimated that the growth rate of dairy cattle number will be 5%~7.5 % in China, so the total number of dairy cattle may reach 13.5 million to 16 million in 2016 and 2020, respectively.

### 1.4.2 Proportion of Large-Scale Farming Continues to Rise

The experience of developed countries reveals that standardized large-scale farming will be the only way forward for dairy development, particularly after a certain level of dairy farming development has been achieved. Several years of development have proved that standardized large-scale farming will be the fundamental focus with a view to solving the current dairy development challenges and accelerating the modernization of the dairy industry.

In 2014, the Ministry of Agriculture will continue to launch standardized large-scale dairy farm construction projects across China, promote demonstrations of standardized livestock farming and shift its focus from “establishing” to “radiating and driving”. At the same time, some large dairy enterprises and large-scale farming enterprises are accelerating construction of their dairy farms. These include more and more large-scale dairy farms, which own thousands or even tens of thousands of dairy cattle. In recent years, due to the impact of rising feed costs, labor shortages and low efficiency, small household farmers are gradually tending to establish farming communities or household farms, and most will choose to exit the dairy farming industry. Therefore, the development of large-scale farms will continue, and is expected to account for 50% of dairy farms in 2020.

### 1.4.3 The “Combination of Crop Farming and Dairy Farming” Model Will Develop Further

Based on the experience of developed countries, the “combination of dairy production and crop production” model is important in the development of the modern dairy farming industry. With the “combination of crop farming and dairy farming”, the dairy farms have access to sufficient high-quality forage, and the manure can be 100% used as fertilizer. This has multiple benefits: it not only reduces feeding costs, but also improves the quality of raw milk while reducing environmental pollution. However, the current dairy farming model in China, regardless of whether large-scale or small-scale farms are involved, basically features “separation between crop farming and dairy farming”, which will inevitably lead to high costs and high pollution, especially for large-scale dairy farms with thousands of dairy cattle. Therefore, from a long-term development perspective, the promotion and application of “combination of crop and dairy” will be a long-term policy for the industry to pursue.

In 2013, the State Council officially introduced the "*Livestock Pollution Prevention Act*" to strengthen technical guidance and services, and promote the economic and efficient utilization of manure. Currently, large-scale enterprises obviously pay more attention to environmental protection and resource recovery when they build up dairy farms, and highlight the land supply and the practical application of "*combination of crop and dairy*". At the same time, with the introduction of policies encouraging household farms, small-scale farmers will inevitably tend to establish household farms and thus the proportion of "combination of crop farming and dairy farming" will further increase.

# CHAPTER 2
# TYPICAL CASE REVIEWS FOR MAJOR DAIRY FARMING AREAS IN CHINA

## 2.1 TYPICAL AGRICULTURAL AREA: CHANGES IN FEEDING METHODS IN SHUANGCHENG CITY, HEILONGJIANG PROVINCE

### 2.1.1 Overview of Dairy Farming in Heilongjiang Province and Shuangcheng City

***Overview of dairy farming in Heilongjiang Province***

Almost all of Heilongjiang Province is located in the best dairy belt in the world. Heilongjiang Province covers a total area of 0.46 million square kilometers, including 180 million mu of arable land. The annual grain production capacity is around 30 million tons, the annual crop straw(maize) production capacity is over 50 million tons and it has 65 million mu of grassland along with a wealth of grassy hills. Because dairy farming started earlier in Heilongjiang than in other regions, and the number of dairy cattle and milk output have grown steadily for many years, the province plays an important role in China.

Data from 2013, released by the National Survey Organization, indicate there were 1.92 million dairy cattle and 5.18 million tons of milk were produced in Heilongjiang Province. This is a decrease of 5.2% and 2.45%, respectively, over 2012. The daily quantity of raw milk purchased by leading milk processing enterprises – including Wondersun, Nestle, Yili, Mengniu, Beingmate and Bright Dairy – fell 10%~20% over that year. Meanwhile, the number of small-scale household dairy farmers in Shuangcheng, An'da, Zhaodong and Fuyu declined by about 10% to 18% and the number of lactating dairy cattle were down by varying levels.

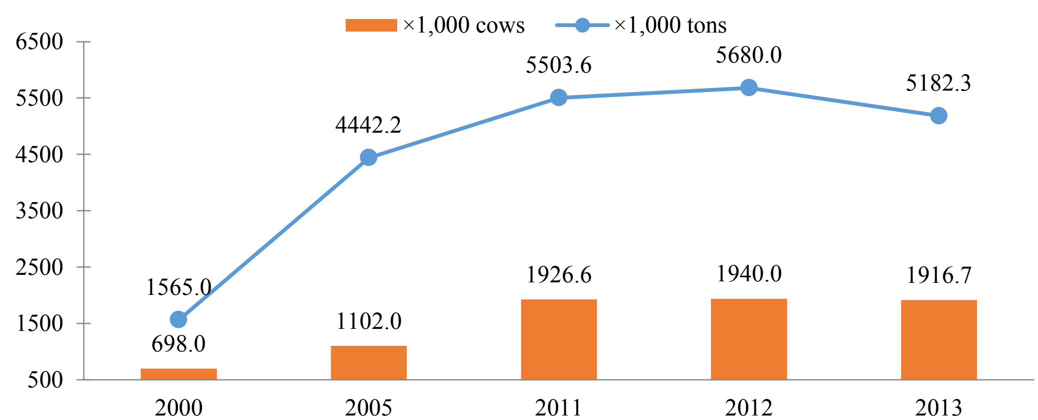



**Figure 2.1 Changes in numbers of dairy cows and total milk production from 2000 to 2013 in Heilongjiang**
**Source: "2013 Dairy Farming Industry Statistics in China"**

In Heilongjiang Province, the main breed of dairy cattle is Holstein, the main farming cities (prefecture-level cities) include Qiqihar, Daqing, Harbin and Suihua, which account for 84% of the total number of dairy cattle in the province. The main dairy farming counties (county-level cities) include Shuangcheng, Anda, Dumeng, Fuyu, Zhaodong, Lindian, Gannan, Longjiang and Qinggang, which account for 55% of the province’s total dairy cattle.

***Overview of dairy farming in Shuangcheng City***

Shuangcheng is known as China's largest dairy county and 80% of the population works in the dairy farming and related industries. The data provided by Nestle, the first leading enterprise to operate in Shuangcheng, illustrates the importance of the dairy farming industry in Shuangcheng City. Nestle reached agreement with the local government in 1986 to establish a presence there and officially began operating in 1990. It purchases local raw milk for processing. In 1994 Nestle reported annual sales of 168 million yuan and paid 15.3 million yuan in taxes, accounting for 15.2% of Shuangcheng City's revenue. In 2002, its annual sales reached 2 billion yuan, with taxes of 230 million yuan, representing 59.3% of the city's revenue. And in 2013, it paid a tax as high as 640 million yuan. It is obvious that the dairy industry has become its pillar industry supporting economic development.

On-site investigations have revealed that there were about 0.27 million dairy cattle in Shuangcheng in 2007. Nestle's maximum daily raw milk processing quantity was 1,560 tons, and there were 34,000 dairy cattle farmers. By 2013, the number of farmers was less than 8,000, with 0.13 million dairy cattle and Nestle purchased only 740 tons of raw milk. Because of the shortage of raw milk sources, Nestle is also considering shifting the dairy farming model from small household farmers to centralized, large-scale farming.

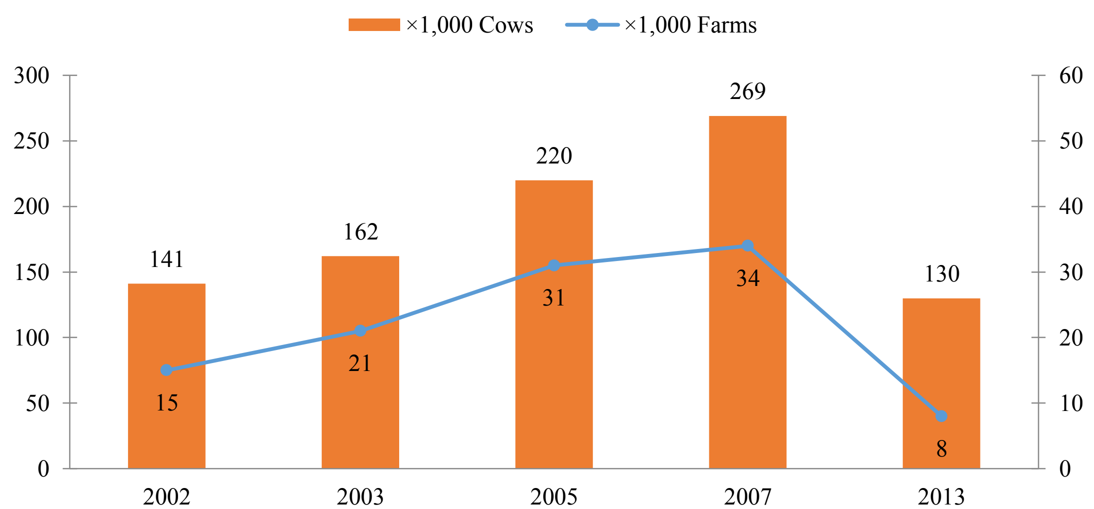



**Figure 2.2 Changes in numbers of dairy cattle and farmers from 2002 to 2013 in Shuangcheng**

## 2.1.2 Dairy Farming Mode in Shuangcheng

***Dairy farming dominated by small-scale household dairy farmers***

The small scale household dairy farmers mainly use a tied feeding system in their backyards, which means there is no strict separation between people's homes and their cattle shed, and no centralized manure storage facilities. The dairy cattle are tied up all day and fed two to three times a day in a traditional manner, which includes 10-12 kg of concentrate feeds and corn stalks at liberty. TMR is not used by individual farmers due to the high investment cost; the dairy cattle drink two to three times per day. Shuangcheng has long, cold winters and the low temperature of the barn and hard concrete ground is uncomfortable for the dairy cattle, which increases the risks of hoof diseases.

***Characteristics of milking and milk collection stations***

Around 80% of milking is done by hand in Shuangcheng, and there is a lack of mechanized milking equipment. Therefore, in the 20 years since it began operating there, Nestle has adopted a cooperative model with local farmers along the lines of "company + farmer + milk collection station" which, in the city, is known as "Nestle mode". The milk collection stations are built by Nestle and the workers are Nestle employees. It constructs milk collection stations (raw milk purchase points) near the villages where dairy cattle are raised by several farmers, and a specific manager is appointed to take charge of testing and collecting the raw milk, however milking or other services are not provided. The small-scale household dairy farmers must first register with Nestle and open a bank account – with a milk payment card at the bank specified by Nestle – and Nestle assigns a code to each farmer and tests the milk corresponding to the code to determine purchasing prices. The small-scale household dairy farmers milk at their homes, fill the milk buckets, and then deliver the raw milk to the milk collection stations for cold storage. Nestle delivers the raw milk to the factory that same day. The payment system is based on the quantity and quality of the raw milk, e.g. freshness, antibiotic residues, milk fat, milk protein percentage and the number of bacteria.

### 2.1.3 Feed and Forage Resources

The main roughage used by household farmers in Shuangcheng City is poor quality corn stems and small amounts of corn stalk silage. Smaller numbers of farmers use whole corn silage and feed dairy cows using quality forage. The feed choices vary widely among farmers; besides corn stalks, some farmers use high-yielding cow corn silage and commercial concentrate feed purchased from feed companies. There were over 30 local feed providers in 2004, notably including Rongyao, WellHope, Purina and ABN. However, the farmers are still in the habit of feeding their dairy cattle soybean cake and corn.

Shuangcheng City does not have rich grassland resources and the roughage options are few, so corn stems are the main roughage for the dairy cattle there. Because of the increased cost of harvesting corn stems, the price of corn stalks rose to 100-150 yuan/ton compared to only 50-60 yuan/ton in 2005. In addition, Shuangcheng also has beef cattle (as many as 0.899 million according to 2012 statistics issued by the Shuangcheng government), which has exacerbated the tight supply of corn stems.

### 2.1.4 Farmland Resources

According to the results of on-site investigations, the dairy cattle farmers have arable land ranging from 15-60 mu, including 6-15 mu for food, and most farmers who own over 50 dairy cattle have arable land ranging from 20-60 mu. Even so, assuming that 2.5 mu is used to provide silage for each dairy cow, once the arable land used for food is deducted, the remaining arable land can only provide silage feeding for 5-20 dairy cattle, which has severely limited the further development of family farming scale.

### 2.1.5 Dairy Cattle Breeds and Improvements

Shuangcheng City mainly has Holstein, and in the 1970s some high performance Holstein were introduced from Germany and the United States, with additional Holstein coming from Australia in recent years. During this period, some farmers introduced numerous hybrids from other regions because they lacked understanding of breeds. The milk yield (ton/year/cow) has remained at the level of 3-4 tons in Shuangcheng City, but due to the impact of higher beef prices in the past two years, the lower performance dairy cattle have been gradually culled out, and the average milk yield in the area gradually increased year by year, reaching about 5 tons in 2013.

The investigation found that there are insufficient data recording systems for most of the dairy cattle; especially for recording pedigree and DHI data. In addition, there was some low-quality frozen semen in the market and certain AI technicians lacked knowledge about breeding and reproduction, thus genetic improvements have progressed much more slowly among small household dairy farms than their larger counterparts.

### 2.1.6 Labor and Education Level

According to 2013 statistics on the dairy farming industry in Heilongjiang Province, farmers have spent an average of less than eight years in school. Because of educational limitations and farmers' limited abilities to understand, most raise their dairy cattle in a traditional way. Among the 116 farmers investigated, over 70 had never read a professional book, and the survey results indicate that nearly half of the farmers are feeding their dairy cattle based on experience, especially in the regions with long dairy farming histories such as Shuangcheng and Anode.

The investigation of family farmers at Xingfu Town Shuangcheng City conducted in 2014 revealed that most of the farmers were around age 40 with junior middle school or below and 15 to 20 years of feeding experience.

The investigation found that the farmers and relevant personnel generally have low technical and cultural knowledge, a poor ability to carry out scientific operations and management, and little awareness or aptitude for adapting to a market economy. There are few inter-disciplinary talents familiar with technology, management and marketing, which has greatly constrained the further innovation and development of family dairy farms.

### 2.1.7 Operating Effectiveness Analysis

The average income is about 3,500 yuan per dairy cow with an annual production of 5 tons. This figure can be over 7,000 yuan in a large-scale dairy farm with a good cattle structure and standardized management. The operating effectiveness analysis is as follows:

| Costs/incomes | Yuan/cattle/year |
|---|---|
| Feed costs | 14,000 |
| AI costs | 120 |
| Medical costs | 200 |
| Water, electricity and other charges | 150 |
| Annual depreciation of dairy cattle | 1,000 |
| Depreciation of barns | 400 |
| Labor costs | 1,000 |
| Calf milk costs | 1,200 |
| Income from calves | 750 |
| Income from raw milk (5 tons, 5 yuan/Kg) | 25,000 |
| Net income per year | 7,680 |
| Feed costs per kg of milk | 2.80 |
| Feeding costs per kg of milk | 3.61 |
| Feeding Cost-Milk Price Efficiency % | 72.2% |

### 2.1.8 Raw Milk Purchasing Policy and Pricing System

***Raw milk purchasing policy***

Because most of dairy enterprises don't have fixed raw milk bases, during tight dairy consumption seasons the dairy enterprises will raise raw milk purchasing prices and lower standards to meet raw milk supply needs. Then, during slack dairy consumption seasons, or in case of an emergency or market and sales downturn, the enterprises will raise the collecting standards and limit purchasing activities in order to protect their own profit. As a result, the raw milk market market will be in a state of shock.

To remedy this unreasonable raw milk pricing mechanism and in order to effectively safeguard the interests of dairy farmers and regulate raw milk transactions, in July 2010 the Heilongjiang provincial government formulated the "Opinions on Further Improving the Management of the Raw Milk Purchasing Price". This established a pricing mechanism consisting of a transaction reference price and the government's guiding price, so when the reference price is unfair, the guiding price will prevail. Under the constraints of the new pricing policy, the Raw Milk Price Coordinating Committee in each county (city) carefully estimates the raw milk production costs on a quarterly basis, and issues unified raw milk purchase guiding prices under the supervision and guidance of the Raw Milk Price Coordinating Committee at provincial level. For example, the guiding price in 2013 was 3.77 yuan/kg, which maintains farmers' enthusiasm to feed their dairy cattle, while also providing a sufficient supply of raw materials to the dairy enterprises in order to realize a healthy dairy development cycle.

In 2013, when faced with an inadequate supply of raw milk and high milk prices, Heilongjiang clarified the price ceiling in order to properly regulate market demand and supply, and control the prices. The measures successfully prevented disruption of market order caused by malicious competition for raw milk supplies.

***Quality of raw milk***

Shuangcheng City is the pioneer in testing milk fat, milk protein, number of bacteria and antibiotics in raw milk. The following table provides an indication of the quality of raw milk among different dairy farming scales.

**Table 2.1 Comparison of raw milk quality from dairies of different scales**

| Farm size | Yearly Milk Yield(t/cow) | Milk fat(%) | Milk protein(%) | TBC(1000/mL) |
|---|---|---|---|---|
| 500-1,000* | 7.00 | 3.90 | 3.50 | 200.00 |
| 300-500 | 6.20 | 3.80 | 3.20 | 250.00 |
| 200-300 | 6.00 | 3.70 | 3.15 | 250.00 |
| 100-200 | 5.50 | 3.50 | 3.10 | 250.00 |
| 50-100 | 5.00 | 3.45 | 3.12 | 500.00 |

*** dairy enterprises that own 500-1,000 dairy cattle are not family dairies; the value represents the data monitored at the demonstration dairy farms of Heilongjiang Dairy Association. This is only used for comparison.**

***Pricing system***

Shuangcheng City was the first area where milk prices were tied to quality. In January 2014, the price of raw milk, from small-scale household dairy farmers, ranged from 4.10 yuan/kg to 4.20 yuan/kg and from farming communities, the price ranged from 4.50 yuan/kg to 4.60 yuan/kg.

**Table 2.2 Price system of raw milk purchased by a company in Shuangcheng City**

| Item | Standards | Fluctuations of unit price of raw milk purchased (Yuan/kg) |
|---|---|---|
| Raw milk production | Daily Tank Milk < 0.5t | Purchased by the milk collection Point/station |
| | Daily Tank Milk > 0.5t | +0.30 |
| | Daily Tank Milk > 3.0t | +0.10 |
| Standard milking parlor | No | +0 |
| | Yes | +0.05 |
| TMR feeding | No | +0 |
| | Yes | +0.05 |
| Cattle welfare | With cubic | +0.05 |
| | Without cubic | +0 |
| Milk protein | < 2.8% | Rejected |
| | 2.8~3.0% | +0 |
| | Above 3.0%, every 0.1 percentage higher | +0.05 |
| Milk fat | < 3.1% | Rejected |
| | 3.1~3.6% | +0 |
| | Above 3.6%, every 0.1 percentage | +0.05 |
| Microorganisms | < 100,000/mL | +0.10 |
| | 10,000~300,000/mL | +0.05 |
| | 300,000/mL | Normal purchase |

### 2.1.9 Main Problems and Future Trends

***Main problems***

a). Few roughage options available, with relatively limited agricultural acreage of silage, alfalfa and other forages in Shuangcheng City.

b). Antiquated dairy farming system, small scale and poor standardization.

c). Serious environmental pollution around the production area; lack of financial support services; farmers feel it is hard to sustain their business, and the support of government policies and local dairy enterprises are needed, especially in the transition from individual farming to large-scale farming.

d). Farmers are generally not well-educated, with few channels to access information; dairy farming personnel structure is not good, age generally exceeds age 40, and 20-30-year-olds don't want to inherit or begin dairy farms or related industries; and a general lack of understanding of modern dairy farming technologies.

e). Relevant employees have uneven technical levels and lack formal vocational education or work experience in a large dairy. Few inter-disciplinary talents available for transition to large-scale farming and personnel often change jobs in large-scale dairies.

f). Inconsistent quality of raw milk; increasing costs of supervision paid by local government and dairy enterprises; the raw milk which could not be processed and is refused by local dairy enterprises was valued at 3 million yuan in 2013.

g). Few dairy cattle sources, the number of cattle has dropped significantly. The local dairies would like to import dairy cattle in consideration of diseases and breeds to support the increased scale. But the number of imported dairy cattle is strictly limited, and the matter of how to access cattle sources for development of large-scale dairies in Shuangcheng City is an urgent problem.

***Future trends***

a). With the development of the dairy industry and feeding model changes, the "Nestle mode" which has brought enormous benefits, cannot really guarantee product quality and safety, or adapt to the new social environment. Therefore, local government and dairy enterprises will support the transition of the breeding model to a larger scale in terms of policies and capital. According to the latest statistics (2013), there are currently less than 8,000 dairy farmers in Shuangcheng City. The number of small-scale farmers account for 80% and the number of large-scale (> 100) farmers account for 17.5%. In 2009, there were a total of 38,000 dairy farmers in Shuangcheng City; only 4% of them had over 10 dairy cattle and 0.3% had over 30 cattle. Relevant authorities predict that in the next 10 years, small-scale household dairy farmers will disappear and the number of farming communities will decrease, while large-scale breeders, with a general scale of 200-400, will continue to grow.

b). Bigger scale dairy farms will be popular in order to meet Nestle's demand for milk processing power. During our investigation we found that local government and dairy enterprises, together with other stakeholders, are trying to introduce a project to Prompt New Dairy Farm Construction. In addition, Shuangcheng City applied for capital support for 23 big dairy farms (2,000-3,000 cows/farms) according to the dairy policies issued by the Heilongjiang provincial government. Meanwhile, further discussion is needed to determine the compatibility with agricultural resources, environments and land policy within Shuangcheng City.

## 2.2 OVERVIEW OF COOPERATIVE DAIRY FARMS AND TREND ANALYSIS IN HEBEI PROVINCE

### 2.2.1 Overview of Dairy Conditions in Hebei Province

Hebei Province has suitable climatic conditions and abundant forage resources for dairy farming, and the important advantage that the number of dairy cattle and dairy output ranks third in the country.

The melamine incident in 2008 was a turning point for the dairy industry, leading to tremendous changes in Hebei's dairy industry.

a). Complete replacement of individual farming with large-scale farming. In 2008, the number of individual famers raising less than 20 dairy cattle was as high as 223,388. This number was reduced to 52,232 in 2011, and there were no individual farmers/dairies keeping less than 50 dairy cattle in 2013.

b). Complete elimination of mobile milk service stations (these milk service stations operated beyond the dairies/communities, collected and delivered raw milk produced by individual farmers using a manual milking method to the dairy enterprises, or provided mechanical milking services to individual farmers, and then centralized and delivered raw milk produced by individual farmers to the dairy enterprises.)

c). Gradual improvement of raw milk production safety supervision and quality testing system. At present, HD camera + network real-time monitoring in the milking hall is fully installed. All raw milk trucks are connected with satellite monitoring, and the dairy enterprises carry out 100% testing of the raw milk delivered. Testing covers milk protein, milk fat, dry matter content, SCC, number of micro-organisms, antibiotic residues, and other items as clearly specified in national standards. The testing indicators are being added to and improved at present.

d). Further improvement of the raw milk pricing system. Raw milk prices are not decided and adjusted at the sole discretion of the dairy enterprises as they were before, but determined based on a combination of basic pricing and a bonus and penalty system, which has changed the passive situation of the dairy farms/community in the dairy interest chain.

Currently there are two distinct differences between the dairy farming industry in Hebei Province and that in other regions of China. The first is the high degree of mechanization. As of 2013, large-scale dairy farming has been achieved in Hebei Province, and 100% of farmers have over 50 dairy cattle. The number of large-scale dairy farms/communities with over 100 dairy cattle is 1,741, and the number of dairy cattle totals 1.56 million, accounting for 76.27% of the province's total number of dairy cattle. The second difference is the large proportion of cooperative dairy farms. According to the analysis of the statistics issued by Hebei provincial husbandry authorities in 2013, 976 dairy farms/communities with over 50 dairy cattle accounted for 56.06% of total number of large-scale dairy farms/communities, and the number of dairy cattle was 828,700, representing 53.11% of the total number of dairy cattle in the province. Among the province's 13 cities, the number of large-scale dairy farms exceeds the number of medium-scale centralized dairy farms in only six cities, namely Shijiazhuang, Tangshan, Qinhuangdao, Xingtai, Zhangjiakou, and Langfang (*Figure 2.3*).

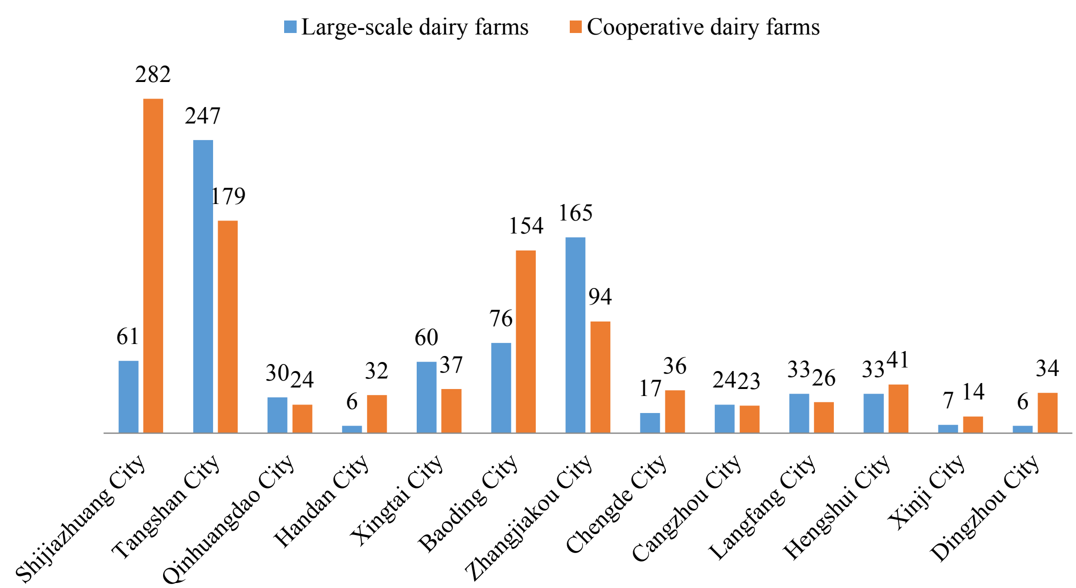



**Figure 2.3 Comparison of number of large-scale dairy farms/communities with dairy cattle in various cities in Hebei Province**

As a special product developed within the special historical background of the dairy industry in Hebei Province, cooperative dairy farms played an important role in promoting large-scale dairy farming in the province. However, as time went by this model became a major obstacle on the road to dairy farming standardization and modernization in Hebei Province. The following sections provide a brief overview and analysis of the development history, operating conditions and future trends of medium-scale centralized dairy farms in Hebei Province.

### 2.2.2 Development Process of Cooperative Dairy Farms in Hebei Province

Prior to 2001, 95% of dairy cattle were raised by families in Hebei Province. In the densely populated urban areas that lack grassland, such as Shijiazhuang, Baoding and Handan, the farmers kept their cattle (perhaps 3-5 or over 10 dairy cows) in courtyards, with a small amount of commercial feed and large amounts of corn stalks and wheat straw collected locally. In the sparsely populated urban areas with rich grassland resources, the dairy cattle mainly graze on the grassland, supplemented by a small amount of concentrated feed.

After 2001, with the rapid development of the Chinese economy, the traditional individual farming model, characterized by low cost, low investment and low output, was impacted by high feed prices and the rapid reduction in grassland resources. In 2003, with the launch of Hebei sand governance actions, Hebei Province People's Government promulgated the "Provisional Regulations on Prevention of Grazing and Implementation of Captivity in Hebei Province", followed in 2005 by the "Circular on Further Strengthening the Prevention of Grazing". Since then, the scattered grazing practice began to comprehensively transit to captivity, and problems such as rising breeding costs and low dairy farming profits became increasingly prominent. Driven by the policies totally preventing grazing, some dairy farmers began to concentrate their dairy cattle in a courtyard or other area and to purchase feed and forage from commercial companies. They then fed the dairy cattle separately – the initial form of medium-scale centralized dairy farms.

### 2.2.3 Overview of Production and Management in Cooperative Dairy Farms in Hebei Province

***Method of production and management***

In cooperative dairy farms in Hebei Province, the standard barns and milking parlors are constructed through the joint efforts of government, dairy enterprises and individual farmers. A dedicated person is responsible for the overall management, and certain management fees are collected to cover the operating incomes of medium-scale centralized dairy farms. The communities who raised their cows under the cooperative model are relatively independent dairy farmers, in other words, cooperative dairy farms are dairy farming units like communities. Cooperative dairy farms seem quite similar to large-scale intensive dairy farms, but the dairy farmers actually own the dairy cattle, and each farmer can provide relatively independent management of the dairy cattle they own.

Under the operation and management rules of cooperative dairy farms currently observed in Hebei Province, in addition to unified milking and unified sales of raw milk, a management model is adopted that comprises “unification + separation”, including unified feeds purchased (unified TMR feeding), unified AI, unified vaccination and unified disinfection + individual feeding, and individual accounting. However, this management method cannot be widely promoted due to its special requirements. *Table 2.3* provides a comparison of the targets and actual status of operation and management for dairy farms in Hebei Province.

**Table 2.3 Comparison between the targets and actual status of operation / management for dairy farms in Hebei Province**

| Management requirements/targets | Actual status |
|---|---|
| Unified milking | Milk collection stations (milking parlors) are available in all cooperative dairy farms across Hebei Province, whereby 100% unified mechanical milking has been realized; milk service station management and monitoring comply with the same requirements as standard larger dairies, completely equipped with HD webcams (the entire process monitored by dairy enterprises); the critical points of monitoring include milking parlors, waiting zones, lactating dairy cattle access channels, raw milk cooling storage zones (milk tank storage zones) and milk truck parking zones (raw milk filling zones). |

| Management requirements/targets | Actual status |
|---|---|
| Unified sales of raw milk | 100% unified sales of raw milk has been realized in all cooperative dairy farms across Hebei Province; the cooperative dairy farms have signed raw milk purchase contracts with dairy enterprises, and the contracts are registered with local husbandry authorities so the buyers cannot change the contract or the raw milk price without permission from the local government and farmers. |
| Unified AI | It is hard to achieve unified AI in the communities, and the operation models are clearly different from large-scale intensive dairy farms:<br>a. Resident AI technicians: no full-time AI technicians are available in most of cooperative dairy farms, and the AI and pregnancy tests are carried out by veterinarians/AI technicians who work in a reasonably mobile manner; they are paid 80-150 yuan immediately on site for these services. Full-time AI technicians are available in the cooperative dairy farms with over 500 dairy cattle; generally one person can handle 500 dairy cattle.<br>b. Operation of AI: because the dairy cattle are bred by individual farmers, and they are not grouped, the farmers must observe oestrus themselves and then contact the AI technicians for timely AI.<br>c. AI programs and frozen semen options: the dairy farmers are not particularly focused on selecting elite bulls but are instead in pursuit of low costs, so there are basically no AI programs in the communities. The frozen semen are mostly state-subsidized free frozen semen. |
| Unified vaccination | 100% unified vaccination has been adopted in the cooperative dairy farms. Because an outbreak of infectious diseases would devastate the industry, the managers of the cooperative dairy farms have attached great importance to vaccination. They regularly carry out quarantines and vaccinations in strict accordance with the requirements of local authorities. In addition, no charge for quarantine and vaccination covers all dairy cattle in Hebei Province, which is also an important reason behind 100% unified vaccination. |
| Unified sterilization | 100% unified sterilization has been adopted in the cooperative dairy farms. Similarly to vaccination, the managers of the cooperative dairy farms attach great importance to sterilization and disinfectants are sprayed throughout communities in a unified manner on a regular basis. In addition, all personnel/material access channels are equipped with disinfection pools, and UV sterilization chambers are available. |
| Individual feeding | Individual feeding is in place at all cooperative dairy farms, which is the biggest difference between cooperative dairy farms and large-scale dairy farms. The Dairy farmers feed their dairy cattle in 1-2 barns without grouping, the management level is far behind, and no TMR feeding methods have been adopted. |
| Individual accounting | 100% individual accounting is in place at all cooperative dairy farms. The dairy farmers pay for raw materials, veterinary clinics and AI services, and the dairy farmers are paid, after certain management fees are deducted by the management of the cooperative dairy farms. This payment depends on the raw milk sold. Individual accounting is easy because of the management model at the cooperative dairy farms. |

***Incomes of cooperative dairy farms***

The incomes of cooperative dairy farms are mainly comprised of management fees, which equal a certain proportion of payments for raw milk. According to a sample survey of cooperative dairy farms in Hebei Province, the current management fee ranges from 0.2 - 0.8 yuan/kg raw milk. Assuming that one lactating dairy cow yields 20kg of raw milk daily and there are 250 dairy cattle in total, about 5 tons of raw milk will be produced every day, and the management fee will be 30,000 – 120,000 yuan per month.

If the owner of a cooperative dairy farm earns only 30,000 yuan per month with 250 dairy cattle, such a low income cannot cover the expenses. In fact, the cooperative dairy farms' profits are based on the different sales prices for raw milk. At present, the raw milk price is determined based on a combination of basic pricing and comprehensive pricing in Hebei Province, and variations in daily milk yields, milk fat, milk protein, SCC, and number of bacteria will directly affect the raw milk sales price. As the individual dairy farmers jointly sell their raw milk, the price difference between bulk sales and separate sales is significant (since 2012, dairy enterprises reject raw milk delivered in batches of less than 2 tons, and individual farmers cannot sell raw milk in batches of less than 2 tons in the formal channels). And the main income of the cooperative dairy farms is comprised of the price differences for raw milk. As revealed in the responses of some farmers and managers working at cooperative dairy farms, although management fees should theoretically be 0.2 yuan/per kilo raw milk sold, the management of cooperative dairy farms benefited from some raw milk price differences after receipt of the payments. In February 2014, the average price of raw milk sold by large-scale (over 500 dairy cattle) cooperative dairy farms to dairy enterprises was 4.8 to 4.9 yuan/kg, but the farmers were only paid by 4.0 to 4.1 yuan/kg. This means about 0.8 yuan/kg was deducted by the management of the dairy farms.

The cooperative dairy farms generally don't need to pay for raw materials and other breeding costs, so their costs primarily include labor costs, raw milk transport costs, fixed asset depreciation, repair costs and other sales expenses. According to the on-farm survey, the operating costs of cooperative dairy farms in Hebei Province was 0.49 yuan/per kilo of raw milk.

Based on a calculation using this ratio, we can conclude that a cooperative dairy farm providing 10 tons of raw milk per day will earn 240,000 yuan/month, and the owner (investor) in charge can achieve a net profit of 93,000 yuan/month.

Dairy farmers usually use relatively simple and primitive methods to estimate their incomes. In terms of their income, they only consider the payments for raw milk and for any dairy cattle sold, and in terms of costs, they only consider raw materials, temporary and long-term laborers, veterinary clinics and AI costs. According to the on-farm survey, in February 2014 the average cost per kilo of feed was 3.04 yuan, and a dairy cow could bring in an average profit of 3,480 yuan per year to the dairy farmers who raised their dairy cattle using the cooperative farming model(excluding the salaries of the dairy farmers) at cooperative dairy farms.

***Feed resources at cooperative dairy farms***

In Hebei Province, the concentrated feeds are primarily commercial feed supplements mainly consisting of corn, soybean meal, rapeseed meal, cottonseed meal, DDGS, and wheat bran. Wheat is not generally used.

The roughage used on these farms mainly consists of corn silage (ordinary commercial corn silage, no special varieties; the usage proportion of whole-plant corn silage is about 30%, most of which is corn stalks), guinea grass (a small amount produced locally, mostly sourced from Inner Mongolia and Northeast China), alfalfa (more than 70% of the alfalfa comes from China), and occasionally peanut vines. It is worth noting that in recent years, more and more cooperative dairy farms have been using alfalfa as roughage, mostly in large-scale dairy farms with over 800 dairy cattle, while corn silage is mostly used on small or medium-scale dairy farms.

***Labor inputs***

As revealed in the on-farm survey, the staffing levels at the cooperative dairy farms is obviously less than those at large-scale intensive dairy farms in Hebei Province (*Table 2.4*). This is because:

a). cooperative dairy farms have few feed processing workers, breeders and cleaners since the farmers do these jobs when they take care of their own dairy cattle;

b). cooperative dairy farms have slack management practices, no full-time veterinarians or AI technicians, and the latter will be hired and paid by the dairy farmers on an irregular basis.

**Table 2.4 Comparison of labor inputs between medium-scale centralized dairy farms and large scale intensive dairy farms in Hebei Province**

| Category of employees (persons/1000 cattle) | Cooperative dairy farms | Large scale intensive dairy farms |
|---|---|---|
| Vet | 0.76 | 1.73 |
| AI technicians | 0.95 | 1.89 |
| Other technicians | 0.38 | 1.34 |
| Total | 19.04 | 41.42 |

**Source: survey on cooperative dairy farms in Hebei Province in February 2014**

***Educational levels of the labor force***

The overall educational level of those working in the dairy farming industry in Hebei Province is low, and most have an educational background of junior middle school or senior middle school. The educational level of the labor force at cooperative dairy farms is lower than that at large-scale intensive dairy farms (see *Table 2.5*).

**Table 2.5 Comparison of educational levels between labor forces at medium-scale centralized dairy farms and large-scale intensive dairy farms**

| Proportion of employees with different educational background levels (%) | cooperative dairy farms | Large-scale intensive dairy farms |
|---|---|---|
| Postgraduate | 0 | 0.46% |
| Undergraduate | 0.99% | 2.05% |
| College students | 3.96% | 5.69% |
| Senior middle school/technical school students | 21.78% | 20.73% |
| Junior middle school and below | 73.27% | 71.07% |

**Source: survey on cooperative dairy farms in Hebei Province in February 2014**

***Quality and price control of raw milk***

The testing indicators include protein, fat, lactose, non-fat milk solids, SCC, number of bacteria, pathogenic microorganisms, heavy metals, aflatoxin, melamine, acidity, boiling test, impurity, etc. In addition, a qualitative and quantitative analysis of antibiotics and pesticides, and veterinary drug residues will be carried out using instruments and kits.

The average basic price of raw milk was about 3.5 yuan/kg in 2013. The comprehensive pricing was determined by the dairy enterprises which may, for example, adjust the raw milk prices according to the scales of the dairy farm (daily milk output), the level of standardization, level of welfare for dairy cattle, feeding conditions and raw milk quality. The basis of the price adjustment is detailed in *Table 2.6*.

***Raw milk quality control and accountability***

Within a cooperative dairy farm, the farmers can independently raise and manage their dairy cattle, but milking and sales of raw milk will be managed by the farms in a unified manner. This is to ensure that if any quality problems are found in fresh and raw milk, the root cause can be tracked and identified, as well as the dairy farmers responsible. The interests of the majority of dairy farmers are thus safeguarded. As for the raw milk quality tracing measures at cooperative dairy farms in Hebei Province, the administrators sample the raw milk at the milking parlor during the milking process, record the sampling dates and store the samples for a period exceeding seven days. If there are any raw milk quality problems which lead to "rejection" by the dairy enterprises, the samples stored are immediately tested and the persons responsible are identified and bear all losses due to "rejection".

***Welfare of dairy cattle***

Welfare facilities for dairy cattle belong to the infrastructure of cooperative dairy farms, and are provided by the owners. However, because the cooperative dairy farms are characterized by slack management and the profits of their owners come from commissions collected from sales of raw milk, the owners do not believe that the availability of welfare facilities is related to profitability. As a result, most cooperative dairy farms have no welfare facilities. Still, some cooperative dairy farms have added neck holders, beds, air coolers and other welfare facilities for dairy cattle in recent years because the raw milk purchase prices quoted by the dairy enterprises are linked to the availability of welfare facilities, and the dairy enterprises provide some subsidies to the contracted dairy farms (for example: Yili provided subsidies of 2,000 yuan/unit for air coolers bought by the contracted dairies/cooperative dairy farms for their barns in 2013).

### 2.2.4 Main Problems and Future Trends among Cooperative Dairy Farms in Hebei Province

***The existence of cooperative dairy farms has become an obstacle to dairy development in Hebei Province, due to the following:***

a). Difficult to achieve scientific feeding management. The self-depended farming(without grouping their cattle in to heifers and milking cows) by individual farmers within the cooperative dairy farms makes scientific grouping or sophisticated feeding management impossible.

b). Difficult to achieve healthy and productive dairy cattle breeding goals. Most of dairy farmers overly focus on low-level investments and do not consider or have the economic means to carry out breed improvements. As a result, most of the dairy cattle are not productive, and the average output per adult dairy cow is only 77.26% of the level at large-scale intensive dairy farms.

**Table 2.6 Basis of raw milk purchase price adjustment adopted by an enterprise in February 2014 in Hebei Province**

| Item | Standards | Fluctuations in unit price of raw milk purchased (Yuan/kg) |
|---|---|---|
| Raw milk output | Daily output < 2 t | Reject |
| | Daily output 3~5 t | +0 |
| | Daily output 5~8 t | +0.03 |
| | Daily output > 8 t | +0.05 |
| Individual feeding | No | 0 |
| | Yes | 0.20 |
| Standard milking parlor | No | +0 |
| | Yes | +0.05 |
| TMR feeding | No | +0 |
| | Yes | +0.05 |
| Cattle welfare | With bedding | +0.03 |
| | Without bedding | +0 |
| Milk protein rate | < 2.8% | Reject |
| | 2.8~3.0% | +0 |
| | Above 3.0%, every 0.1% higher | +0.05 |
| Milk fat rate | < 3.1% | Reject |
| | 3.1~3.6% | +0 |
| | Above 3.6%, every 0.1% higher | +0.03 |
| Microorganisms | < 100,000/mL | +0.01 |
| | 100,000~300,000/mL | +0 |
| | 300,000~2,000,000/mL | -0.05 |
| | > 2,000,000/mL | Reject |
| Number of SCCs | < 200,000/mL | +0.03 |
| | 200,000~400,000/mL | +0.01 |
| | > 400,000/mL | -0.03 |

c). Difficult to achieve healthy breeding. The investments in disease treatment and breeds are generally low at the cooperative dairy farms, and the dairy cattle portfolio is below par (the number of adult cows accounts for about 40% of the total in some cooperative dairy farms). In addition, there are often outbreaks of mastitis, hoof diseases, metabolic diseases and other major illnesses.

d). Difficult to achieve sound production. Because the profits of the owners of the cooperative dairy farms mainly come from commissions collected from raw milk sales, the owners regard investments in waste treatment as an unnecessary burden, leading to worrisome environmental pollution problems.

***Local governments actively promote the transition from cooperative dairy farms to modern, standard dairy farms***

At present, local governments in Hebei Province are vigorously promoting the transition from cooperative dairy farms to large-scale intensive dairy farms. In 2012, 33 cooperative dairy farms successfully transformed into large-scale intensive dairy farms, and there are plans for the transformation of an additional 150 cooperative dairy farms every year under government guidelines.

In September 2013, Hebei Provincial People's Government issued the “Opinions on Accelerating the Development of the Dairy Industry of Hebei Province” (Ji Zheng [2013] No. 57), which clearly states that the raw milk used for producing infant milk powder must come from standardized dairy farms. This is meant to kick-start the transition from cooperative dairy farms to standardized dairies, and includes the allocation of funds totaling 125 million yuan for four consecutive years to specifically subsidize the dairies which meet the milk powder production standards. In addition, a subsidy in the form of an award will be provided at a rate of 2,000 yuan/adult cow.

Currently, the main criteria adopted by the local governments in Hebei Province to determine the successful transition include grouped feeding and TMR feeding in individual groups. The transition options include:

a). the owners of the cooperative dairy farms buy the dairy cattle owned by the farmers, after which the cooperative dairy farms can transition to large-scale feeding enterprises solely owned by the owners;

b). issue shares to dairy farmers, and after the transition the owners will be responsible for production and management, and the dairy farmers can be paid dividends based on the shares in these joint-stock enterprises.

***Transition is very difficult and the road ahead is long***

Despite the availability of significant subsidies as incentives, the transition remains fraught with difficulties. On the one hand, the dairy farmers who work on the cooperative dairy farms have a strong sense of ownership and think they should manage their own dairy cattle. If the cooperative dairy farms are transitioned, they will lose control over the management of their dairy cattle, the risks will be high and the incomes will not be protected. On the other hand, the transition will cause more investments for the owners of the cooperative dairy farms, most of the production and operation risks will be transferred to them, and the benefits are limited. Although the government provides a lot of incentives, most farmers still do not want to transition to large-scale dairy farms.

## 2.3 SUBURBAN AREAS-CHANGES IN BEIJING/TIANJIN DAIRY FARMING MODELS

Both Beijing and Tianjin are advantageous regions for dairy development as determined in the new "*Layout of National Competitive Agricultural Regions* (2008-2015)", and the suburban dairy development model has been adopted in both locations. This model is particularly applicable to the regions with limited land resources, high labor costs, abundant resources, rich technical and traffic resources, strong dairy processing capacities, high demand for dairy products, and short distances between origin and market. The suburban dairy development model requires the farmers to pursue quality and efficiency instead of quantity and to do so as quickly as possible. It also shifts the focus to more yields, stable yields, health, specialization, intensification and standardization.

### 2.3.1 Overview of Dairy Farming in Beijing/Tianjin

***Layout of dairy farming***

The industry development pattern, which features modern production, cooperative organization and social technical services has been adopted for dairy farming in Beijing. As indicated in the overview of the agricultural economy and leading industries of Beijing, most of the dairy development areas are located in the new urban development zones and protected ecological conservation zones, including South Beijing dairy industry (belt backboned by Shunyi, Tongzhou, Daxing and Fangshan), and North Beijing dairy industry (belt backboned by Yanqing, Miyun and Huairou). The seven counties (districts) had a total of 132,200 dairy cattle in 2012, accounting for over 87% of the total number in Beijing.

Dairy farming in Tianjin is mainly concentrated in competitive regions such as Wuqing District, Beichen District, Jinghai County and state-owned farms, where there were a total of 121,500 dairy cattle in 2012, accounting for over 77% of total number in Tianjin.

***Dairy cattle and milk output***

As indicated in the statistics released by China Dairy Yearbook and Beijing Dairy Association (*Figure 2.4* and *Figure 2.5*), the number of dairy cattle in Beijing began to grow rapidly after 1998, and the highest number of 185,200 was reached in 2004. The number of dairy cattle declined slightly in 2009, and then basically stabilized at about 150,000. As of the end of 2013, the number of dairy cattle was 144,400, including 91,100 adult cows, and the total milk output was 614,600 tons. The SUNLON Group Beijing Lvhe Cattle Co., Ltd. is the largest in the breeding scale, with leading technologies and productive dairy cattle. In 2012, the company's milk production accounted for 28.37% of the city's total, with an annual yield of 10.9 tons/cow it has achieved a record of maximum output per dairy cow in large-scale intensive dairy farming. The group is an important force that can drive the improvement of the dairy production level in Beijing.

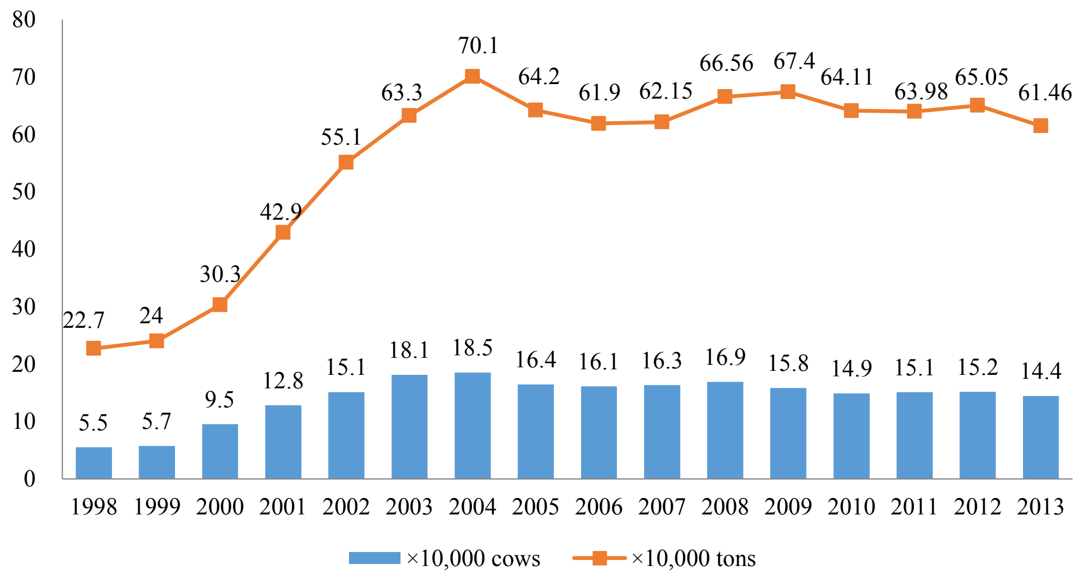



**Figure 2.4 Trends in dairy cattle numbers and dairy output from 1998 to 2013 in Beijing**
**Source: "China Dairy Yearbook" and "2013 Beijing Dairy Development Report"**

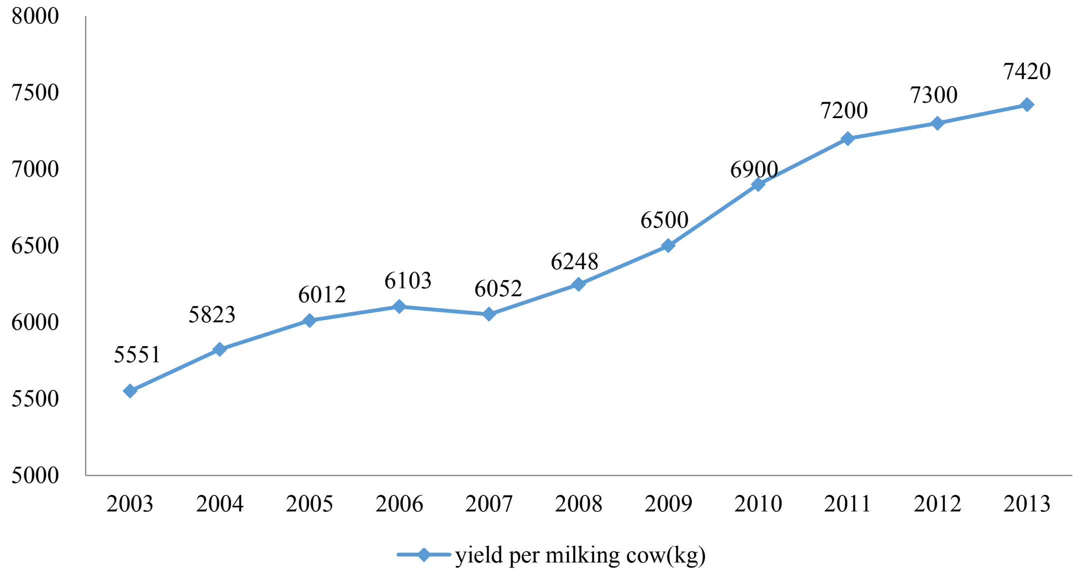



**Figure 2.5 Trends in yeild per milking cow in Beijing (2003-2013)**
**Source: data from Beijing Dairy Association**

As indicated in the statistics released by China Dairy Yearbook and Tianjin Dairy Association (*Figure 2.5* and *Figure 2.6*), the number of dairy cattle in Tianjin increased from 27,000 to 155,800 from 1998 to 2012, with an average annual increase of 13.34%. During the same period, dairy output increased from 117,000 to 678,700, with an average annual increase of 13.38%, while the number of dairy cattle has remained stable at around 150,000 since 2007. The growth of total dairy output will be mainly attributed to the growth of output per dairy cow. The number of dairy cattle in Tianjin was 151,000 in 2013, with an annual output per cow of 7.25 tons. As an advanced dairy production enterprise in China, the annual output per dairy cow was 10.5 tons in 2013 in Tianjin Jialihe, whereby one dairy farm had 900 dairy cattle, including over 500 adult cows, and the average annual output per dairy cow reached 12.24 tons.

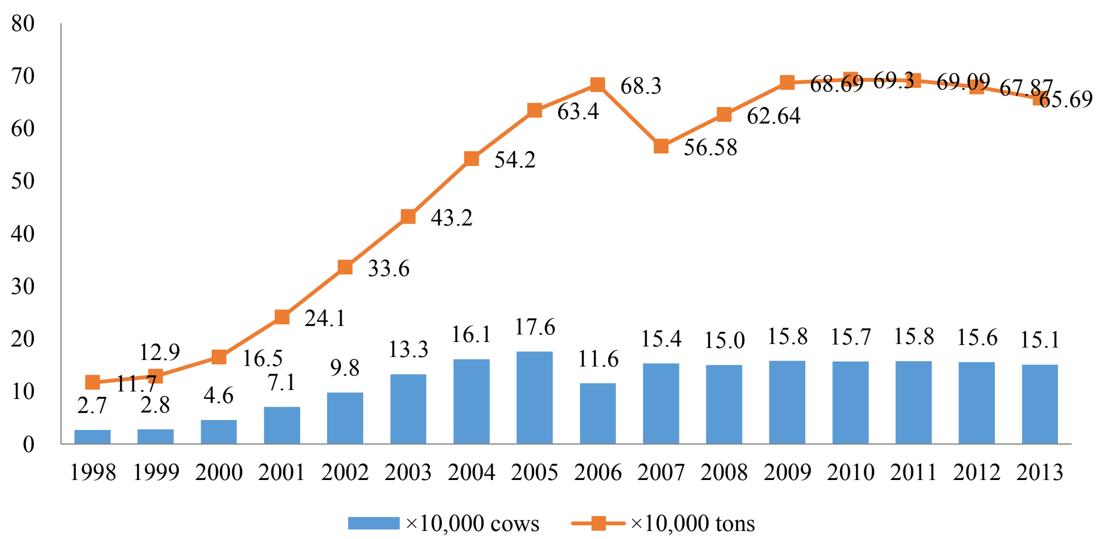



**Figure 2.6 Trends in dairy cattle numbers and dairy output from 1998 to 2012 in Tianjin**
**Source: "China Dairy Yearbook" and data provided by Tianjin Dairy Association**

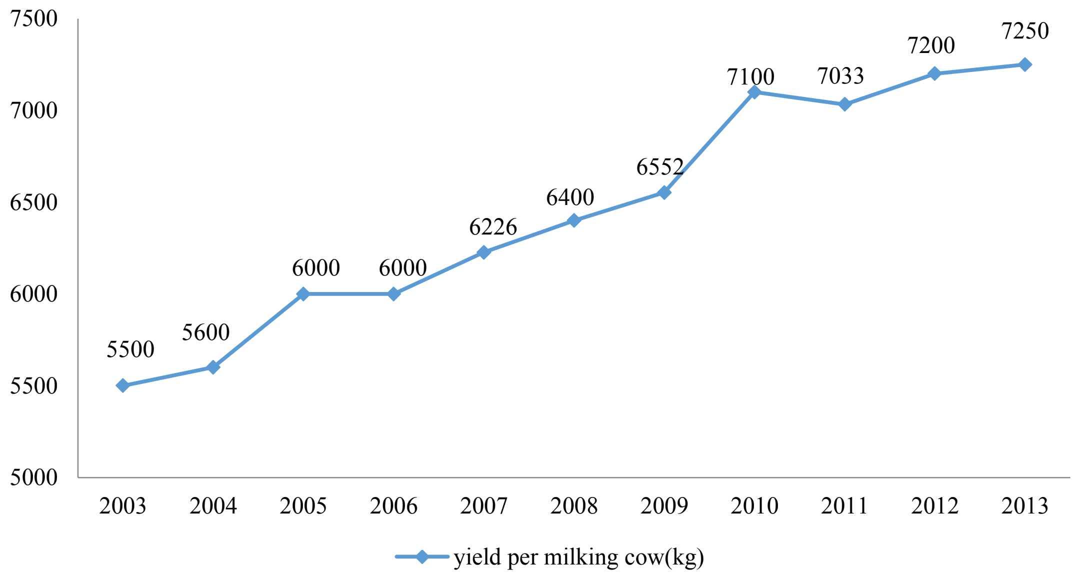



**Figure2.7 Trends in variations of output per dairy cow in Tianjin from 2003 to 2012**
**Source: "China Dairy Yearbook" and data provided by Tianjin Dairy Association**

***Changes in proportions of different farming scales***

The project aimed at transferring household dairy farming to dairy farms/cooperative dairy farms was successfully completed in 2011 in Beijing. Currently, 100% of milking is done mechanically, there were 301 large-scale intensive dairy farms with over 100 dairy cattle, and the number of dairy cattle accounted for 84.2% of the total number in Beijing.

Compared with Beijing, Tianjin lags behind in the number of large-scale intensive dairy farms. At present, the proportion of dairy farms with less than 100 dairy cattle is high and although the proportion of dairy farms with 20-99 dairy cattle is declining slightly, it is still the most popular farming scale, accounting for 30.60% of total number of dairy farms.

## 2.3.2 Industry Needs Analysis

***Feed resources***

Beijing and Tianjin have similar feed resources. The raw materials in the concentrated feeds used for dairy cattle mainly include corn, wheat, wheat bran, soybean meal, cottonseed meal, rapeseed meal, flax meal, corn germ meal, extruded soybeans, soybean hulls, DDGS, whole cottonseeds, etc. The most commonly used materials include corn, soybean meal, wheat bran, cottonseed meal and rapeseed meal. Roughages mainly include corn silage, alfalfa, and guinea grass. The alfalfa is mainly imported from the United States, with only small amounts coming from Ningxia and Xinjiang in China, and the guinea grass is mainly sourced from Inner Mongolia and Heilongjiang.

***Genetics and breeds***

Holstein is the major cattle breed in Beijing, accounting for 97.5% of all dairy cattle; Jersey accounts for 0.5% and Simmental accounts for 0.5%. There are a small number of other breeds as well.

Beijing is the pioneer in terms of breed development across China, in addition to semen and embryo production, and it has ranked first in terms of sales volume for many years, accounting for over 30% of the national market. The breed development system is preliminary faormed backboned by bull stations, critical farms and nucleus farms. The highly efficient bull breeding technical system has been established and is backboned by genomic selection, molecular genetic defect detection techniques and early superovulation techniques. Its efficiency has also been greatly improved. For example, in the Beijing Dairy Cattle Center, which is the biggest bull station offering the most semen in China, there are

198 high-quality Holstein bulls, offering as many as 4 million doses of high-quality frozen semen. Output per bull is 40,000 doses, giving it top ranking in China for 13 consecutive years. The Center has 1,300 high-quality Holstein cows, whereby annual milk yield per adult cow is 10 tons, and that total includes 200 cows with annual milk yields of 12 tons.

In Tianjin there are 157,700 Holstein dairy cattle (99.87%) and 200 Jersey cattle (0.13%).

***Health and welfare***

a). Disease prevention and control

Over the years, Beijing's dairy farming industry has firmly observed a year-round disease prevention concept and dairy farms (communities) have sound daily dairy cattle disease prevention and control facilities and regulations. The epidemic prevention and supervision departments in all districts (counties) are very helpful in guiding dairy farms (communities) to carry out the basic disease prevention and control efforts. Good prevention and control outcomes have been achieved for major zoonosis and high-impact Class I and II infectious diseases. FMD vaccination is carried out at all dairy farms and brucellosis and tuberculosis testing is carried out every spring and autumn; any animal who tests positive will be killed and eliminated.

A farmers' accountability system of vaccination and quality safety has been implemented in Tianjin, whereby letters of undertaking are signed. A supervisor accountability system has been implemented, and a supervisor is available at each dairy farm. Epidemic prevention and risk assessments are carried out on the dairy farms, and supervision is carried out according to Class A, B and C. Mandatory Type O, Type Asia Type I and Type A FMD vaccinations are adopted for the dairy cattle, and the mass vaccination density is over 90%, of which the vaccination density for the specific dairy cattle is 100%.

b). Animal welfare

Improvements in dairy cattle welfare and the dairy farming environment not only help to achieve healthy conditions, but also significantly improve cattle performance. Therefore, the importance of improving dairy cattle welfare is increasingly recognized in the dairy industry.

Currently some new large-scale dairies in Beijing and Tianjin commonly use free-stall systems. Dry manure or sand is used as the bedding material on most of dairy farms, and the beds and rest zones are soft and dry. The playground is raked or plowed to make it smooth and soft, so that the dairy cattle can enjoy a comfortable space.

To prevent sliding or injury while minimizing the negative impact of cement roads on cattle hooves, rubber mats are laid where cattle often pass, such as at feed channels or milking channels. This reduces contact with the rough ground and makes cattle hooves healthier.

Beijing and Tianjin have hot summers and concentrated rainfalls, so dairy cattle are prone to heat stress, with highly productive dairy cattle especially sensitive to this issue. Some 80% of the barns are open or semi-open, which basically ensures ventilation. More than half the dairy farms are equipped with fans, sprays and other summer cooling facilities which effectively reduce the heat stress.

***Land resources***

Since 1985, milk production has been continuously growing in China, but the share of Beijing milk products in the national industry is continuously declining, from 5.4% in 1985 to 1.7% in 2011. On the one hand, the declining share of Beijing milk products is due to increasingly concentrated dairy production in China. On the other hand, it follows the decrease in land and water resources in Beijing's suburbs that are available for dairy development as well as economic development. Dairy farming takes a lot of land, including both direct occupation for dairy farming and indirect occupation for the production of feed, manure storage and sewage treatment. For example, assuming that each dairy cow consumes 7 tons of silage every year, about 738,500 tons of silage is needed for about 105,500 lactating dairy cattle (2012 figures). 250,000 mu of arable land will be needed to fulfill the needs of lactating dairy cattle, assuming that 3 tons of silage can be produced on every mu of arable land. This puts tremendous pressure on Beijing's increasingly tense agricultural land, and it is a major limiting factor in the development of Beijing's dairy farming industry. Similar to Beijing, Tianjin's land resources available for dairy farming are also increasingly scarce given the accelerated process of urbanization. Meanwhile, waste treatment is another significant problem currently facing the dairy farming industry. Therefore, the development of ecological farming and the gradual decrease in pollution and emissions are future development directions for dairy farming in Beijing/Tianjin.

***Labor input and educational background***

The legal representatives of large-scale intensive dairy farms in Beijing have higher educational backgrounds, 87.2% have a diploma beyond senior middle school, but this number is only 50% among cooperative dairy farms and small-scale household dairy farms. In terms of the distribution of technical personnel in the dairy farms, it is strong at large-scale intensive dairy farms, with an average of 1.8 veterinarians/per farm, 1.5 AI administrators/per farm and 1.0 technician/per farm. However, cooperative dairy farms and small-scale household dairy farmers have weak technical know-how, especially small-scale household dairy farmers, where there is only 0.3 veterinarian/per farm, 0.2 AI administrator/per farm and 0.2 technician/per farm. The cooperative dairy farms and small-scale household dairy farms need to further improve their professional quality and staffing structure.

In Tianjin, the average employment costs for skilled workers at dairy farms are generally the following:

recent technical school graduates interning: 1,500-1,600 yuan/month;

undergraduates: 2,000 yuan/month;

formal workers: 2,500-3,500 yuan/month.

In Tianjin Jialihe, for example, most personnel (50%) have graduated from college, 15-20% have graduated from university, and other employees have poor educational backgrounds, ranging from junior middle school to senior middle school diplomas.

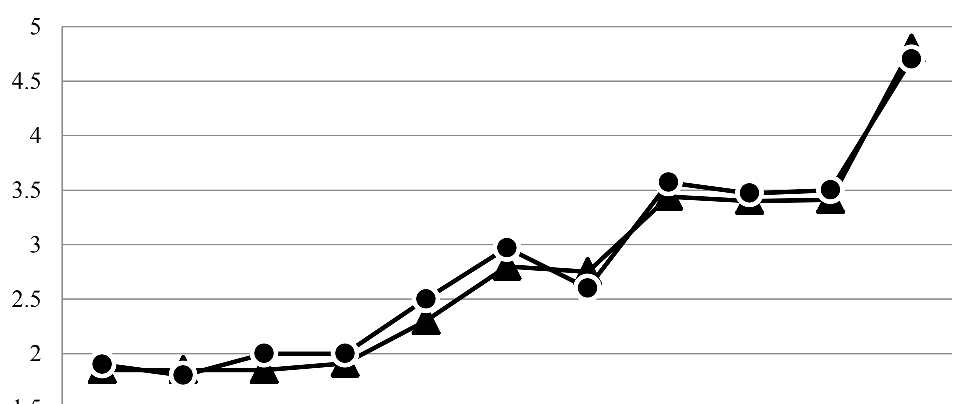
## 2.3.3 Analysis of Operating Performance

***Milk price and milk purchase system***

Trend variations in milk purchase prices in Beijing and Tianjin are shown in Figure 2.8. The raw milk purchase price gradually increased since 2003 in Beijing, fell slightly after the melamine incident in 2008 and then continued to rise. By the end of 2013, the raw milk purchase price was about 4.7-5.3 yuan/kg. There are no milk price protection measures, and the milk price mainly depends on market mechanisms. There are two means used by dairy farms, cooperative dairy farms and small-scale household dairy farms in Beijing to transport raw milk to the dairy processing plants:

a). Larger dairy farms transport their raw milk to the processors themselves;

b). Small household dairy farms milk their dairy cattle at the cooperative farms and the owner is then responsible for collecting, storing, and selling the raw milk to processors.




| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Beijing | 1.85 | 1.85 | 1.85 | 1.91 | 2.3 | 2.8 | 2.75 | 3.44 | 3.4 | 3.41 | 4.8 |
| Tianjin | 1.9 | 1.8 | 2 | 2 | 2.5 | 2.97 | 2.6 | 3.57 | 3.47 | 3.5 | 4.7 |

**Figure2.8 Fluctuation trends of raw milk purchase prices in Beijing and Tianjin (2003 -2013) yuan/kg**
**Data: survey data**

The milk purchase price trends in Tianjin are the same as in Beijing. By the end of 2013, the raw milk purchase price was about 4.5-5.2 yuan/kg. The prices depend on different pricing systems used by different buyers.

Raw milk is the source of dairy products, and its quality is the main factor affecting the quality of dairy products. Dairy processing plants have strict inspection procedures and test specifications when purchasing raw milk. The testing indicators include protein, fat, lactose, non-fat milk solids, SCC, number of bacteria, pathogenic microorganisms, heavy metals, aflatoxins, acidity, boiling test and impurity, etc. At the same time, a qualitative and quantitative analysis of antibiotics and pesticides as well as veterinary drug residues is carried out using instruments and kits. Melamine is a mandatory testing factor since the melamine incident in 2008.

***Analysis of operating performance***

*Table 2.7* shows the results of a cost-benefit analysis for different scales of dairy farms in Beijing. The dairy farming industry was characterized by low overall profitability in 2012 in Beijing, and with the increase of the scale, the average profitability is showing a rising trend. The average profitability of small-scale household dairy farms with less than 100 dairy cattle is low; the average profitability of medium-scale dairy farms with 100-500 dairy cattle is lower than the average value across the city; and the average profitability of dairy farms with over 2,000 dairy cattle is 24.64%. With the expansion of the scale of dairy farms, milk production costs will rise, but the growth rate of milk sales prices is higher than the growth rate of production costs, which is the root cause of the improvement in average profitability given an increase in scale. The operating performances of dairy farms and large-scale dairies were better than in 2012 due to the significant increase in milk purchase prices in 2013.

**Table2.7 Cost-benefit analysis of different scales of dairy farms in 2012 in Beijing**

| Costs and profits | Average | Less than 100 cattle | 100-499 cattle | 500-999 cattle | 1000-1999 cattle | More than 2000 cattle |
|---|---|---|---|---|---|---|
| Average milk price (Yuan/kg) | 3.20 | 3.03 | 3.20 | 3.31 | 3.44 | 3.53 |
| Total milk cost (Yuan/kg) | 3.04 | 3.04 | 3.09 | 3.04 | 2.84 | 3.00 |
| Average profitability (%) | 9.78 | 6.17 | 6.21 | 12.22 | 26.59 | 24.64 |

**Source: survey data**

The variations in feeding costs are basically the same as those of raw milk prices in Tianjin and Beijing, and the profitability of different scales of dairy farms (communities) in Tianjin is similar to Beijing, whereby the profitability of large-scale intensive dairy farms is the highest (see *Table 2.8*).

**Table 2.8 Costs and earnings per unit of main product in 2010 in Tianjin (Yuan/50 kg)**

| Economic indicators | Average sales price of raw milk | Production cost of raw milk | Net profit of raw milk |
|---|---|---|---|
| Small scale | 144.67 | 102.32 | 42.18 |
| Medium scale | 168.30 | 115.50 | 52.71 |
| Large scale | 172.58 | 110.35 | 62.15 |

**Sources: Wei Sufen, et al. Analysis of Economic Performances and Research on Development Countermeasures for Dairy farming in Tianjin, 2013, 20 (1): 46 - 51.**

## 2.3.4 Main Constraints

At present, the main factors restricting the suburban dairy farming industry include environmental factors, resource factors and technical factors.

***Manure treatment and environmental factors***

a). In traditional dairy farming (with a cow yard outside the barn), the cow yard is a prominent agricultural nonpoint source of pollution

Manure collection is achieved with a low level of mechanization, but relies completely on manual labor. Most cow yards don't have facilities to prevent liquid waste from leaching, sewage drainage or rain water and sewage separation measures, so that the nitrogen, phosphorus and other pollutants from urine and manure seep, leak or flow and thus pollute the environment.

b). Low availability of supporting waste treatment facilities

Dairy farms produce a lot of manure, and currently the most widely used methods of manure elimination, such as composting and biogas generation, cannot process all the manure in a timely manner. Therefore, supporting waste treatment facilities are urgently needed at the dairy farms, and it is necessary to strength rain proof and seepage proof management, establish effective manure treatment channels, and find a reasonable place to dispose of the waste to reduce environmental pollution.

c). Low availability of supporting environmental control facilities

Beijing and Tianjin are geographically close, feature hot and rainy summers, and high temperatures and humidity can make the dairy cattle suffer from heat stress, so cooling and ventilation equipment are particularly important to avoid a significant impact on production. Currently, small and medium-scale dairy farms have a low availability of summer cooling facilities, and the lack of appropriate technologies and financial bottlenecks have become two major obstacles to availability of environmental control facilities at these farms.

***Resource factor***

a). Land resources

Dairy farming requires a lot of land, but given their urban settings, Beijing and Tianjin have limited agricultural land resources, and there is a declining trend. Beijing, for example, had 207,358 $hm^2$ of unused land in 2008, including only about 15,600 $hm^2$ of land suitable for agriculture, mainly in Yanqing Basin and along the Yongding River. And the land suitable for forestry and farming was mainly distributed in hilly or semi-hilly zones, making development and utilization is difficult.

b). Water resources

Dairy farming consumes a lot of water, and dairy cattle must rely on water to maintain normal physiological functions and activities as well as to complete the digestion, absorption and metabolism of nutrients. A dairy cow needs 3-5 liters of water to produce 1 kg milk, which means that a productive dairy cow needs 120 liters of fresh water every day. In addition, flushing and disinfecting milking equipment requires large amounts of hot water. Beijing has serious water shortage issues, and water resource limitation would severely restrict the development of dairy farming industry.

***Technical factors***

In terms of technological level, the rate of high-yield dairy cow is low in Tianjin. And although there is a large-scale Chinese Holstein nucleus that was initially formed in Beijing, there is still a gap compared with developed countries, and the industry must rely on imports, especially for high-quality dairy cattle breeds. Therefore, it is very important to further improve the high quality breed development system in Beijing and Tianjin to realize a true supply of high-quality breeds.

There is a relative lack of on-site technicians and their level of expertise is lower than in other industries. It is therefore necessary to increase efforts to train on-site professional and technical personnel based on a model of theoretical + practical training, with an emphasis on selection of breeds, AI, reproduction health, disease treatment and information management. This would improve the professional skills of the personnel, so as to realize scientific feeding practices and improve breeding efficiency at dairy farms.

## 2.3.5 Future Trends

***Develop the suburban dairy industry, aiming towards increased eco-friendliness, higher quality and higher efficiency with a moderate scale***

The "*The act on the scale livestock and poultry farming pollution prevention*" has been in effect since January 2014. Under the act, livestock farms (communities) are required to build up the appropriate manure, sewage and rainwater diversion facilities, livestock manure and sewage storage facilities, as well as anaerobic treatment and composting, organic fertilizer processing, biogas generation, biogas slurry separation and transport, sewage treatment, dead animal body treatment and other comprehensive utilization and safe disposal facilities based on the scale of farming and pollution prevention needs. Due to ever stricter environmental standards and increasing pressure on waste treatment, there are more stringent requirements for suburban dairy farm development models. At the same time, given the rapid urbanization process, the amount of dairy farming land in Beijing/Tianjin is restricted by reduced land resources (for dairy farming and forage planting) and urban water shortages as well as the impact of the planning and development of husbandry industry in surrounding provinces. In addition, there is great pressure to prevent infectious diseases, so the dairy farming spatial pattern is moving from nearby suburbs to the outer suburbs, or even to other provinces and cities. It is therefore necessary to promote dairy farming in Beijing/Tianjin less from a quantitative development perspective to qualitative development, and carry out appropriate scale farming as well as develop suburban farming industries with their own characteristics in overall consideration of the resources and environmental issues.

Six suburban districts (counties), namely Mentougou, Fangshan, Pinggu, Huairou, Miyun and Yanqing, are defined as the "ecological conservation zones" of Beijing, and are the ecological barriers and water conservation points for the city. This means their special natural conditions can be utilized while balancing environmental and ecological considerations to develop a suburban organic dairy industry characterized by the production of high-end products.

***Increase scientific and technological support and investments, and ensure the supply of high-quality genetics; promote scientific dairy farming, and raise the overall dairy farming level***

Strengthen the high-quality genetic resources supply capacities. The Beijing Dairy Cattle Center and Tianjin Dairy Cattle Center can be used to take maximum advantage of available resources, focus on scientific and technological innovations, improve the genetic development system backboned by bull stations, nucleus farms and nucleus dairy farms, cultivate breeding bulls and cows, and increase frozen semen and embryo production capacity. All this will transfer the increased breed supply capacities from Beijing/Tianjin to the national dairy farming industry across China.

Promote the development of small-scale farmers to larger scale farmers by demonstration of farming technologies and management skills. Scale farming is a way to improve efficiency and standardization is the platform to ensure quality. Small-scale farmers must strengthen their professional farming training, management and technical service to enhance the professional quality of their laborers, especially focusing on the training of small household and cooperative dairy farmers.

For example, they should learn from the management model of Beijing Capital Agribusiness Group Beijing Lvhe Cattle Co., Ltd., namely the advanced management experiences characterized by intensive, modern, standard, network-like and intelligent practices, to strengthen the training efforts at dairy farms and cooperatives and enhance the understanding and interest of farmers in advanced management technologies, while striving to optimize the farming environment and improve feeding and management level.

***Improve industry support mechanisms, particularly increased financial subsidies***

In order to promote the upgrades and healthy and sustainable developments of Beijing/Tianjin suburban dairy industries, the dairy industry must also be protected, and the government should increase subsidies to ease the financial pressure on dairy farms, and particularly on dairy farmers. Raw milk sales channels must also be rationalized to ease the worries of farmers in the market. In addition, the development of dairy cooperatives must be encouraged and the bargaining power of farmers in the market enhanced.

In Tianjin, 60% of farmers work on cooperative dairy farms, so for this location, it is effective to increase the transformation of cooperative dairy farms to large-scale dairy farms. It is necessary for local government to increase the access thresholds and set up higher requirements for dairy farming in order to accelerate dairy industrialization. More subsidies should be provided to the dairy farms (communities) with 300-500 dairy cattle, 500-1,000 dairy cattle, and over 1,000 dairy cattle, respectively, and the standardization of construction of large-scale intensive dairy farms should be part of the planning. Meanwhile, with the support of government subsidies, completely new technologies, new processes, new product applications, improved technological levels and production levels should be proposed, ensuring the basic stability of the number of dairy cattle and improving milk quality. This will achieve a healthy, efficient and sustainable development of the dairy industry.

## 2.4 GENERAL SITUATION AND DEVELOPMENT TREND ANALYSIS OF HOUSEHOLD PASTURE DAIRY FARMING IN HULUNBEIER LEAGUE

### 2.4.1 Present Situation and Development Trend of Dairy Farming Industry in Inner Mongolia Autonomous Region

***China's largest province for dairy farming***

Inner Mongolia Autonomous Region is China's most typical core region for dairy industry development. It ranks first in the number of dairy cattle, raw milk output, processing capacity, processing enterprise sales revenue and per capita milk possession. In 2012, total dairy production reached 9.307 million tons, including 9.102 million tons of milk which represents one-fourth of total production in China.

***Representative region of grazing dairy farming***

Animal husbandry of Inner Mongolia Autonomous Region represents China's pasture animal husbandry. In Inner Mongolia Autonomous Region, the total area of natural grassland is 78.81 million hectares and the available grassland area is 63.59 million hectares, accounting for 66.6% and 53.8% of total land area, respectively. More than 20% of China's available natural grasslands are distributed in Inner Mongolia Autonomous Region. Abundant grassland resources bring a unique advantage to Inner Mongolia Autonomous Region, with rich natural resources of natural grasslands per capita and good grazing conditions for dairy farming.

Locally, household dairy farming prevails. With very limited capital, the vast majority of farmers cannot afford to buy too many cows so that they conduct family-based small-scale household dairy farms under extensive operation. By the end of 2011, small-scale operations of 20 cows or less dominated the dairy farming of Inner Mongolia Autonomous Region (see *Table 2.9*).

***Small-scale household dairy farms with low dairy production efficiency***

With the development of China's dairy industry, dairy farming began to transform from quantity growth to qualitative efficiency. It is difficult for small-scale household dairy farms to meet modern high-efficiency production levels and facilitate the promotion and popularization of modern dairy farming technologies. By the end of 2012, the annual average yield per cow had reached only 5.19 tons/head in Inner Mongolia Autonomous Region, below the 5.5 tons/cow average in China, indicating the lower productivity of the dairy farming industry.

***Disordered grazing operation and increasingly tight grass resources***

There are abundant grass resources in Inner Mongolia Autonomous Region, but arid and semi-arid grasslands are prevalent, accounting for about 73% of the total area. Natural grasslands cover a large area on the whole, but productivity is relatively low and stability is poor. In addition, a considerable portion of the grasslands have a very weak ecological environment. Previously, natural grassland productivity was overestimated and an increase in livestock was the first target of economic development in the pasture area. This meant that most of pasture areas became overgrazed, causing serious grassland degradation. As revealed by China's third prairie census, grassland degradation in Inner Mongolia accounted for 39%, meaning the area ranked first among China's five major pasture areas. In accordance with the fourth prairie census at the beginning of the century, nearly three-quarters of prairies in the region were degenerated to varying degrees so that the region became one of the most serious cases of degradation.

During the 60 years from 1950 to 2010, the population engaged in the animal husbandry sector increased by 5.1 times, from 296,000 to 149.9 million people, but yield of grass per mu in the natural grasslands decreased by 5.8 times from 109.5 kg to 18.9 kg. Throughout the region, total storage of edible forage grasses fell by 7.8 times, from 111.59 million tons to 14.36 million tons. These changes meant that storage capacity with natural grass per animal husbandry employee decreased by almost 40 times (*Table 2.10*).

**Table2.9 Dairy farming of Inner Mongolia Autonomous Region in 2011**

| Farm Size (head) | Indicator | Numbers | Farm Size (head) | Indicator | Numbers |
|---|---|---|---|---|---|
| 1~19 | Farm numbers | 317011 | 200~499 | Farm numbers | 667 |
| | Proportion (%) | 94.63 | | Proportion (%) | 0.20 |
| | Annual cattle numbers | 1,259,226 | | Annual cattle numbers | 229,949 |
| | Proportion (%) | 46.10 | | Proportion (%) | 8.42 |
| 20~99 | Farm numbers | 15883 | 500~999 | Farm numbers | 178 |
| | Proportion (%) | 4.74 | | Proportion (%) | 0.05 |
| | Annual cattle numbers | 694,442 | | Annual cattle numbers | 132,481 |
| | Proportion (%) | 25.42 | | Proportion (%) | 4.85 |
| 100~199 | Farm numbers | 1180 | Above 1000 | Farm numbers | 90 |
| | Proportion (%) | 0.35 | | Proportion (%) | 0.03 |
| | Annual cattle numbers | 186,076 | | Annual cattle numbers | 229,313 |
| | Proportion (%) | 6.81 | | Proportion (%) | 8.40 |

**Data Source: 2012 China Dairy Yearbook**

**Table 2.10 Storage of Natural Grass Per Capita of Population Engaged in Animal Husbandry in Inner Mongolia Autonomous Region**

| Year | Forage Grass Yield Per Unit Area (Kg / mu) | Total Storage of Natural Grass (Ten thousand tons) | Population in Animal Husbandry (Ten thousand persons) | Grass Storage Per Capita (ton) |
|---|---|---|---|---|
| 1950 | 109.5 | 11,159 | 29.6 | 377 |
| 1970 | 63.0 | 6,359 | 96.9 | 65.6 |
| 1980 | 43.5 | 4,091 | 183.8 | 22.3 |
| 1990 | 30.0 | 2,891 | 191.2 | 15.1 |
| 2010 | 18.9 | 1,436 | 149.9 | 9.6 |

**Data Source: Statistical Data of Survey and Design Institute for Inner Mongolian Grassland**

***Dairy farming development towards large-scale and intension***

The Melamine scandal in 2008 marked the end of the small dairy farming pattern and accelerated the transformation of Inner Mongolia Autonomous Region from quantity expansion to qualitative efficiency with a development trend toward large scale dairy farming instead of small household farming. As a result: dairy enterprises such as Yili and Mengniu built a number of large-scale farms; Shengmu High-tech and Benniu also invested in the construction of large scale dairy farms; dairy farming enterprises such as Dairy United expanded production scale by distributing dividends with cow leasing; some large family farmers with relatively large business capacity became household pastures with a certain scale (50 to 100 dairy cattle); some small family farmers suffered continuous losses and left the sector due to discriminatory milk prices of dairy enterprise, lack of policy support, high cost and other factors. Following these adjustments, the dairy farming industry in Inner Mongolia Autonomous Region adopted a dairy production pattern dominated by small household pastures/farms and supported by small, medium-sized and large farms.

***Developing ecological household pasture farms to promote transformation and upgrading of pasture animal husbandry***

The ecological household pasture farm is a basic animal husbandry production unit that operates large-scale intensive dairy farms, standardized production and intensified operation under the premise of ecological protection of the pasture farm and on the basis of a household operation in order to achieve the target of win-win for animal husbandry production and ecological construction in the pasture. The ecological household pasture farm is different from large-scale intensive dairy farms and cooperative dairy farms:

a). operators of the household pasture farms are relatives;

b). they include some planting lands or pastures;

c). they have some modern farming facilities.

Large-scale intensive dairy farms are gradually being built in the Inner Mongolia Autonomous Region, but pasture animal husbandry activities that rely on local rich grass resources still account for the majority of local dairy farming industry. Small-scale household grazing and semi-grazing dairy farms continue to account for 94.63% of the local dairy industry. The focus of local dairy industry construction and the main operation model of local pasture animal husbandry will be to guide dairy farmers from small household operation to appropriate medium or large-scale intensive dairy farms and to achieve cropping and raising integration management of household pasture farms on the basis of abundant grass resources. Construction of ecological household pasture farms will effectively promote large-scale development of pasture animal husbandry, improved quality and efficiency and upgrading of the pasture animal husbandry.

***Hulunbeier League - representative ecological household pasture in Inner Mongolia Autonomous Region***

Hulunbeier has a total grassland area of 8.8 million hectares, including an available grassland area of 6.7 million hectares. It has come to represent pasture animal husbandry and is one of three major raw milk producing areas in Inner Mongolia Autonomous Region. In 2013, Hulunbeier raised a total of 752,300 dairy cattle and produced 1,343,700 tons of raw milk. More than 70% of the dairy farming industry of Hulunbeier's small-scale grazing / semi-grazing operations are comprised of at most 20 cows. Hulunbeier was the first region to advocate the ecological household pasture business model and has become a typical example of ecological household pasture dairy farming in Inner Mongolia Autonomous Region.

### 2.4.2 Production and Operation of Ecological Household Pasture Farming in Hulunbeier

***Characteristics of Production and Operation***

a). Diversified and multi-species operation

At the beginning of 2013, the first group of 501 early ecological household pasture farms in Inner Mongolia were approved, 100 of which were in Hulunbeier which ranked first in terms of the quantity of ecological household pasture farms. Among the 100 ecological household pasture farms, only four farms have dairy cattle as their main activity while the others are mainly engaged in mutton production with auxiliary dairy and beef cattle operations.

b). Combination between barn feeding and grazing

All local ecological household pasture farms have their own grasslands and cowsheds. Cows graze outdoors in the daytime but have semi-grazing and semi-barn feeding using concentrate feeds at night in seasons with rich grass. During years when water is abundant and grass thrives, they graze outdoors all day without receiving concentrate feeds. All the cows are barn fed during non-grazing periods (from September to 15-30 days before the grass sprouts the following spring).

c). Antiquated farming techniques and lack of scientific knowledge of feeding management

Cow feeding management for household pasture farms mainly relies on the herdsmen's many years of feeding experience and there is a lack of scientific feeding management knowledge. Most herdsmen have no nutritional knowledge of feed ingredients and fail to consider scientificity and rationality of feed mix, so their feeding management is relatively extensive.

d). Hand milking coexists with machine milking, causing a large potential risk to raw milk

In 2009, Hulunbeier People's Government issued the Implementation Plan for *Raw Milk Purchase Management in Hulunbeier* (HZZ [2009] No.76) to completely eliminate hand milking at the pasture farms and replace it with machine milking using milking parlors with auxiliary bucket milking machines by the end of December 2009. Subsequent years saw vigorous construction of standardized milk stations and bucket milking machines were provided to herdsmen and household pasture farms in remote regions. A total of 360 standardized raw milk collecting stations with machinery milking were built and equipped with 231 transport vehicles for transportation of raw milk. Almost every household pasture farm was equipped with a mechanical milker. But most local headsmen were used to traditional hand milking, while the labor supply is tight and is only increased by having to drive cows to milk stations. For that reason, only 50% of household pasture farms truly realized mechanical milking while the remainder continued to use traditional hand milking.

The problem with hand milking is that the raw milk is completely exposed to the external environment, disinfection cannot be guaranteed in the milking process and containers are not necessarily sanitary so that there is a large potential safety hazard. In addition, the fact that hand milking coexists with individual milk purchase almost becomes a major feature of Hulunbeier.

#### *Cow Breeds and Production Performance*

Cows raised on local household pasture farms mainly include Chinese Holstein, San-he cattle and dual-purpose Simmental, of which the largest proportion are Chinese Holstein, representing about 61.31% of total herds. Due to the extensive farming model of semi-grazing and semi-house feeding coupled with a lack of scientific feeding management, cows at household pasture farms generally have lower production performance. The Chinese Holstein cows can produce a yield of about 4 tons to 4.5 tons per year while San-he cattle and dual-purpose Simmental can produce only about 2 to 3.5 tons. As indicated by detection data from the local development and reform commission, milking cows at local small dairy and small-scale household pasture farms produced 4.3 tons on average in 2012.

#### *Feed Resources*

Local household pasture farms feed cows by allowing them to leisurely graze on fresh grass and supplement with concentrate feeds in the grazing season and with green hay and concentrate feeds in the non-grazing period. The concentrate feeds consist of purchased commercial concentrates, rapeseed meal and bean cakes. A portion of the hay is harvested from their own grasslands and the rest is purchased. With the development of household pasture farms, corn silage feeding technique was promoted and a number of silage pits were built on several local household pasture farms. Still, so far only about 12% of these have adopted corn silage feeding.

#### *Land Resources*

Local ecological household pasture farms are matched with grasslands or crop producing land, which can be used upon payment of an annual fee according to a contracting or land transfer system. Due to the diversification of livestock species, local government has no specific requirements for the ratio of the area of grasslands or forage land to the number of livestock. The current survey reveals that household pastures accommodating 400 to 500 sheep and 30 to 50 cattle generally have a grassland area of 1,600 mu to 2,000 mu, while those with 500 to 1000 sheep and 50 to 200 cows generally have a grassland area of 3,000 mu to 5,000 mu. Large farming households (more than 1,000 sheep and more than 200 cattle) have a grassland area of 5,000 mu to 10,000 mu.

#### *Labor Force Input*

Household pasture farms mainly rely on family members for livestock farming labor. They are responsible for the main production and operation activities of pastures, communication with milk stations or dairy enterprises as well as other relevant management issues. For this reason, household pasture farms with more than 50 cattle generally need to hire workers for feeding, milking and barn cleaning. In addition, they need to hire temporary workers for grazing during the grazing season at the price of 25 to 45 yuan/cattle/month. In the harvesting season, they need to hire temporary workers for harvesting and grass transport at the price of about 200 yuan/day/person. All 25 household pasture farms surveyed hired temporary seasonal workers, of which 17 hired workers for a long period with an average of 3.82 hired laborers/household (65/17).

Household pasture farms generally have no fixed technicians, such as vets and breeding staff, but mainly rely on social services (local animal husbandry stations, AI stations, etc.).

***Labor Force Education***

The sample survey data shows that family members, long-term employees and temporary employees of household pasture farms generally have a low level of education (*Figure 2.9*), with 62.13% having a primary level education level or below. The low education level of the labor force is a direct cause of the low capacity of learning and accepting scientific farming knowledge and new technology. This discourages a modern, standardized and scientific development of household pasture farms.

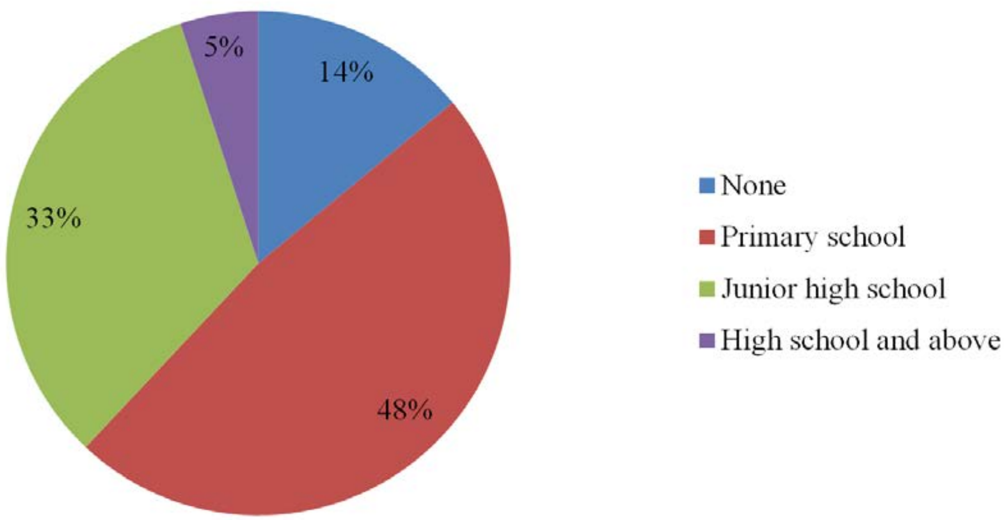



**Figure 2.9 Distribution of Labor Force Education Level among Household Pasture farms**

***Quality and Price Control of Raw Milk***

a). Quality control of raw milk

In Hulunbeier, there are a total of 26 dairy enterprises that have set up milk collection stations for purchasing raw milk, but only one dairy enterprise collects all raw milk from standard milk collection, appoints one person at the milk station for milking supervision and achieves 100% testing and sampling for each batch of fresh and raw milk while rejecting fresh and raw milk from hand milking. The dairy enterprise follows strict requirements for the quality of raw milk. Its purchase price is 0.2 to 0.4 yuan/kg higher than that of other dairy enterprises, but the purchased milk volume is very small. The other 25 dairy enterprises purchase raw milk by milking at the milking station, on-site purchase and other methods. They can also ensure 100% sampling detection, but the requirements for purchased raw milk are lower. They only need to ensure the milk contains no antibiotics, aflatoxin, melamine and other forbidden substances.

b). Price control of raw milk

Only one dairy enterprise has signed a long-term purchase contract with dairy farmers and milk stations and developed a negotiation mechanism for the raw milk purchase price to jointly determine price rises or declines with dairy farmers in Hulunbeier. The other dairy enterprises build one-off trading relationships with dairy farmers and milk stations and the purchase price of raw milk is generally decided by the dairy enterprises so that interests of dairy farmers cannot be guaranteed. Before January 2013, only the enterprise that had signed a long-term purchase contract with dairy farmers and milk stations adopted a purchase price of 2.86 yuan/kg for raw milk while the purchase price for the other dairy enterprises was below 2.4 yuan/kg, and there was even a minimum purchase price of 1 yuan/kg for raw milk in 2009 and 2010.

In Hulunbeier, dairy enterprises generally set raw milk purchase prices for household pasture farms of 0.3 to 0.5 yuan/kg below the local average price. In accordance with testing data from the local development and reform commission, small-scale household pasture farms had an average sales price of 2.99 yuan/kg for raw milk in May 2013, which was 7.72% lower than the local average purchase price for raw milk (3.24 yuan/kg) in the same period.

c). Operating Effect Analysis

Operating incomes of household pasture farms mainly depend on milk yield. *Table 2.11* shows the survey results of two household pasture farms with different yields but whereby the other conditions were the same (grassland occupancy, labor employment, etc.).

As shown from comparing the two samples above, the yield directly affected the incomes of the two household pasture farms under similar management conditions. It is worth noting that dairy farmers failed to consider their own labor costs in the income calculation. If personal labor costs are considered, dairy farming income would be very limited. For this reason, dairy farming of household pasture farms is a low-profit business.

**Table2.11 Comparative Analysis on Influence of Milk Production on Household Pasture Farm Incomes (2013)**

| Sample 1 | | Sample 2 | |
|---|---|---|---|
| Total dairy cattle number | 21 | Total dairy cattle number | 10 |
| Milking dairy cattle number | 18 | Milking dairy cattle number | 7 |
| Cow Breed | San-he | Cow Breed | Holstein |
| Average milk price | 3.58 | Average milk price | 3.65 |
| Yield of milking cow | 2,333 | Yield of milking cow | 3,591 |
| 1. Income (average) | 7,654 | 1. Income | 91,758 |
| Including: milk | 7,155 | Including: milk | 91,758 |
| Calves | 495 | Calves | |
| 2. Total feeding cost | 5,756 | 2. Total feeding cost | 6,035 |
| 2.1 Feed | 2,560 | 2.1 Feed | 2,657 |
| 2.2 Forage grass | 2,620 | 2.2 Forage grass | 2,485 |
| 2.3 Medical treatment | 6 | 2.3 Medical treatment | 4 |
| 2.4 Breeding | 80 | 2.4 Breeding | 60 |
| 2.5 Utilities | 70 | 2.5 Utilities | 50 |
| 2.6 Depreciation of fixed assets | 420 | 2.6 Depreciation of fixed assets | 779 |
| Including: houses | 340 | Including: houses | 480 |
| Equipment | 80 | Equipment | 299 |
| 3. Profits | 1,898 | 3. Profits | 3,140 |

### 2.4.3 Constraints for Development of Ecological Household Pasture Farm

***Insufficient investment and narrow financing channel***

Dairy farming requires high investments in infrastructure construction, machinery and purchase of dairy cattle and a large amount of early capital input, and dairy farming is subject to long-term operation and slow effects, so that many household pasture farms find it difficult to maintain daily operations due to a lack of working capital. It can be said that a capital shortage has become an important bottleneck restricting the development of household pasture farms. In the survey, many household pasture farms expressed their desire to expand their farming scale and purchase advanced facilities and improved breeds, but they cannot due to insufficient finances. Household pasture farms mainly have two financing channels in addition to self-financing by dairy farmers:

a). loans from rural credit cooperatives and a small number of commercial banks; loans from dairy processing enterprises. Generally, small enterprise loan amounts are too small to support extended reproduction of pastures;

b). loans from rural credit cooperatives and commercial banks charge high interests and have short repayment periods, putting significant pressure on the pasture operation.

***Difficult to tap into government support policies***

Household pasture farms generally hope to take advantage of capital support from the government to improve farming conditions and expand farming scale. But China's construction funds for large-scale farms can only be used for transformation and expansion of large-scale farms with more than 300 cows. Therefore, household pasture farms with 50 to 200 cows only can apply for general subsidies to purchase agricultural machinery, for breeding and disease prevention. Access to support from other policies or project funds is limited.

***Feeding Industry and Forage Production Base***

Most household pasture farms are short of land for producing forage that matches their farming scale, so they need to purchase a lot of their feed and forage grasses. In addition, a lack of matched crop farming land cause the manure treatment problems to the household pastures.

***Underdeveloped infrastructure construction and low mechanization level***

Some of household pasture farms have poor dairy barn facilities and a low level of specialization and standardization so they have a hard time meeting the requirements for cow health care and quality milk production. And while some household pasture farms meet the conditions for large-scale construction, standardized production and modern farming, they face modern production equipment mismatching and other problems.

***Low technical level and extensive production***

Household pasture farmers and laborers generally have low educations and the farms suffer from a shortage of full-time vet technicians, AI technicians and nutritionists. Dairy farming mainly relies on family members' experiences, accumulated over many years and on-site services of mobile technicians provided by local competent departments. This affects the acceptance and application of advanced concepts and techniques and thus constrains the vitality and vigor of the household pasture model. Some household pasture farms are relatively extensive in production and subject to the problems such as low feed quality, inadequate nutrition, low yields, weak risk resistance and poor milk production performance.

### 2.4.4 Support Policy System for Ecological Household Pasture farms

***To strengthen the financial subsidy***

A gradual adjustment of the direction and structure of subsidy funds is required along with effectively strengthening the guiding role of financial subsidy policy, incline livestock semen subsidy, animal epidemic prevention grant, machinery purchase subsidy and grassland ecology awards for ecological household pasture farms. This last must encourage the farms to develop cooperative dairy farming among household pasture farms to achieve unified services in the technical training, feed supply, health management, disease control, breeding, milking, sales and other aspects.

***To strengthen support for infrastructure construction***

The subsidy for standardized construction of dairy farming must be strengthened, there must be a focus on supporting transformation and expansion of standardized cow barns and the purchase of matched mechanical facilities, and the subsidy threshold must be lowered to give policy support to ecological household pasture farms with 50 to 200 cows.

***To coordinate planting land / pasture circulation***

Policy guidance and standardized rules and procedures for land (pasture) transfer must be strengthened to provide a favorable policy environment for composite feed base/pasture construction of ecological household pasture farms and to further expand facility land policies for household pasture farms engaged in dairy farming.

***To improve financial and insurance services***

An innovative new loan guaranteed mortgage method must be introduced whereby houses, dairy farms and insured cows are taken as the mortgage, the loan period is extended, loan amounts are improved, loan interest rates are reduced and financing channels are further increased. All this to encourage social capital for the construction of household pasture farms for the purpose of solving their financing difficulties as well as to carry out and improve policy insurance of dairy farming and the epidemic prevention mechanism to reduce farming risks.

***To strengthen staff skill training***

Targeted and complete technical guidance and service for dairy farming and for operators and employees of the ecological household pasture farms are needed so as to improve the professional quality and scientific and technological culture as well as promote advanced practical technologies for the improvement of economic benefits for pasture farms.

***To improve social service level***

Agricultural technology service agencies must be encouraged to develop the mechanical equipment suitable for household pasture farms, organize experienced dairy farming experts to constitute a technical service group for household pasture farms, and strengthen the support for stock breeding, feeding management, disease prevention and control as well as introduce and promote new varieties and technologies to provide household pasture farms with a full range of technical services and guidance.

## 2.5 SWOT ANALYSIS OF CHINA DAIRY FARMING INDUSTRY

***STRENGTHS***

**Large-scale intensive dairy farms**

S1: Beneficial economies of scale;

S2: High milk yield, high milk quality;

S3: To an extent, beneficial economies of scale;

S4: Guaranteed raw milk quality.

**Small-scale household dairy farms**

S1: Utilization of rural labors, a road to wealth and prosperity;

S2: Utilization of a large amount of rural surplus roughages;

S3: Composting small-scale manure to produce organic fertilizer;

S4: Potential to transform into family farms.

***OPPORTUNITIES***

**Large-scale intensive dairy farms and cooperative dairy farms**

O1: They have gained national attention. Dairy development has the priority for support, and each province has its corresponding financial support policies;

O2: Due to raw milk shortage in 2013, strengthening the construction of the milk production base is a priority development direction for milk processing enterprises;

O3: Two-child policy, accelerated urbanization and China's economic development will create a significant increase in milk needs;

O4: Transforming and upgrading cooperative dairy farms is the priority direction of China's dairy provincial governments and milk processing enterprises;

O5: Land transfer policy will ensure land from large dairy farms is used to develop combinations of crop planting and rearing.

**Small-scale household dairy farms**

O1: National policies in support of family farms will promote the transformation of small-scale household dairy farms to family dairy farms;

O2: Development of a variety of farms businesses, including dairy and beef.

***WEAKNESSES***

**Large-scale intensive dairy farms**

W1: Difficult or impossible to match land resources to large number of dairy cows;

W2: Have to purchase whole plant corn from farmers around the large-scale dairy farms to meet the corn silage requirement for dairy cows. Inability to control the harvest time of corn so a large variation in whole corn silage results.

W3: Problems of environmental pollution and manure processing and using existing land due to a lack of farmland;

W4: Risk of spread of epidemic diseases due to high rearing density.

**Cooperative dairy farms**

W1: Cows are farmed in a centralized manner, and there are too many individual farmers in one community, each with a small number of cattle on stalk fields. Farmers feed their own cows. Cows are milked and milk is sold based on united farms. It is impossible to group feed cows;

W2: Low quality of roughage. Utilization rate of whole plant corn silage is lower than 30%. A large number of low-quality yellow silage and corn stalk is used;

W3: No fixed place to store manure. Problems with environmental hygiene;

W4: Farmers are poorly educated and 80% have education levels below junior college.

**Small-scale household dairy farms**

W1: Low individual milk yield, and low procurement price of raw milk;

W2: Low business benefits;

W3: No attention to breeding and strain selection, lacking of pedigree and necessary technical materials;

W4: Fewer opportunities for support from the government and others sources.

***THREAT***

T1: Dairy farming costs are rising and profits are falling;

T2: High morbidity and short life time of dairy cattle;

T3: Separation of planting and rearing on dairy farms. Low absorptive capacity of manure;

T4: Dairy products import tariff reduction. China’s dairy industry will be facing fierce competition from foreign dairy companies.

# CHAPTER 3
# CHINA'S RAW MILK QUALITY CONTROL SYSTEM

In order to ensure food safety and improve the level of cattle breeding, China has promulgated a series of standards and regulations in recent years to create a norm for the quality standards of raw milk, and to strengthen the supervision and management of the various production processes for raw milk. Dairy companies have also developed comprehensive quality standards for the acquisition of raw milk, and improved the raw milk pricing system on the basis of national standards. At the same time, dairy farms (households) are gradually improving their raw milk quality control system.

## 3.1 THE QUALITY STANDARDS OF RAW MILK IN CHINA

### 3.1.1 National Standard

Currently, China has more than 100 standards introduced by national or industry-based competent authorities, aimed at a sound quality management standard system for raw milk. To regulate the indicators of raw milk quality, China adopted and endorsed the "*raw milk*" (GB19301-2010) standards in 2010 based on the situation in China's dairy industry at that time. Indicators of "*raw milk*" quality are mainly sensory requirements, physical, chemical indicators and health indicators.

The milk protein, bacteria and other indicators in the new national standard are all lower than the standard requirements issued in 1986 and do not require a somatic cell limit. There is no uniform grading system for the quality of raw milk or competitive pricing system. The key indicator is also far lower compared to developed dairy countries. The new "raw milk" national standard caused widespread debate and controversy in the dairy industry and domestic media. However, the national standard is based on the status quo that China dairy industry was dominated by small household dairy farms and came in response to the melamine scandal in 2008. With the development of large scale intensive dairy farms and significantly improving of raw milk quality and safety levels, it is necessary to consider the revising the standard.

### 3.1.2 The Enterprise Standard of Raw Milk in China

In order to improve food safety assurance, large dairy companies have developed a series of enterprise standards for raw milk according to both enterprise development and needs based on national standards. These regulate raw milk production and acquisition activities at multiple levels. The enterprise set up raw milk test standards including alcohol positive milk, thermal stability, anti-agent solution, aflatoxin, adulteration and other relevant physical, chemical and health indicators, in addition to conventional milk components. At the same time, the relevant physical, chemical and health indicators of enterprise standards were higher than the national standards. For example, the milk protein content is generally 5% to 10% higher than national standard. Some dairy companies also provide indictors of somatic cell counts as one of the main factors to determine the raw milk price. For instance, Shanghai Bright Dairy Group requires a somatic cell count below 400,000 / mL, imposing a fine if levels exceed the standard and issuing a reward for 0.1 yuan per kilogram lower than the standard.

Local governments have different policies governing the dairy industry and have introduced their own raw milk standards suitable to their respective regions. For example, Tianjin passed "*Breeding management technical specifications of cattle producing quality raw milk* "(DB12/T 423-2010) in 2010, as a local standard for raw milk.

## 3.2 RAW MILK PRICING SYSTEM IN DIFFERENT BREEDING PATTERNS OF CHINA

China's acquisition and testing system for raw milk is gradually integrating with the international structure. Our raw milk pricing system is based on "*the acquisition of raw milk standards*" that was established in June 2010. At present, China's raw milk pricing system is divided into a competitive system and a minimum purchase price protection system. The competitive pricing system is determined by dairy companies though testing the indicators of raw milk. On the basis of a fixed basis price, taking milk fat and protein content as a benchmark, achieving bacteria and somatic cell counts as a grading reward system, factors such as the freezing point, nitrite, aflatoxin, antibiotic residues and other indicators are examined. The minimum purchase price protection system is determined by dairy companies, governments, farmers' cooperatives and price departments that develop the minimum purchase price for raw milk by adding cost and reasonable profit. This price is then regularly fine-tuned. The minimum purchase price varies widely among the different areas, and is generally higher in south China – including Shanghai, Guangzhou and other areas – compared to northern areas like Inner Mongolia and Heilongjiang.

Each dairy company has developed a detailed ladder price adjustment system on the basis of the minimum purchase price. According to the daily delivery of milk, degree of farm standardization and raw milk quality, companies establish different pricing systems based on large-scale intensive dairy farms, cooperative dairy farms and small-scale household dairy farms. Meanwhile, factors such as season and climate can also somewhat affect the price of raw milk. In contrast to south China, the price of raw milk in northern China is higher in the winter and spring while in the south it is higher in summer and autumn.

### 3.2.1 Raw Milk Pricing System in Large-Scale Intensive Dairy Farms

The quality of raw milk from large-scale intensive dairy farms generally exceeds the national standards due to their high feeding level. Large-scale intensive dairy farms have begun to implement a competitive price system. Dairy companies have developed detailed, workable acquisition grading standards for raw milk. In some areas, the government implements a daily detection mechanism by third-party testing organizations. In Shanghai, dairy farms will get awarded by dairy processing company if somatic cell counts are less than 400,000/mL according the detailed incentives and penalties policy. Some huge large-scale intensive dairy farms have more say in establishing the selling price of raw milk. They can get higher basis prices than smaller large-scale cattle farms after negotiating with the dairy companies. For example, the raw milk price was 5.8 yuan/kg for Modern Farming Inc. in the winter of 2013, while average price for a small large-scale farm was 5.0 yuan/kg.

### 3.2.2 Raw Milk Pricing System for Cooperative Dairy Farms

The milk quality at cooperating dairy farms cannot match that of large-scale intensive dairy farms, in the areas of physical, chemical and health indicators, due to inferior feeding and management. Raw milk prices for cooperative dairy farms suffer from "price discrimination" by dairy companies and the basis prices are generally 10% to 20% lower than for large-scale intensive dairy farms. While the rewards and punishments policy is similar, the lower base price results in a lower selling price of the same quality of raw milk from cooperative dairy farms.

### 3.2.3 Raw Milk Pricing System in Small-Scale Household Dairy Farms

The small-scale household dairy farm structure cannot effectively control feeding and management, disease prevention, milking hygiene and other rearing processes, which leads to relatively lower raw milk quality in the areas of physical, chemical and health indicators. At the same time, the hand milking used widely in rural areas has already been replaced by station milking machines, which has largely improved the raw milk quality. The farmers first sell the raw milk to milk stations, while these sell the milk to dairy companies. This results in even more serious "price discrimination", whereby the basis of the raw milk price is about 10% lower for cooperative dairy farms. Farmers in some areas simply sell the raw milk at the minimum purchase price.

## 3.3 RAW MILK QUALITY CONTROL SYSTEM FOR DIFFERENT BREEDING PATTERNS IN CHINA

In recent years, China introduced a series of policies, laws and regulations, including the "Milk consolidation and revitalization plan", "National Dairy Development Plan (2009 - 2013)" and "dairy quality and safety supervision and management regulations", among others, to safeguard the quality and safety of raw milk. These policies proposed the establishment of a milk quality standard system, strengthening the raw milk quality monitoring system, improving the dairy inspection system, establishing a product quality traceability system, improving the quality and safety management level of dairy enterprises, strengthening the regulation of milk stations and milk transport vehicles. The introduction of these policies plays a positive role in the security the quality control system for raw milk for different cow breeding patterns.

At present, there are three major farming systems in China's dairy industry. Due to the different forms of production organization and production levels, there are obvious differences in the control of raw milk quality. Overall, the raw milk quality and control measures are better at large-scale intensive dairy farms than cooperative dairy farms, and both of these are better than at small-scale household dairy farms.

### 3.3.1 Raw Milk Quality Control at Large-scale Intensive Dairy Farms

Large-scale intensive dairy farms have good conditions in place in every each area of cattle feeding, including farm design, reproduction and breeding, supplying high-quality forages, feeding and management, disease prevention, application of new equipment and generally trained workers. Standardized construction and the establishment of a production process standard enables the large-scale farms to achieve a high level of farm management including breeding, raw milk production processes and raw milk sales cycle, leading to a high level of raw milk quality that exceeds the national standard requirement. Some of the larger large-scale intensive dairy farms will test the quality of raw milk themselves before transport to ensure its quality before it leaves the farm. All this means that the large-scale intensive dairy farms have a complete raw milk quality control system. In some large large-scale farms, raw milk goes directly into processing after milking without cold chain transport links, which reduces the risk of raw milk transport issues. In order to further ensure and improve the quality of raw milk, large-scale intensive dairy farms are paying more attention to cow welfare, strengthening milking hygiene, mastitis prevention and controlling infectious diseases.

### 3.3.2 Raw Milk Quality Control in Cooperative Dairy Farms

Cooperative dairy farms have adopted centralized breeding, unified milking and a unified prevention system, which improves the health security of raw milk in production processes and eliminates adulterated retail behavior. Some cooperative dairy farms implement the group feeding and TMR technology. It is controlled in dairy rearing and the raw milk production process at cooperative dairy farms. At the same time, there is strict supervision when raw milk is sold, at the milk station and during transport, ensuring the quality of raw milk basically meets the requirements. In order to further ensure and improve the quality of raw milk, the cooperative dairy farms are mainly focused on strengthening feeding and management, ensuring the supply of high-quality forage, improving the quality of employees and increasing dairy technical input.

**Table 3.1 Comparing the quality of raw milk under different farming systems**

| | Fat(%) | Protein(%) | Somatic Cell Count($10^4$/mL) |
|---|---|---|---|
| **Large-scale intensive dairy farm** | 3.62 | 2.94 | 28 |
| **Cooperative dairy farms** | 3.46 | 2.95 | 50 |
| **Small-scale household dairy farm** | 3.29 | 2.89 | |

**Source: Li Shengli, "Chinese raw milk Investigation Report" China Dairy, 2008**

### 3.3.3 Raw Milk Quality Control at Small-scale Household Dairy Farms

In the past, small-scale household dairy farms were the main dairy industry model. However, the poor quality of feed, low level of feeding technology, non-compliance of raw milk production and preservation lead to poor raw milk quality which cannot match that of the large-scale intensive dairy farms and cooperative dairy farms. This was the major reason that the national standard requirement of raw milk quality in China was low. The raw milk quality control mechanisms are now gradually improving in family feeding systems. The original method of hand milking has been basically eliminated, replaced by milking parlors at milk stations. This prevents adulterated retail behavior and, to a certain extent, ensures the safety of raw milk. Milk stations retain samples of raw milk from the famers, greatly reducing the levels of antibiotics, mycotoxins and other residues. Due to the fact that small-scale household dairy farms combine dairy activities with cultivation, they have a better feeding environment and dairy welfare. This has a somewhat positive influence on the quality of raw milk. But small-scale household dairy farms are relatively backward in their use of roughage, feeding technology, raw milk production and other processes, with a great deal of room for improvement.

## 3.4 TRENDS IN RAW MILK QUALITY CONTROL SYSTEMS IN CHINA

The quality of raw milk is improving gradually thanks to strengthened raw milk production supervision by the government, the transformation of dairy farming and strict management of dairy enterprises. China's raw milk quality control system will be more robust and mature in the future. It will achieve further development in the areas of policy, supervision, raw milk production, third-party testing systems and other aspects.

### 3.4.1 Policy of Continuous Improvement, Strengthening of Raw Milk Supervision

The government gradually introduced a series of policies after 2008 to rectify and comprehensively standardize milk production, acquisition, processing, marketing and other aspects. It also completed dairy quality standards and established a dairy quality and safety supervision system. And the policies and regulations will continue to be expanded in the future. Currently, government agencies are working to develop "substandard raw milk processing norms", which will regulate the process of detecting substandard milk including milk with excessive levels of antibiotics, toxic and hazardous milk, and milk which surpasses microbiological levels as well as unqualified physical and chemical indicators. This will further promote the improvement of the raw milk quality control system.

China began implementing a national raw milk quality and safety monitoring plan in 2009, and conducted 77,000 monitoring inspections through mid-2013. But the monitoring frequency of regulatory targets (milk stations and transport trucks) is still low. The sampling frequency for each milk station was only 0.3 percent throughout the year, and still has higher quality and safety hazards. In addition, China initially established a provincial Ministry of raw milk quality and a safety inspection system, which it plans to gradually extend to cities and villages, will gradually improve the capacity of quality and safety monitoring. In future, the increase in funding, monitoring technology, facilities and other aspects will increase the monitoring capacity, expand the scope of sampling, improve the sampling frequency and accelerate the establishment of a raw milk quality and safety risk early warning system.

### 3.4.2 Further Improving the Quality and Safety of Raw Milk

Developments in the dairy industry in all advanced countries and regionally has proven that expanding large-scale intensive dairy farming, improving breeding and rearing technologies, using mechanized production, improving cow productivity and labor productivity and strengthening standardized breeding are the path to develope the dairy industry. This is also China's approach to developing its dairy industry. With improvements in dairy breeding levels and higher proportions of large-scale intensive dairy farms, China will improve raw milk quality from dairy breeds, feed materials, feeding and management, cow health, cow welfare, the milking process, milk storage and transportation links, thus further reducing the chance of raw milk security risks.

### 3.4.3 Exploring the Establishment of a Third-Party Raw Milk Quality Detection Mechanism

Experience from the dairy industry in developed countries shows that the third-party testing agency plays a key role in competitive pricing systems. Third-party testing agencies are independent of the dairy farmers and dairy processing enterprises, they are accredited and assessed by the government, and recognized by farmers and processing enterprises. The third-party testing agencies will inspect each batch of raw milk before it is sold. Milk prices play a major role in dairy farming income, so the implementation of a fair competitive price and exploring the third-party testing mechanism will not only protect the interests of dairy farmers, but also improve awareness of quality and safety among dairy farmers. The third-party testing mechanism would therefore be to a major step towards improving the safety and quality of raw milk. Shanghai was the first to implement the third-party testing agency system in China and established the Shanghai Dairy Quality Supervision and Inspection Station. Under the mechanism, each batch of raw milk is sampled, and the results affect the purchase price. This preliminary exploration and accumulation of experience will help China establish a third-party testing agency system.

### 3.4.4 Establishment of Traceability System for Liquid Milk

A dairy traceability system could effectively identify the cause of any problems, and trace them back to the source of the liquid milk, playing an important role in monitoring and feedback in raw milk quality control. Currently, many countries, particularly those in Europe as well as the United States, have already started to build a liquid milk traceability system. Some multinational dairy companies have made great efforts to explore dairy retrospective systems and have achieved some success. A number of individual companies have reached 100% traceability capability, and can track any marketed defective products to the cow causing the problems, or trace the defective products back to the place of production within a few minutes. The government clarified the traceability definitions and requirements in 2005, so establishment of a liquid milk product traceability system is the basis of dairy industry quality certification system. This is a requirement for promoting the modernization of the dairy industry, improving the quality and safety of dairy products and will also be an important step towards a raw milk quality control system.

### 3.4.5 Strengthen Supervision of Infant Milk Powder

The quality and safety of infant formula milk powder is not only a matter of life and death issue, but also a major economic and social problem. In recent years, China has established a series of policies to ensure the safety of infant formula powder. In 2013, nine ministries jointly issued a notification on strengthening quality supervision of infant formula powder, bringing supervision of the quality of infant formula milk powder to a new level. The notification increased the requirements for raw milk production, purchase, transportation, and processing sectors, strengthened the supervision of all aspects of raw milk production, introduced a social supervision mechanism and increased punishments for illegal activities. Supervision of infant milk powder plays a positive role in the further development of the dairy industry and the improvement of raw milk quality.

**Table 3.2 SWOT analysis of raw milk quality control system in China**

| |
|---|
| ***STRENGTHS*** |
| **S1**: Dairy processing companies have established laboratories that can detect raw milk quality (physical indicators, health indicators, heavy metals, antibiotics, toxins and pesticides); |
| **S2**: Development of large-scale intensive dairy farms; |
| **S3**: Improvement of the third-party testing system, increasing support for construction of raw milk testing laboratories and DHI center; |
| **S4**: Improvement of supervision and testing levels, expansion of regulatory scope; |
| **S5**: Education on melamine incident in dairy industry. |
| ***OPPORTUNITIES*** |
| **O1:** Constant perfection of laws and policies; |
| **O2:** Introduction of infant milk powder regulatory policies; |
| **O3:** High media attention on the dairy industry; |
| **O4:** Increasing policy and financial support for the construction of milk source base. |
| ***WEAKNESSES*** |
| **W1:** Uneven levels of dairy breeding technology; |
| **W2:** Protein content (2.8%) of state acquisition standard for raw milk is lower than international standards, the total number of bacteria (2,000,000) is much higher than international standards; |
| **W3:** Lack of raw milk pricing system linked with somatic cell count except at individual dairy companies; |
| **W4:** Low detection frequency at single target and hard to cover all; |
| **W5:** Relatively low quality of employees. |
| ***THREATS*** |
| **T1:** Cattle diseases (metabolic disease, foot disease, mastitis, etc.), prevention and control of major infectious diseases; |
| **T2:** Threat of high-quality imported dairy products. |

# CHAPTER 4
# ANALYSIS OF CHINESE DAIRY POLICY

## 4.1 DAIRY POLICYMAKERS AND IMPLEMENTERS IN CHINA

Policy is about "the guidelines for action, developed to achieved route in a certain historical period", according to Woodrow Wilson. Policy is a set of laws and regulations enacted by politicians (namely those who have legislative power), and performed by administrative staff. Central government (CPC and central government) play an essential role in the development and implementation of policy in China. The 18th CPC National Congress emphasized that "the maintenance of central authority is fundamental to guarantee the solution of problems of imbalances in economic and social development, as well as to achieve social progress.'

For years now, dairy products have drawn much attention from high-level policymakers. In 1958, Chairman Mao Zedong mandated the "development of dairy production to increase fresh milk and dairy product supply". Ex-President Hu Jintao once proposed that "Milk is the healthy food choice as we enter into era of a moderately prosperous society, not only for infants and the aged, but most importantly for primary and secondary students. It is essential for enhancing the physical fitness of the entire Chinese nation." And more recently, Premier Wen Jiabao said that "I had a dream, that every Chinese person would be able to have 1 liter of fresh milk per day, especially the children." On 28 January 2014, when President Xi Jinping visited the Yili fresh milk producing location, he asserted that "food safety should be highly valued". The reasons why dairy products catch the attention of policymakers are:

a). dairy products are beneficial to the fitness of consumers;

b). dairy farming helps increase the income of farmers;

c). the safety of dairy products has attracted a lot of attention from society at home and abroad.

In China, policymakers and implementers include: the State Council, the National Development and Reform Commission, the Ministry of Finance, the Ministry of Agriculture, the Ministry of Information & Industry, the Ministry of Commerce, the State Food and Drug Administration, the State Administration of Industry and Commerce and local government departments at all levels.

## 4.2 DIFFERENT DAIRY POLICIES IN CHINA

There are generally three types of dairy policy in China: (1) supportive policy, (2) restrictive policy and (3) punishment policy, respectively.

### 4.2.1 Supportive Policy

The function of supportive policy is to encourage enterprises and individuals to move closer to a specified target, or to make efforts to achieve specified goal. There are various approaches taken by both central and local governments in using supportive policy: a) fund support; b) land concessions; c) other preferential policies.

***a). Fund support.*** From 2008 to 2011, the central government invested 1.7 billion yuan to promote a standardized and scaled dairy farming model, which subsidized 2,474 (community) dairy farms.

***b). Land concessions.*** In the dairy sector, land concessions are available during certain periods, namely when a dairy farming community is being constructed, a dairy product processing factory is being expanded, and so on.

***c). Other preferential policies.*** Tax deduction and preferences are commonly used policies.

### 4.2.2 Restrictive Policy

Restrictive policy is basically implemented to avoid the phenomena or trends which run contrary to the orientation of policy. For example, after the melamine issue, the government introduced restrictive policy for fresh milk collecting stations to increase the safety of dairy products.

### 4.2.3 Punishment Policy

Punishment policy is mainly targeted at violations of corporates or individuals. For example, to punish illegal or criminal acts in the dairy production sector, the State Council implemented *Circular*, stating that the aim was "to strengthen the interface of administrative law enforcement and criminal justice, and severely punish those illegal and criminal acts regarding dairy products."

## 4.3 DAIRY POLICY ADVANCING WITH TIMES

### 4.3.1 Early Stages of Dairy Policy (1949 - end of 1990s)

In 1962, in the aftermath of the civil war, in order to guarantee the milk supply to children, senior citizens and the ill, the State Council allocated 20 million yuan and the Ministry of Land Reclamation as well as Beijing Municipality allocated 10 million yuan to support the agri-farming industry of Beijing. This initiative led to the construction of more than 40 dairy farms to address the city's insufficient milk supply.

In the 1980s, the government began efforts to improve the food structure. In 1980, the State Council mentioned in the policy approval that: "we should speed up the development of the livestock industry, improve the proportion of animal husbandry in agriculture and increase the proportion of eggs, meat and dairy products in the food supply." In 1983, the central government proposed a target of "achieving 70% self-sufficiency of milk supply in medium-sized and large cities." Then, after 1992, the subsidy was cancelled and the price of milk was fully liberalized.

### 4.3.2 Dairy Policy from 2000 to 2007

The challenges to the Chinese dairy industry are: (1) the increment speed of raw milk supply is not in line with that of dairy product demand; (2) the annual yield per cow is low (average yield is less than 3,000 kg per cow per year; (3) while many dairy processing companies emerged, most are small scale (more than 15,000 processing companies, but processing capacity of most companies is less than 50 tons per day); (4) integration of upper and lower levels of dairy supply chain is low, relationship between dairy farmers and dairy processing companies is not aimed at long-term mutual-benefit, but simple trading relations; (5) worries about WTO accession of China, which raises the question of the potential effect of WTO accession on China's dairy industry.

In light of the above, China's dairy policies mainly focus on the following topics:

***Optimized dairy production structure***

The purpose of this policy is to take full advantage of local resources and market demand, thus increasing the supply of dairy products.

In 2002, the Animal Husbandry and Veterinary Bureau of MoA formulated *Prior area development planning of dairy industry*, based on national dairy production, resources distribution, dairy processing, market consumption and other factors.

*The Tenth Five-year Plan and 2015 Forecasting Planning for Livestock industry* was adopted in 2002.

In September of 2007, the State Council proposed in its *Comment on enhancing a healthy and sustainable development of dairy industry*, that policymakers start emphasizing a "reasonable allocation of resources".

***Dairy farming model***

From 2000 to 2007, relevant government policies on promoting dairy industry development could be classified according to two periods of analysis: the first stage involves encouraging individual farmers to raise cattle, and second stage involves optimizing the dairy farm model and encouraging the establishment of a dairy farming community and scaled farming.

It was clear at the dawn of the 21st century that the quantity of cattle was insufficient. The central government (the State Council) proposed to "support dairy base construction and adjust dairy herd structure, as well as enhance the foundation of the dairy industry". Ministry of Agriculture also proposed "actively seeking funding from government departments, especially from financial departments, and seeking credit support from financial sectors for dairy development to provide dairy farmers with long-term, low-interest or no-interest loans." Some dairy processing companies "provide loans or guarantees" to farmers who purchase dairy cattle.

With the support of policy and from companies, the small-scale family-based dairy farm model was formed. In 2002, the average number of dairy cattle owned per household was 3-5 heads.

After entering into 21st century, the significant increase in the scale of dairy farming led to a shift in the central government's dairy policy to "scaled farming" and "standardized farming". At the end of 2005, the Minister of MoA – Mr. DU Qinglin – said the policy was to "enhance the scaled development of the dairy farming community, and promote standardization of a livestock demo base."

Some local governments provide financial subsidies to encourage famers to expand their scale. In 2007, the State Council began working on gradually solving the small-scale and scattered farming problem. In 2007, the MoA stated that, "until 2012, the proportion of scaled dairy farming in the dairy industry was estimated to be 50%."

***Dairy Genetic Improvement***

Another huge challenge to China's dairy industry is the low yield level of milk, which is 3,000 kg per cow per year. The major reasons for this are: a) the quality of the Holstein dairy cattle is not good enough; b) the proportion of crossbreed of Holstein and local scalper is also substantial. To optimize the dairy herd, at the beginning of the 21st century, MoA proposed that "we should make full use of quality genetic resources at home and abroad, to establish a provenance production base, and meet the demands of speedy development of the dairy industry." At the same time, the MoA's Bureau of Reclamation stated that the aim was "to put emphasis on the fundamental construction of the dairy breeding system, including the dairy breeding centers in Beijing and Shanghai and their supporting embryo transplanting sites." In 2001, MoA proposed in the *Comment on speeding up the development of livestock industry*, that "we should positively import quality species from abroad, to improve the breeding level and quality of livestock products."

In 2006, the Ministry of Science and Technology considered "enhancing dairy genetic improvement and breeding system establishment, and speeding up the cultivation of China's own dairy breeding species" as the main trend and emphasis of the "eleventh five-year planning on dairy development".

In 2005, the MoA began providing subsidies for 675,000 dairy cattle in 15 counties of Heilongjiang, Hebei, Inner Mongolia and Shanxi Provinces, in the form of two doses of frozen semen (price: 10 yuan/dose) for each female cattle.

***Dairy processing company***

At the beginning of the 21st century, Chinese local dairy processing companies were "small-scale and low-technology". "Within the 1,500 dairy processing companies, the processing capacity of most is less than 50 tons per day".

The general Office of the State Council thus proposed "to support several large dairy processing enterprises or groups, with driving effect nationwide" and to "strengthen support for dairy development". *The tenth five-year planning 2015 and Forecasting Planning on livestock industry* proposed "to build and expand 20 dairy processing companies with the capacity of processing 200 tons of fresh milk per day, and 10 dairy processing companies with the capacity of processing 500 tons of fresh milk per day". From 2001-2005, the total investment for this project was 17.5 billion yuan.

***Food safety***

The government has gradually realized the significance of food safety. *The comment on speeding up the development of livestock industry* issued by MoA mentioned the focus would to be to "establish a feed safety guarantee system", "carry out inspection and supervision of feed quality, and severely punish the violations related to abuse of illicit drugs as well as feed additives."

### 4.3.3 Dairy Policy from 2008 - 2012

The dairy product pollution issue turned out to be a significant food safety matter in 2008. CCP and the State Council attached high importance to food safety. The General Secretary (Mr. HU Jintao) and Premier (Mr. Wen Jiabao) made several comments on and references to this issue. The melamine event directly affected dairy policymaking and execution.

***Food safety***

Following the melamine scandal involving infant formula in 2008, on 20th September the State Council issued *the Circular on How to Deal with the Infant Formula Event*. The Circular required a thorough inspection of the dairy products industry to guarantee the quality and safety of dairy products, and severely penalize those who are responsible for violations."

On 7 November 2008, the Development and Reform Commission, the Ministry of Agriculture, the Ministry of Commerce, the Ministry of Health, the AQSIQ, the Ministry of Industry and Commerce, the PBOC, the China Banking Regulatory Commission, the China Insurance Regulatory Commission, the Central Propaganda Department and the Supervision Bureau jointly issued *the Outline of Planning on Consolidation and Revitalization of the Dairy Industry*. The Outline states that "the fact that this event happened reflects the long-term contradictions in the dairy industry of China: 1) imbalance in attention to quality and quantity in dairy production; 2) lack of inspection of fresh milk and dairy products. 3) enterprises lack social responsibility; 4) lack of inspection of milk collection stations; 5) dairy farming model lags behind."

On 6 October 2009, the 28th meeting of the State Council passed *the Regulation on Dairy Quality and Safety Supervision and Management*. The Regulation stated that "Dairy farmers, fresh milk purchasers, dairy product producers and sales companies should be responsible for the quality of dairy products from production, purchase, transportation to sale, and they should be the first responsible parties for dairy product quality." And "local government should take overall responsibility for the dairy product quality in its administrative areas"; "the responsible government leadership should be penalized if serious problems or significant harm is caused."

On 11 April, the MoA promulgated *the Regulation on Punishment of Violations in Dairy Farming and Fresh Milk Purchase Sectors*, and clarified punishment and penalty regulations.

***Dairy farming model***

After the melamine event in 2008, the government considered standardized and scaled farming as an effective practice to avoid future food safety events, because it is impossible to effectively supervise tens of thousands of dairy farmers. Therefore, the policy began to lead the dairy industry to standardization. An important document entitled *Planning on Consolidation and Revitalization of The Dairy Industry* introduced in November 2008 proposed, until end of October 2011, "promoting the standardization and integration of the dairy industry", "increasing the proportion of the scaled dairy farming community (with more than 100 cattle) from 20% to 30%."

The CCP and State Council paid high attention to the scaled and standardized farming in the dairy industry. In 2010, *the Central Document No. 1* further emphasized the importance of speeding up the large-scale and standardized farming of livestock and aquaculture, and supporting the establishment of "a large-scale dairy farm (community)". The subsidy standard in 2010 was: 500,000 yuan for dairy farms with 0-499 heads of cattle; 1 million yuan for dairy farms with 500-999 head of cattle and 1.5 million yuan for dairy farms with more than 1,000 heads of cattle. In 2011, the subsidy was increased to: 800,000 yuan for dairy farms with 300-499 heads of cattle; 1.3 million yuan for dairy farms with 500-999 head of cattle and 1.7 million yuan for dairy farms with more than 1,000 heads of cattle. With strong support from the central government, the proportion of large-scale dairy farms nationwide reached 28% at the end of 2010.

In 2012, MoA stated it would "accelerate the construction of high-standard demonstration farms", "and thus enhance the overall level of the livestock and poultry industry of China."

***Dairy genetic improvement***

In 2008, the MoA proposed the following requirements for dairy genetic improvement: "the overall target for dairy genetic improvement is to increase the average yield of dairy cattle in priority areas to 7,000 kg per cow per year, and increase the yield of dairy cattle in other areas by 500 kg per cow per year; meanwhile, to gradually develop genetic improvement technology in line with international standards." Requirements of the policy are: a) individual production performance test; b) register quality breeding cattle, through individual genetic evaluation and body type identification; c) organize joint progeny testing on young cattle, breed quality by breeding bulls through genetic evaluation, and thus promoting genetic improvement. The MoA stated the necessity of "speeding up the systematic reform of state-owned bull stations, and developing several bull stations with strong capability." The subsidy for quality cattle breeding was increased to 240 million yuan in 2008.

On 27 August 2011, Premier Wen Jiabao proposed that, "I have a dream, that a country with a population of 1.3 billion should breed its own dairy species." Breeding China's own high-yield dairy species will be the target supported by policy over the next several years.

***Dairy processing company support and restriction***

After the melamine event in 2008, the orientation of policy mainly focused on making the needed improvements at dairy processing enterprises, closing a group of small-scale companies with low management capacity and speeding up the concentration of dairy processing productivity. The policy was strictly focused on the "investment behavior" in dairy industry, with strict requirements for the expansion of existing dairy processing companies.

*The Outline of Planning on Consolidation and Revitalization of the Dairy Industry"*, jointly developed by the NDRC and other departments, proposed that "the infant formula event reflects the long-term contradictions in the dairy industry of China: imbalanced attention to quantity versus quality in dairy production; lack of inspection of fresh milk and dairy products." It also stated that "enterprises lack social responsibility." To solve this problem, the Outline required "establishing a strict quality management system for dairy processing companies, and all the companies should implement *Good Practice for Dairy Processing Company* (GB12693) and the HACCP system." The Outline also required the Ministry of Industry and Commerce to make the necessary improvements in the dairy industry within six months, to close those companies which could not meet the requirements, and shut down any illegal business." And meanwhile, there would be "support for the loan requests of dairy processing companies with good faith businesses."

In 2009, the Ministry of Industry and Commerce introduced *the Industrial Policy for Dairy Processing Industry* (revised in 2009) and regulated details on the new construction and expansion of dairy processing companies. As for industrial layout, the Industrial Policy determined that in the Northeast China and Inner Mongolia production areas, "the priority is milk powder, dry cheese, cream and UHT milk". In the Northern China industrial area, "the priority is milk powder, dry cheese, UHT milk, pasteurized milk, and yogurt." In the Northwestern China Industrial area, "priority should be milk powder, dry cheese, cream and casein, which are suitable for long-distance transport," and to "properly control construction of processing projects, encourage the development of dairy products with local characteristics." In the Southern China industrial area, "the priority should be pasteurized milk, dry cheese and yogurt." In suburban areas surrounding large cities, the "priority should be pasteurized milk, yogurt." It also states that "the raw milk processing capability of newly-constructed or expanded milk powder projects should be more than 300 tons per day, while that of newly-constructed or expanded fresh milk projects should be more than 500 tons per day," and "newly-constructed or expanded milk processing projects should have stable and controllable dairy bases, the yield of which should be able to meet more than 40% of demand."

***Optimize district layout***

*The National Dairy Development Planning* proposed "five dairy producing areas" as a priority for development. 1) The Northeast China and Inner Mongolia dairy development priority area, including the four provinces of Heilongjiang, Jilin, Liaoning and Inner Mongolia; targets are to "develop large dairy family farms, a large-scale farming community, and significantly develop medium-sized dairy farms." 2) The Northern China dairy development priority area, including the four provinces of Hebei, Henan, Shandong and Shanxi; target is to develop "large-scale dairy farms". 3) The Western China dairy development priority area, including six the provinces and districts of Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang and Tibet; target is to develop large-scale dairy farms (and communities). 4) The Southern China dairy development priority area, which includes the 13 provinces of Hubei, Hunan, Jiangsu, Zhejiang, Fujian, Anhui, Jiangxi, Guangdong, Guangxi, Hainan, Yunnan, Guizhou and Sichuan; target is to develop medium-sized dairy farms. 5) The suburban areas surrounding large cities, including the four municipalities of Beijing, Tianjin, Shanghai and Chongqing; targets are "develop and breed a high-yield dairy core herd, increase the dairy genetic improvement level and promote standardized production."

***Science and Technology Research and Development***

Science and technology are primary productive forces. The rapid and sustainable development of

China's dairy industry needs the support of science and technology. It is put forward in *the State Council's Opinion regarding the Promotion of Sustainable Healthy Development of Animal Husbandry* (hereinafter referred to as "the Opinion") that "to accelerate the research and development of high-tech animal husbandry and veterinary research, active use should be made of information technology and biotechnology, while new varieties of livestock and poultry should be cultivated. China should persist in combining independent innovation and technology introduction, and continuously improve the standard of technical equipment for animal husbandry development". The point of the Opinion is quite clear, namely while continuing with independent research, advanced technology from abroad should be introduced.

In accordance with the *National Distribution Norm of Predominant Regions of Dairy Cattle (2008-2015)*, the new technologies in connection with the dairy industry that should be developed with priority include: (a) DHI(Dairy Herd Improvement) technology, "to establish and improve dairy cattle production and form testing technology platform"; (b) efficient breeding technology for dairy cattle, utilizing advanced means to "improve the reproduction rate of the dairy herd, shorten the calving interval, and cultivate a fine species of breeding cattle adopting artificial insemination and embryo transfer technology"; (c) standardized scale-farming technologies; (d) production and processing technologies for silage and fine forage; (e) disease control and prevention technologies for tuberculosis, brucellosis, mastitis, endometritis, limb and hoof disease, breeding disorders, metabolic diseases, etc.; (f) raw milk quality control technologies, and (g) dairy community (farm) management technologies.

### 4.3.4 Dairy Industry Policy in 2013

In China's dairy policy enacted after 2013 the governing style of the new administration led by XI Jin-ping and LI Ke-qiang can be felt, in that it is practical and well-executed.

***Circular on Further Strengthening the Quality & Safety of Infant Formula Products***

Opinions are put forward to "reshape consumer confidence in domestic milk powder", therefore we need to "refer to drug management measures to further improve the requirements for production equipment and facilities, raw materials control, manufacturing process control, inspection and testing capabilities, personnel qualifications, environmental conditions control and R & D capabilities, etc." and to "suspend the operation of enterprises without quality assurance and with backward production technology, equipment and facilities and inspection and testing conditions for rectification; and to discard those that are still below standard after rectification."

The Circular requires a) "strengthening the normative guidance and technical training for dairy cattle farming" and b) "promoting the standardization of scale-breeding of dairy cattle".

Policies will be introduced to "increase the support for the development of the infant formula milk powder industry, encourage technological upgrading of enterprises and enhance testing and inspection capabilities through financial subsidies and the implementation of preferential taxation as well as other forms. Encourage and support corporate mergers and acquisitions, increase industrial concentration, promote the standard and modern scale-development of enterprises".

***Detailed Rules for the Examination of Production License for Infant Formula Milk Powder (2013 edition)***

In December 2013, the State Food and Drug Administration issued the *Detailed Rules for the Examination of Production License for Infant Formula Milk Powder* (2013 edition) (hereinafter referred to as the "Rules") in order to set a higher threshold for dairy processing enterprises.

The Rules provide that "Enterprises with only packing venues, processes, and equipment, yet without complete production process conditions, shall not be granted a production license. Enterprises only producing infant formula base powder rather than the final product of infant formula milk powder shall not be granted a production license. From the date of release hereof, application by newly-established enterprises for offsite production of infant formula milk powder using base powder as raw material by dry mixing and wet mixing processes shall not be accepted."

The Rules provide that "where the main raw material is raw milk, such raw milk should all come from its self-built and self-controlled milk base, and gradually ensure that such raw milk comes from the farms wholly owned by the enterprises or constructed by the holding companies of the enterprises."

Processing enterprises are required to "establish a review system of raw material suppliers". In addition, “each batch of whole milk powder and skimmed milk powder purchased shall be inspected, and each batch of whey powder and whey protein powder shall be inspected”.

Factory self-inspection for each batch of infant formula milk powder shall be conducted. Factory inspected products should retain inspection reports and maintain inspection records, which shall be kept for three years. Samples of products shall be retained, of which the quantities should meet the re-examination requirement and be saved until the expiry of shelf life. The Rules provide that enterprises should establish a product recall system and a consumer complaint handling mechanism.

Corporate executives, quality and safety management, production management, and those authorized to determine quality safety should have a Bachelor’s degree or above in food or related majors, be qualified based on theoretical and practical training, have mastered quality safety knowledge on infant formula milk, understand the responsibilities and obligations to be borne, and have no record of violating the *Food Safety Law of People's Republic of China*.

### 4.3.5 Suggestions for Dairy Policy

***Get the market more involved and playing a positive role.*** To ensure a better and more sustainable development of the dairy industry, including the improvement and completion of a market mechanism as well as government regulatory capacity, the market could play a more positive role, under the overall guidance and supervision of government.

***The sustainable development of China’s dairy industry should be effected in a proper sequence.*** Any industry has an inherent law of development, and things go wrong if actions are taken too hastily or with destructive enthusiasm. The Netherlands improved the average scale of dairy farms to 100 over a period of more than 100 years; it is now still among the world’s dairy giants and its experience of development is worth examining.

***Thorough validation is needed before implementing new policies to avoid creating new problems while solving others.*** For example, the government encourages large-scale dairy farming to improve the food safety of dairy products, however, scaled farming has been causing serious environmental pollution problems.

***Strict regulation and policy to avoid environmental pollution caused by dairy farming should be implemented.*** With the expansion of the dairy farming scale and increase in quantity, dairy manure has been putting considerable pressure on the ecological environment, including pollution of the water, soil and atmosphere. Therefore, strict regulation and policy to avoid these problems caused by dairy farming is required now (based on how much manure can be adequately utilized per mu).

***Policy on training talented dairy farming personnel.*** At present, there are not many talented personnel in China who are highly knowledgeable about modern dairy farming technology, so policies and equipped facilities are needed to train staff efficiently. The Netherlands has the most advanced dairy farming technology, so it is suggested that staff be sent to the Netherlands or that Dutch experts be invited to conduct domestic training in China with a view to cultivating a certain level of dairy farming talent who get master of advanced technologies.

***Push efforts to match planting structure and dairy farming.*** While expanding the dairy farming scale, the crop planting structure also needs to be adjusted and aligned with dairy farming. This means, for example, expanding the planting area of quality pastures.

# Part II

## DEVELOPMENT OF DAIRY INDUSTRY IN CHINA

# CHAPTER 5
# CHINESE DAIRY INDUSTRY

## 5.1 GENERAL OUTLOOK FOR THE CHINESE DAIRY INDUSTRY

The Chinese dairy industry started in the 1950s and entered a rapid development phase from 1978 to 1990. In 1990, national dairy production reached 312,100 tons and was valued at 3.672 billion yuan, an increase of 5.7 times compared with 1978 (46,500 tons). During this period, the structure of dairy products changed from milk powder as the sole category to multi-brands of liquid milk and formula powder.

From the early 1990s to 2008, the Chinese dairy industry saw a rapid rise in production capacity and processing scale as well as an upgrade in dairy processing equipment and product structure. In 2008, China became the third-largest dairy producing country (37.82 million tons) after India (94.6 million tons) and the United States (82.6 million tons), bypassing Russia, Germany and France.

However, in the wake of the "*Melamine Scandal*" in 2008, the Chinese dairy industry entered a period of reorganization and adjustment. After years of re-development, it gradually recovered in both quantity and quality. In 2011, dairy production reached 24.88 million tons and was valued at 229.417 billion yuan – about 18.3 times the level of 1998 – and accounted for 16.48% of the total value of the food industry. In value terms, the share of dairy in China's Gross Domestic Product (GDP) increased from 0.14% in 1998 to 0.49% in 2011, which indicates a stronger contribution from this industry in the national economy. However, despite these significant achievements, the Chinese dairy industry is still facing many issues, such as a shortage of quality raw milk and the relatively unbalanced structure of dairy products. Currently, the average annual milk consumption of urban residents is less than 30kg. In addition, the industry's overall processing technology and equipment are still outdated and need to be improved to close the gap with developed countries. Still, this situation provides plenty of scope for substantial development in the Chinese dairy industry.

## 5.2 REGIONAL DISTRIBUTION OF THE CHINESE DAIRY PROCESSING INDUSTRY

The regional distribution of dairy products in China is closely associated with market demand and availability of resources. Fig 2.1 illustrates the distribution of dairy products among the main districts.

### 5.2.1 Northeast China and Inner Mongolia District

The northeast China and Inner Mongolia dairy industrial district covers Heilongjiang, Jilin, Liaoning and Inner Mongolia. This region is located in the internationally recognized gold milk area (40° north latitude -47°); rich in sunshine and forage resources, it is well known for the vast grasslands of Inner Mongolia and Duerbote prairie in Heilongjiang. The interannual temperature varies significantly. The region's milk production (16.75 million tons) accounted for 43.29% of total Chinese milk production in 2012. There are 159 dairy processing enterprises located here and the total dairy production (6.34 million tons) represented 24.91% of China's total national dairy product output. Since this region is far removed from the main dairy sales regions, the core product in this district is mainly ultra-high temperature sterilized milk.

### 5.2.2 North China District

The north China dairy industrial district, including Hebei, Shanxi, Shandong and Henan, is an emerging key zone of dairy cattle farming and fresh milk production. The Bashang and Kangxi grasslands in Hebei province are an extension of the Inner Mongolia prairie. This region has abundant feed resources, good processing locations, and large cities for dairy consumption. In 2012, milk production in this region (11.85 million tons) accounted for 30.62% of total national milk production. There are 174 dairy processing enterprises here and dairy production (8.34 million tons) accounted for

32.76% of total national dairy products output. The main dairy products are ultra-high temperature sterilized milk, pasteurized milk and yogurt, thanks to the close proximity of big cities.

### 5.2.3 The northwest District

The northwest dairy industrial district, including Tibet, Shanxi, Gansu, Qinghai, Ningxia and Xinjiang, has a long history of dairy cattle farming and milk consumption. It is worth noting that 22% of China's high quality grassland is located in Xinjiang. In 2012, milk production in the region (5.23 million tons) accounted for 13.51% of the total national milk production. However, the region's relatively antiquated economic development paradigm and lack of dairy processing capacity has led to lower commodity prices for raw milk. Currently, there are only 106 dairy product processing enterprises, whose dairy production output (3.09 million tons) accounted for 12.16% of the national total. The main products of this district are liquid milk and casein.

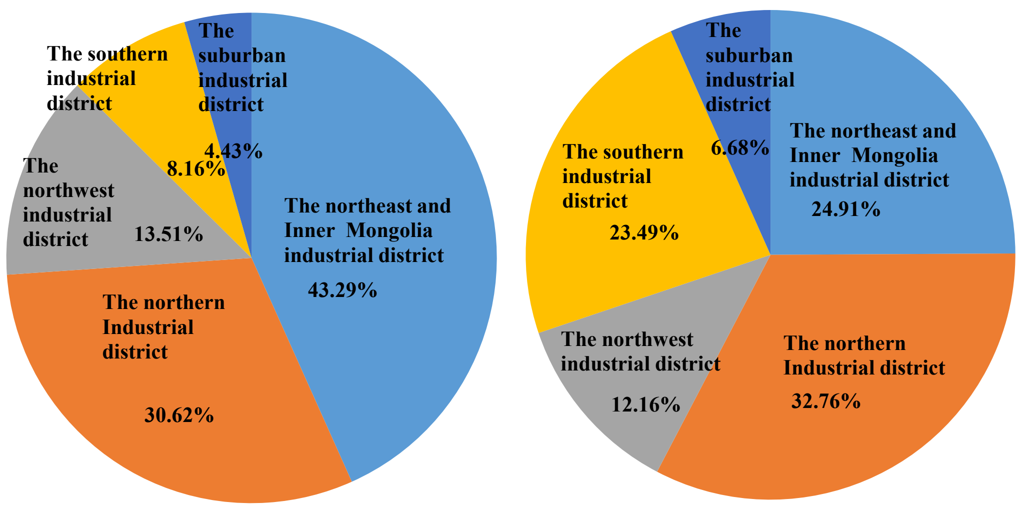



**Figure 5.1 Milk production (left) and dairy products output (right) of different dairy industry districts in China in 2012**

### 5.2.4 The Southern District

The southern dairy industrial district, including Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Hubei, Hunan, Guangdong, Guangxi, Hainan, Szechwan, Guizhou and Yunnan, is an important region for dairy consumption. This district is characterized by fewer dairy cows but more buffalo, a large population density and a higher economic development level. Dairy product output is quite low due to a lack of available raw milk. In 2012, milk production in the region (3.16 million tons) accounted for 8.16% of the national total. There are 171 dairy product processing enterprises, whose production (5.98 million tons) accounted for 23.49% of total national dairy product output. The main dairy products are pasteurized milk and yogurt.

### 5.2.5 The Suburban District

The suburban dairy industrial district, including Beijing, Tianjin, Shanghai and Chongqing, has an urban dairy production system with a highly developed dairy farming structure, large population and huge consumer market. However, the total output of milk is quite low and the processing capacity is high. The district has 34 dairy processing enterprises, whose production (1.70 million tons) accounts for 6.68% of the total national dairy product output. The region's main dairy products are pasteurized milk, yogurt and other products stored at low temperatures.

As mentioned above, there is a mismatch between dairy product processing locations and consumption markets in the different regions of China. To address this issue, efforts should be made to vigorously promote the dairy farming and processing industry in southern China.

## 5.3 DAIRY PROCESSING AND TECHNICAL APPLICATION

### 5.3.1 Liquid Milk

***Liquid milk is currently the most widely consumed dairy product in China.***

Since 2000, the growth of China's dairy production has brought about vast changes in the structure of its dairy products industry (see *table 5.1*). The yield of liquid milk reached 21.47 million tons in 2012, up by 13.01 times compared with 2000. The percentage of liquid milk in total dairy production rose from 64% to 85%, while that of solid dairy products dropped from 36% to 16%.

Liquid milk mainly comprises UHT milk, pasteurized milk, yogurt, and milk beverages, whereby the majority of production focused on UHT milk. In fact, the rapid development of liquid milk is the result of the increased consumption of UHT milk, which has a shelf life of over six months and is produced using ultra-high temperature sterilization and aseptic canning technology. Such technology ensures that the milk quality is maintained during long-distance transportation from northern to rural markets that are lack of cold-chain transportation system in South China. Despite the enormous variation in China's dairy product structure, the relatively single-product dominated industry structure continues act as a drag on the development of China’s dairy industry, which requires more types of products to satisfy the blossoming market.

***Well-developed liquid milk processing technologies.***

In recent years, dairy processing technology has improved significantly in China, especially in certain large leading dairy enterprises, where processing technologies and capacity have reached the levels of developed countries.

China has achieved the localization of equipment for milk clarification and homogeneity, however their flexibility still cannot match those of foreign products. There are many aseptic filling facilities in domestic companies, but the ultra-high sterilization equipment mainly comes from developed countries and domestically-manufactured equipment is still used on a trial use basis. Packaging is mainly done using equipment from Germany and Sweden, such as Tetra Pack. Some domestic filling machines have been made available to the market, such as the milk filling machine from Hangzhou East Asia Company, which has advantages in enabling flexible packaging. But overall, China's dairy processing machines for membrane filtration sterilization, ultra-high temperature sterilization and aseptic filling are still imported.

***The low adoption rate of new technology***

Liquid milk sterilization methods mainly include UHT sterilization and pasteurization, and some companies applied ultra-pasteurization to prolong the shelf-life of liquid milk production. However, there are concerns about, for instance, the fact that the shelf-life of pasteurized milk is shorter and that UHT milk sterilization causes excessive nutrient loss. The application of other sterilization technologies such as membrane filtration, high-voltage pulsed electric field, and high-density carbon dioxide are not widely applied.

### 5.3.2 Milk Powder

***Formula powder is the main focus of investment***

Milk powder is the principal solid dairy product. Over the past 20 years, improvements in the standard of living have led to significant changes in the Chinese milk powder industry. Gradually, industrial milk powder production has given priority to infant formula powder, powders for the middle-aged and senior citizens, functional powder and whole milk powder. The growing consumption of formula powder has increased the demand for high-quality raw milk. Currently, locally produced raw milk is largely used to manufacture liquid dairy products, while only a small proportion is used to produce industrial powder and is not enough to satisfy demand.

***Lack of high-level processing engineering***

Currently, online detection of raw milk and ultra-high temperature sterilization in China depend on the use of facilities imported from abroad. Although domestic equipment is available, the processing stabilities of homogenizer, single-effect evaporator, double-effect evaporator and instant spray equipment still lag behind the global standard, which seriously affects products' dissolution characteristics.

**Table5.1 Chinese liquid milk and solid dairy products (2000 - 2012) (Unit:10,000 tons)**

| Year | Total Dairy product | Liquid milk | | Solid milk product | |
|---|---|---|---|---|---|
| | Output | Output | Proportion | Output | Proportion |
| **2000** | 225 | 143 | 64% | 82 | 36% |
| **2001** | 320 | 246 | 77% | 74 | 23% |
| **2002** | 448 | 355 | 79% | 93 | 21% |
| **2003** | 724 | 583 | 81% | 141 | 19% |
| **2004** | 949 | 807 | 85% | 143 | 15% |
| **2005** | 1310 | 1146 | 87% | 165 | 13% |
| **2006** | 1460 | 1244 | 85% | 216 | 15% |
| **2007** | 1787 | 1441 | 81% | 346 | 19% |
| **2008** | 1810 | 1525 | 84% | 285 | 16% |
| **2009** | 1935 | 1642 | 85% | 293 | 15% |
| **2010** | 2163 | 1849 | 85% | 314 | 15% |
| **2011** | 2488 | 2061 | 83% | 327 | 17% |
| **2012** | 2543 | 2147 | 84% | 396 | 16% |
| **Growth rate(%)** | 1030.2 | 1401.4 | | 382.9 | |
| **Annual growth rate(%)** | 22.4 | 25.3 | | 14.2 | |

***Low level of processing technology***

All of the nutritional components of Chinese infant formula powder adhere to specifications set in foreign countries, which may not be suitable for the needs of Chinese infants. Basic research on breast milk in China is still at the intermediate stage, and only several big dairy companies such as Yili group are now devoting into the research of Chinese breast milk and infant nutrition. In addition, the combination technique of using dry and wet methods for producing infant formula milk powder is rarely put into practice in China.

***Low application rate of new powder packaging technology***

Milk powder packaging technique is vital in the production of high-quality product. Although there is no difference in nutrition and hygiene levels between domestic milk powder and foreign brands, the packaging of Chinese brands is not as attractive as that used for foreign brands. Inflatable packaging is commonly used to protect the powder from being contaminated with properly mixed gas compositions, however this technology is not yet commonly seen in China.

## 5.3.3 Cheese

***Cheese consumption increases dramatically***

Chinese cheese consumption is still in its infancy. Unlike in developed countries, where cheese is well consumed by the general public, in China cheese is only consumed by certain ethnic groups on special occasions. However, the growing popularity of fast food, such as hamburgers and pizza, has caused cheese consumption in China to grow dramatically. And yet, due to the lack of raw milk, only 0.2% or less of the raw milk supply is used to process cheese.

Originally, cheese was mainly imported. In 2000, China imported 1,968 tons of cheese and imports then increased year-by-year reaching 38,800 tons, 90 times the level of 1998. The slower development of the cheese industry in China is mainly related to consumption traditions and habits of certain ethnic groups. Generally, Chinese people prefer mild, milky flavors rather than mature products with salty flavors.

***Dependence on imported processing equipment***

Owing to the low output of cheese in China, only equipment suitable for the small-scale production of cheese is available in the market. Foreign countries are still the main source of equipment, including automatic cheese tanks, stretchers, vacuum squeezers, melting pots for processed cheese and cooling machines.

***Application of cheese research technology demands acceleration***

In Chinese cheese production, remanufacturing technology is relatively well developed. However, the technologies for cheese curd control, high-melt cheese production, mature acceleration and membrane filtration are still rather less developed.

## 5.3.4 Yogurt

***Fewer product varieties and monotonous industry structure***

Though the yogurt industry is developing at a fast pace in China, the types and flavors of yogurt are not as varied as in the developed countries.

According to relevant statistics, in 2001 900 new varieties of yogurt were being produced in developed countries, 72% of which in Europe, while Chinese products remain limited to stirred yogurt containing only some probiotics, fruits and grains.

***Starter culture relies on importation***

In China, the technology of strain screening and preservation is mature, but the quality of starter cultures and related research still requires strengthening. In addition, specialized and sustainable resources of lactic acid bacteria are badly needed.

Most strains added to yoghurt are discovered abroad. Moreover, strain investigation and evaluation systems geared towards the physical condition of the Chinese people have not been developed. In brief, the fermented dairy industry in China still has a long way to go.

# CHAPTER 6
# INTRODUCTION TO KEY DAIRY PRODUCT ENTERPRISES

In 2012, there were 649 dairy processing enterprises in China. There are 333 enterprises in the northeast China and Inner Mongolia dairy industrial district and the north China dairy industrial district, accounting for 51.3% of the total number of national dairy enterprises. And the total assets and profits of these two districts represent 32.2% and 33.0%, respectively, of the country as a whole. Milk production in the southern and northwest dairy industrial districts (19 provinces in total) is low and the number of enterprises is smaller. However, although the number of enterprises in the suburban industrial district is small, the scale is large (for specific data, please see *Table 5.1*). The key dairy enterprises in China include Yili Industrial Group Company, Mengniu Dairy, Bright Dairy and Sanyuan Foods. Operational details of these companies in 2013 is showed in *Table 6.1*.

**Table 6.1 Companies in 2013**

| Company | Sanyuan | Bright | Yili | Mengniu | Beingmate |
|---|---|---|---|---|---|
| HQ | Beijing | Shanghai | Huhehaote | Huhehaote | Hangzhou |
| Revenue (Billion yuan) | 3.79 | 16.29 | 47.48 | 43.36 | 6.12 |
| Revenue growth % | 6.61% | 18.26% | 13.78% | 20.40% | 14.24% |
| Gross margin rate % | 21.51% | 42.88% | 28.78% | 26.98% | 19.73% |
| Net profit (billion yuan) | -0.23 | 0.41 | 3.19 | 1.63 | 0.72 |
| Net profit growth % | -806.25% | 30.43% | 85.61% | 25.25% | 41.54% |
| Main Product Type | Liquid (>80%) | Liquid (>70%) | Liquid (78%) | Liquid (89%) | Power(93%) |
| Owned ranch numbers | 36 | 13 | 800 | 22* | 1 |
| Cattle Numbers(thousand) | 50 | 12 | -- | 180 | 4 |
| Milk collection (ton) | 1200 | 2200 | 9500 | 8600 | 350 |
| Main Market | Beijing(& Around) | East China | North /South China | North /South China | North /South China |

* over 10,000 cows per ranch

## 6.1 BEIJING SANYUAN FOODS COMPANY LIMITED

Beijing Sanyuan Foods Company Limited (Sanyuan Foods) mainly focuses on dairy processing but has also diversified to other businesses, such as the Sino-foreign joint business of the McDonald's fast food chain. Its predecessor was Beijing milk station, which was founded in 1956. It was then renamed Beijing Dairy Company in 1968. Beijing Sanyuan Foods Co. was established in 1997, and restructured to form Beijing Sanyuan Foods Company Limited in 2001. On 15 September 2003, it was successfully listed on the Shanghai Stock Exchange. Sanyuan Foods now owns total assets of over 10 billion yuan, has about 20,000 employees, 13 state farms, 20 professional companies, 22 Sino-foreign cooperative enterprises and four overseas companies.

### 6.1.1 Products and Production of the Enterprise

Before 2008, the average annual revenue of Sanyuan Foods was around 1 billion yuan, but this has significantly increased since 2009. The latest data show that the company's revenue climbed 6.61% to 3.78 billion yuan in 2013 (see *Figure 5.2*).

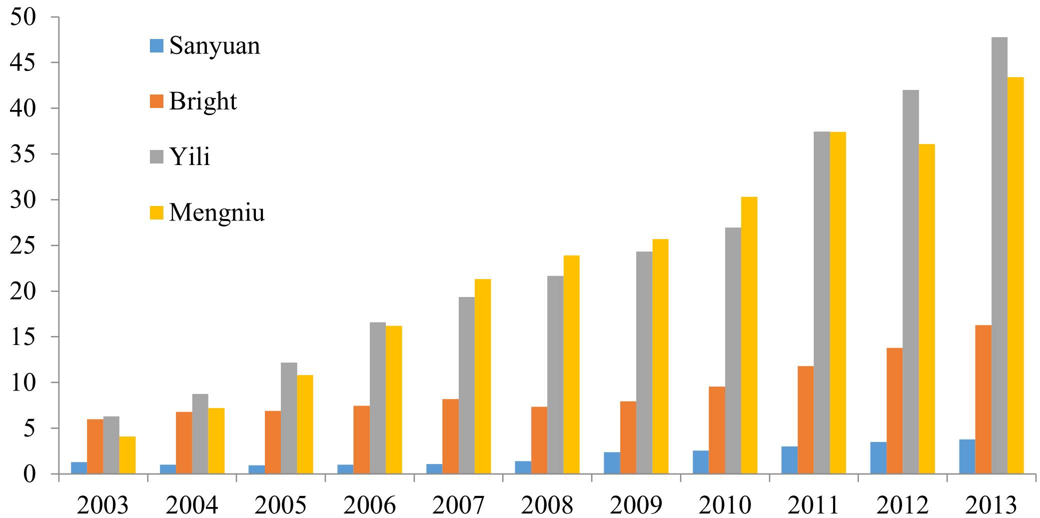



**Figure 6.1 Companies operating income in 2003-2013 (Units: Billon Yuan)**

In recent years, the gross profit margin of liquid dairy products has been relatively stable, while that of solid milk has increased significantly (see *Table 6.2*). Enterprise reports show that gross margins from solid dairy products increased by 14.25% in 2013 compared with 2012. On the other hand, the revenue increase inside the Beijing market is stable, and revenues outside Beijing have also increased year-on-year, accounting for a larger proportion of the total revenue (see *Table 6.3*). In 2013, operating income from outside Beijing markets accounted for 50.63% of the total revenue, with an increase of 12.84% over 2012.

**Table 6.2 Products, revenue and profit of Sanyuan Food (Units: Billon Yuan)**

| | 2013 | | 2012 | | 2011 | |
|---|---|---|---|---|---|---|
| | Operating revenue | Gross profit rate% | Operating revenue | Gross profit rate% | Operating revenue | Gross profit rate% |
| Dairy products | 37.116 | 26.09 | 3.514 | 22.49 | 3.020 | -- |
| Liquid milk | 4.242 | 32.78 | 2.871 | 25.76 | 2.449 | -- |
| Solid milk | 5.512 | 43.79 | 0.643 | 7.89 | 0.571 | -- |

**Table 6.3 Regional business income of Sanyuan Food (Units: Billon Yuan)**

| District | 2013 | 2012 | 2011 |
|---|---|---|---|
| Beijing | 1.849 | 2.186 | 1.741 |
| Outside Beijing | 1.896 | 1.328 | 1.280 |

### 6.1.2 Main Products and the Application of Key Technologies

Sanyuan has a diversified product range, including products stored at room temperature (high quality milk, flavored milk, and milk drinks), low-temperature products (cold fresh milk, cold sour milk), plum garden products (flavored milk tea), infant milk powder, adult milk powder, cheese and hundreds of others.

To fulfil the particular requirements of urban dairy products, Sanyuan Foods established an aseptic production line using membrane technology to develop and produce "Sanyuan acme SEL milk". For consumers with special needs, Sanyuan Foods developed "Sanyuan low-lactose milk ", "Sanyuan milk for breakfast" and "Sanyuan mozzarella cheese", using high technology to improve its brand image and market competitiveness. It is worth noting that the company’s cheese products are made using advanced production and packing process technology as well as a strain of lactobacillus to accelerate cheese maturation developed by Sanyuan Foods. To meet the special taste preferences of the Chinese, Sanyuan Foods adds lactobacillus to its pizza hut products, which are the highest profit value products among its domestic fast food franchise companies, such as McDonald’s.

### 6.1.3 Enterprise Competitiveness

a). Sanyuan Foods focuses on building its credit system and enterprise brand image. In recent years, there were many milk safety incidents in China, but Sanyuan Foods came through it, maintaining good quality products and winning the trust of consumers. This “good fortune” is due to its "company + farm" approach to milk processing and dairy farming. The fact that its major raw milk locations are located in Hebei and Beijing helps the company better manage its processes, and thus ensure the safety of the raw milk source. In 2009, the largest raw milk supplier of Sanyuan Foods – Green Lotus Dairy Center – rebuilt the 75 milking parlors of its 26 modern dairy farms in order to improve the quality of raw milk. At present, Sanyuan Foods collects 1,200 tons of milk per day. Its raw milk quality exceeded EU standards with 3.6% butterfat, 3.0% milk protein, less than 50,000/ml of total bacteria counts and below 200,000 cells/ml for SCC. Sanyuan Foods will invest more in raw milk production locations and plans to raise over 180,000 dairy cows with company-controlled pasture production.

b). The company attaches significant importance to product research and development as well as strengthening cooperation among enterprises. Sanyuan’s plum garden dairy product is made using a traditional Chinese dairy process in combination with modern technology. During development, the quality of the dairy products is the first priority while the tastes of the Chinese people are also taken into account. Meanwhile, Sanyuan has established a supply relationship with fast food companies such as McDonald's and Pizza Hut to ensures its cheese product sales channels. The research and development projects in the next phase are mainly focused on meeting the demand for Chinese infant formula powder, and Sanyuan Foods will therefore strengthen the development of its powder products.

c). The city market and milk business development are also a focus. Using the pasteurized milk technology, Sanyuan Foods developed the business of home milk delivery in Beijing, Tianjin, Baoding, Tangshan and Qinhuangdao. Pasteurized milk is now delivered every day to more than 50,000 homes.

## 6.2 BRIGHT DAIRY & FOOD CO., LTD.

Bright Dairy & Food Co., Ltd. (Bright Dairy) is a listed joint-stock enterprise specializing in the development, production and sale of milk and dairy products, the rearing and care of dairy cows and bulls, logistics distribution, and the development, production and sale of health and nutrition products. On 28 August 2002, Bright Dairy was successfully listed on the Shanghai Stock Exchange. The company developed a world-class dairy product research and development center, dairy product processing facilities and advanced dairy product processing techniques. It is one of the largest dairy production and sales companies in southern China.

### 6.2.1 Products and Output Value

The company’s operating revenue has been increasing, with the exception of 2008, and has risen especially rapidly in the past three years. The latest data showed that the operating revenue in 2013 was 16.29 billion yuan, up 18.26% over 2012.

Its main source of income is the operating revenue from liquid milk. As is shown in *Table 6.4*, liquid milk accounts for more than 70% of total annual income, and is continuing to increase. The year-on-year growth of operating revenue for liquid milk was 17.52% in 2013, and the gross profit rate remained stable. The operating revenue from other products has also increased in recent years, but the gross profit rate fell 8.77 percentage points in 2013 compared with 2012.

**Table 6.4 Business data and product series of Bright Dairy**

| | 2013 | | 2012 | | 2011 | |
|---|---|---|---|---|---|---|
| | Operating revenue (Billion Yuan) | Gross profit rate (%) | Operating revenue (Billion Yuan) | Gross profit rate (%) | Operating revenue (Billion Yuan) | Gross profit rate (%) |
| Liquid milk | 11.620 | 42.88 | 9.888 | 43.29 | 8.481 | 46.22 |
| Other dairy products | 3.792 | 15.03 | 3.164 | 14.05 | 2.611 | 15 |
| Others | 0.767 | 12.10 | 0.579 | 20.87 | 0.484 | 28.29 |

Although Bright Dairy is a suburban dairy enterprise, its main source of operating revenue comes from other parts of China and overseas. As is shown in *Table 6.5*, the revenue from these three regions is increasing, while the distribution among each has barely changed, at 30%、55% and 15%, respectively.

**Table 6.5 Business income of Bright Dairy in different regions**
**(Unit: Billion yuan)**

| Region | 2013 | 2012 | 2011 |
|---|---|---|---|
| Shanghai | 4.657 | 4.163 | 3.384 |
| Other parts of China | 9.053 | 7.567 | 6.152 |
| Overseas | 2.469 | 1.901 | 1..46 |

## 6.2.2 Main Products and the Application of Key Techniques

The product range of Bright Dairy includes fresh milk (basic milk, functional dairy products and children's products), yoghurt, room temperature milk (pure milk, yogurt, flavored milk and children's products), milk powder (infant formula, adult formula and industrial milk powder), cheese (including cream) and juices.

Bright Dairy has a relatively large market for its pasteurized milk, mainly because of its cold-chain system covering the Yangtze River Delta around Shanghai. Bright Dairy is market leader in China in its technique of making processed cheese. It has applied for seven patents for processed cheese in recent years, and has developed a series of processed cheeses including Mozzarella processed cheese, high-calcium processed cheese and plain processed cheese.

## 6.2.3 Enterprise Competitiveness

a). Building of the cold-chain system. Early in 1992, Bright Dairy introduced the French concept of fresh-keeping milk and applied the cold chain system in production. Currently, Bright Dairy has established the complete cold chain system to fully assure product quality. The dairy facilities of Bright Dairy are equipped with mechanical milking equipment and constant temperature refrigeration systems at the world advanced level. The company's processing plants are equipped with the latest production lines and processing is done in a fully enclosed environment, so that the temperature during processing is also maintained below 4℃.The Bright Dairy logistics center is refrigerated and fresh Bright Dairy products are all transported using imported refrigeration equipment. In the past two years, constant delivery carts and enclosed boxes have been used to deliver milk to homes throughout the city, to ensure the freshness and nutrient value of Bright milk. This service has now been expanded to 14 other cities, so the company supplies 1,150,000 bottles per day, 700,000 of which are for the Shanghai market.

b). Focus on innovation. Each year, the company develops over 60 new products through different technical programs, 30 of which go to market. In the past three years, the sales value of new products exceeded 1 billion yuan each year, accounting for over 25% of the company's total sales. The products emphasize three aspects: probiotics, bio-activator products and characteristic products development at the present stage.

c). Close attention to safety of the milk source. Bright Dairy has more than ten dairy farms of its own, with over 12,000 dairy cows producing an annual milk yield of over 8,500kg. Over the years, the unit yield has remained over 8,500kg. As Bright Dairy is taking an increasingly important place in the national market shares, its milk source locations are spreading from only having one raw milk base in Shanghai to dozens of raw milk bases spreading all over Heilongjiang, Hebei, Inner Mongolia, Shaanxi and other provinces in China. Together, these areas collect 2,200 tons of raw milk per day. The structure of its milk source locations and farms guarantees the quantity of the milk source. The raw milk meets the EU standard, with 3.7% butterfat content, 3.1% milk protein, less than 50,000/mL total bacteria counts and less than 200,000 cells/ml for SCC.

## 6.3 INNER MONGOLIA YILI GROUP

Inner Mongolia Yili Company Limited (Yili Group), the largest dairy product processing enterprise in China, is also the only national enterprise to serve both the Olympic Games and World Expo in China. In 2014, Yili Group ranked $10^{th}$ ($1^{st}$ in Asia) in Rabobank's global dairy rankings, becoming the first Chinese company to make the list.

### 6.3.1 Enterprise Value and Products

As a leading brand in the Chinese dairy industry, Yili Group's operating income has been rapidly and steadily growing, and increased 15.5 times from 27.02 billion yuan in 2001 to 41.991 billion yuan in 2012 (see *Figure 5.2*). Its growth picked up from 2008, with an average annual rate of 18%, and revenues reaching 47.78 billion yuan in 2013. During that year, the net margin was 3.20 billion yuan and the growth rate an impressive 84.4%.

The Group's main source of revenue is liquid dairy products, which accounted for 70% in 2013 (see *Table 6.6*). The growth in refrigerated products has remained stable, and its high-end product profits continued to increase. Yili Group focuses on the domestic market, which it is aiming to expand. Data from the first half of 2013 shows that North China (31.34%) and South China(28.05%)make up 59.39% of its total revenue.

**Table6.6 Yili Group Product Operations**
**(Unit: Billion yuan)**

| | 2013 | | 2012 | | 2011 | |
|---|---|---|---|---|---|---|
| | Income | Gross Profit rate % | Income | Gross Profit rate % | Income | Gross Profit rate % |
| Liquid milk | 37.12. | 26.09 | 322.71 | 26.87 | 269.33 | -- |
| Cold drinks | 4.24 | 32.78 | 42.94 | 34.61 | 42.21 | -- |
| Powder and dairy products | 5.51 | 43.79 | 44.84 | 44.15 | 56.42 | -- |

### 6.3.2 Key Technologies and Products

Yili Group consists of five divisions: liquid milk, cold drinks, milk, yogurt and raw milk. These comprise more than 1,000 product lines, such as pure milk, milk drinks, ice cream, milk powder, tea powder, yogurt and cheese products. For many products, its output, selling scale and brand value rank first in China.

The Group is focusing on the organic milk industry chain and successfully developed "Golden Erie organic milk". It also introduced the concept of "meal replacement milk" which, depending on individual eating habits, comprises such concepts as mixing cereal with milk. It also developed the product "multi-grain". For people with lactose intolerance, Yili Group developed "nutritional Shuhua milk", which is a large profit-maker for the company. Currently, Yili is concentrating on infant formula powder through its development of "Jinling Crown" for Chinese infants and young children. Its market share continues to grow.

### 6.3.3 Enterprise Competitiveness

Increase milk locations. Yili's milk and dairy production locations are located in the Tianshan, Hulunbeir and Xilin Gol regions, from Xinjiang, Heilongjiang, Inner Mongolia and other regions to Beijing, Tianjin, Shanxi, Shandong, Henan, Hebei, Hubei, Anhui and Gansu. Yili Group invested 10.2 billion RMB to build up its own dairy farming bases all across China over the past ten years. By the end of 2013, Yili Group owned about 2,400 dairy farms, and more than 95% of raw milk materials came from the farms owned by itself.

Focus on the development of new products. Yili is the only company with its own research institute and dairy patent information platform, which develop hundreds of new products every year. Yili has been working on research into infant formula milk powder and has established the "China breastfeeding Database" to collect and analyze the composition of breast milk of Chinese mothers, accumulating data for future research. Yili Group infant formula milk powder has the largest market share in small and medium-sized cities in China. It is now developing hypoallergenic formula milk powder and functional milk powder, with a view to providing different nutritional formula powders for different types of people.

## 6.4 INNER MONGOLIA MENGNIU DAIRY GROUP

Inner Mongolia Mengniu Dairy Company., LTD (Mengniu dairy) was founded in January 1999. It owns total assets of 7.6 billion yuan. The group, with an annual production of 7.58 million tons per year, was listed on the Hong Kong Stock Market in June 2004. The Group mainly produces three categories of products: liquid milk, ice cream and dairy products, and markets 200 dairy products in total.

### 6.4.1 Products and Output Value of the Group

Before 2011, the operating income of Mengniu Dairy grew rapidly, however the last two years have seen a slowdown. The operating income in 2012 was 360 billion yuan, which was almost nine times the value of 2003 (see *Figure 6.2*). Recent data shows that Mengniu Dairy reported an operating income of 43.36 billion yuan in 2013, up 20.4% compared with the same period in 2012. Net profit was 3.76%.

Liquid milk (yogurt, milk beverages, UHT milk) is still the main income source of Mengniu Dairy (see *Figure 6.2*). In 2013, the liquid milk revenue was up 17.2% to 37.90 billion yuan, and – similar to 2012 – accounted for 87.32% of the company's total revenue. Ice cream revenues have remained stable for many years, accounting for 8-9% of the total income. The share of liquid milk, milk beverages and yogurt has increased rapidly. In 2013, the revenue share of milk beverages and yogurt rose to 23.96% and 12.44%, respectively, of the total liquid milk revenue. The revenue from other dairy products, such as milk powder, was 2.18 billion yuan in 2013, up 393% from 2012 (see *Figure 6.2*).

### 6.4.2 The Main Products and Application of Key Technologies

Mengniu Dairy has launched a series of low-temperature dairy product lines such as pure milk, milk deluxe, deluxe fiber milk, Xin Yang Dao Zhen Yang Milk, Future Star DHA Kid Milk, Fruit Milk Drink, Champion Yogurt, all of which are popular in the market.

Recently, the company cooperated with Hansen Company of Denmark and People's Physique LABS Probiotic Group in an effort to develop premium infant formula milk powder. Also, through an alliance targeted at developing yogurt products with DANONE, the company established the world's leading low-temperature dairy research center.

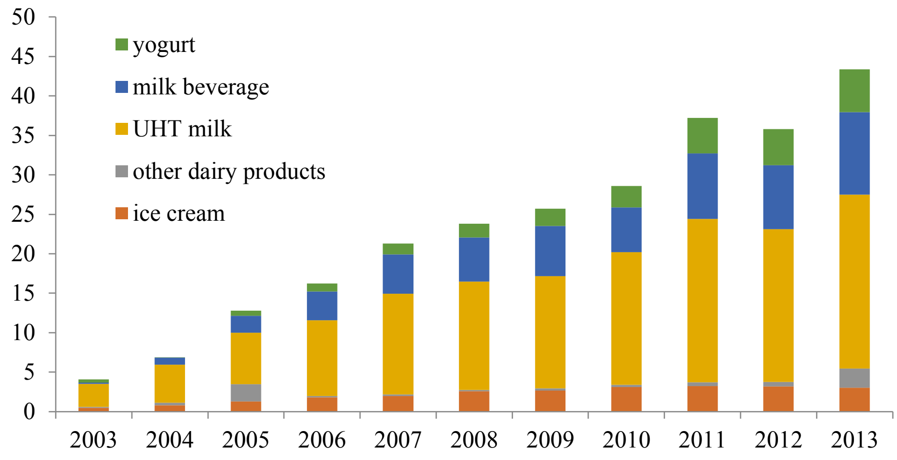



**Figure 6.2 Revenue from various products (2003 to 2013)**
**(Unit: Billion Yuan)**

### 6.4.3 Enterprise Competitiveness

Cooperation with Modern Dairy Company. In order to strengthen construction of dairy locations, it worked closely with Modern Dairy Company, which has the largest number of domestic dairy farms among the listed enterprises. In 2013, the company owned 22 farms with over 10,000 cows, which yield an annual production of 2,600 tons of high quality fresh milk. Raw milk produced by these dairy farms generally has 3.8% milk fat, 3.4% milk protein, microbial counts below 10,000 cfu/ml and below 200,000 cells/mL for SCC, which meets EU standards.

Upgrade the core dairy districts. By providing entrusted loans, advancing payments, equity investments in the construction of multiple modern and large-scale dairy farms, the company intends to strengthen the expansion of its own dairy farming community. In 2013, milk provided by large-scale and intensive dairy farms reached 93% of the total volume of milk processed. The daily milk output of raw milk is currently 8,600 tons.

Reinforce management on quality and safety of milk stations. To guarantee the quality and safety of the raw milk it uses for dairy processing, Mengniu Dairy established 25 divisions responsible for acquisitions and milk quality testing in Hohhot, Beijing, Bameng, Baotou, Chabei, Baoding, Baoji, Jiaozuo, Luannan, Saibei, Shanxi, Shenyang, Hisashi, Tai'an, Tongliao, Tangshan, Taiyuan, Ma On Shan, Ulanhot, Wuhan, Qiqihar, Yinchuan, Suqian, Sichuan, and Hengshui.

Tighten cooperation with domestic and foreign institutions. In a strategic cooperation with Arla Denmark, it co-founded a research center to focus on fodder production, milk processing and advanced detection methods for milk analysis. The group also collaborates with China Agricultural University in developing functional dairy products. Recently, the group began cooperating with COFCO to introduce more capital and management experience in business operations.

## 6.5 BEINGMATE

Beingmate was founded in Hangzhou In 1992. Currently, it is expanding its business to Shanghai, Beijing, Shenyang, Wuhan, Chengdu, Dunhua and Zhengzhou. Beingmate is a professional company focused on the infant milk industry. In April 2011, Beingmate was successfully listed on the Shenzhen Stock Exchange Market. The company has more than 1,000 employees and total assets of over 500 million yuan, with a rapid pace of development.

### 6.5.1 Output Value

As shown in *Figure 6.3*, in the first quarter of 2013 Beingmate generated total revenue of about 6.12 billion yuan and 0.72 billion yuan of the net margin , with an annual growth rate of 14.24% and 41.54%, respectively. Meanwhile, the revenue from milk power increased 14.98% to 5.72 billion yuan and the gross margin rate was down 3.76% at 62.2%. Company reports show that the sale of milk powder increased by 19.28% compared with 2012, reaching 55,000 tons.

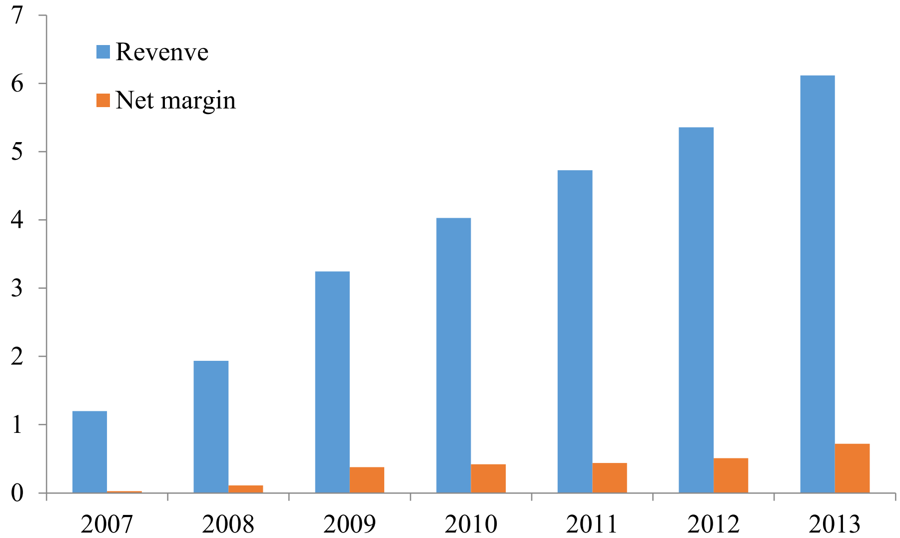



**Figure 6.3 Revenue and net margin of Beingmate from 2007 to 2013**

## 6.5.2 Main Products and Key Technology

Beingmate's activities fall mainly into six categories: infant food, infant products, infant care advice, life science, health care for infants & mothers, and infant cradling and loving. Of these six business scopes, infant food is the main activity and includes infant formula milk, weaning food and supplement food. As one of the three major baby food enterprises in China, Beingmate owns the largest weaning food production base in Eastern China and its products are popular throughout the country.

## 6.5.3 Enterprise Competitiveness

***Expand raw milk locations.***

Beingmate's milk locations are in Anda, Heilongjiang Province, within the zone above 45 degrees north latitude. The company owns a fresh milk storage facility that processes 350 tons per day. Meanwhile, to ensure the quality of its products, the company uses milk powder imported from the Netherlands.

***Increase investment in processing techniques.***

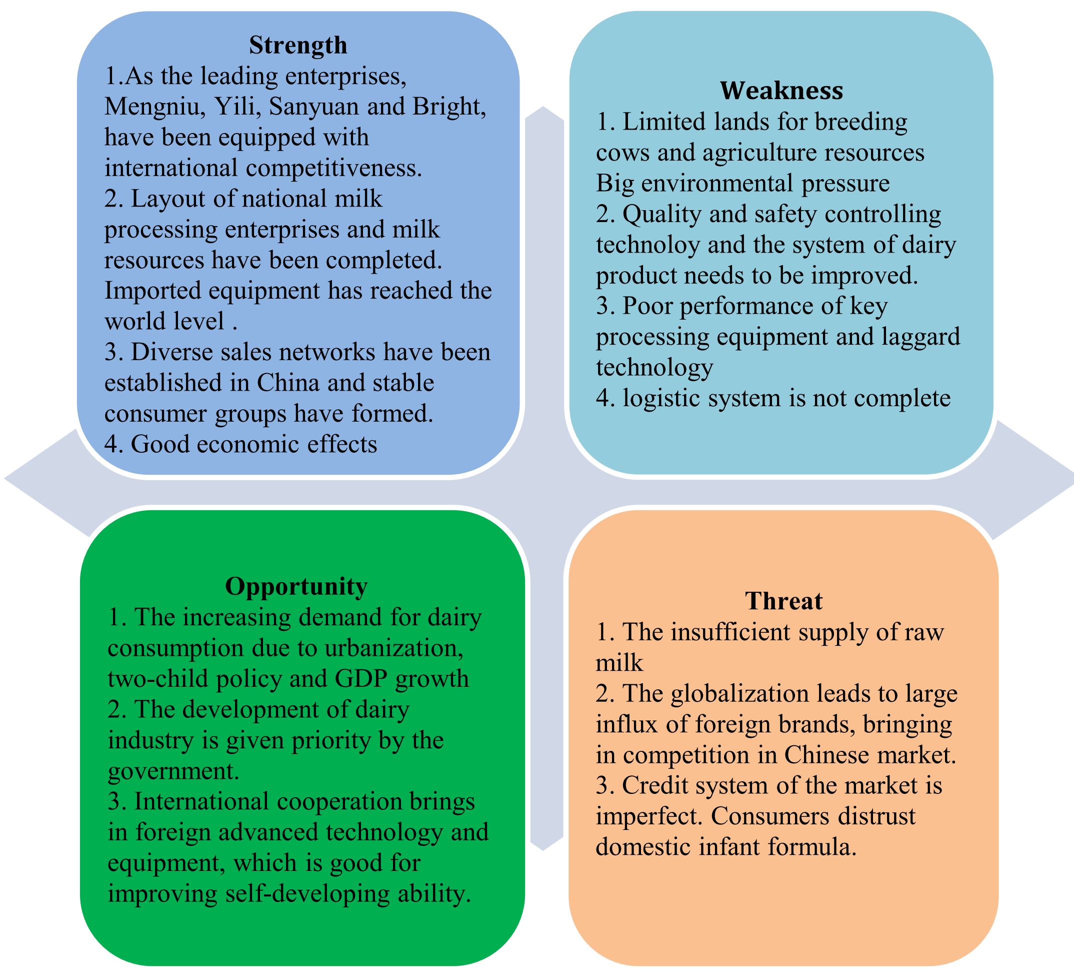
In cooperation with Stork Veco in the Netherlands, Beingmate invested 1.3 billion yuan to assemble the Shaffer three-way milk concentrator and set up a production line for high-end infant formula.

***Focus on infant formula research.***

In order to develop high-end infant formula and bionic infant formula with nutritional contents that are similar to the breast milk of Chinese women, the company established the breast milk research center. Taking account of the physiological characteristics of Chinese babies, Beingmate provides various kinds of products, professional formula and meticulous parenting plans.

# CHAPTER 7
# DEVELOPMENT TREND ANALYSIS OF CHINESE DAIRY INDUSTRY

The Chinese dairy industry began developing only recently and at a low level, but has made rapid progress, particularly after reforms were introduced and the Chinese market opened up. Dairy production has been increasing at double-digit rates each year, which is more than the world's average level(1%) over the same period. Dairy production in China has seen tenfold growth over the past 10 years. However, compared with developed countries, the per capita milk consumption remains very low. After the dairy industry rectification in 2011, the number of dairy processors was reduced by nearly 50%. At the same time, the size of dairy processing enterprises, the level of equipment know-how, the quality assurance system and milk self-supply ratio all reached new heights and a modern dairy industry is clearly emerging. With the development of China's economy, the dairy industry will enjoy more scope for development. A SWOT analysis of the Chinese dairy industry reveals significant strengths and good opportunities for the development of this industry. However, there are still areas requiring improvement and many challenges to face.




According to the SWOT analysis, the development trend of the Chinese dairy industry has the following aspects.

## 7.1 CONTINUING TO STRENGTHEN CONSTRUCTION OF MILK SOURCE BASE

According to "Dairy Industry Policy in China (revised 2009)", Chinese dairy companies should have their own milk bases. Newly established dairy processing projects should have stable and controllable milk bases which shall provide fresh milk no less than 40% of the processing capacity. Meanwhile, those projects aimed at modification or expansion should not be less than 75% of the original processing capacity of dairy processing factories. Establishing a domestic dairy industry to ensure the supply and quality of raw milk has become a key competitiveness issue for dairy companies. However, quality and a sufficient raw milk supply are still concerns facing Chinese dairy processing enterprises. Currently, the daily milk supply/demand gap is as high as 2,000-3,000 tons for Yili and Mengniu, and about 450 tons for Sanyuan and Bright, respectively. Therefore, the key tasks for the large dairy companies in China are continuous investment in the construction of large-scale dairy farms, improving the milk production management system, increasing the milk supply in various effective ways, providing a sufficient supply of safe, high quality raw milk at a reasonable cost, and ensuring the safety of milk production.

On the other hand, owing to the limitation of agricultural resources in China, a strategy of focusing on the domestic milk supply while seeking potential international milk bases overseas shall be pursued. For example, Mengniu, and Yili are setting up milk production bases in Australia and New Zealand. In 2011, Bright dairy purchased shares in Synlait Dairy Company of New Zealand in the form of a capital investment expansion, taking 51% of the total equity.

## 7.2 ESTABLISH AND IMPROVE THE QUALITY AND SAFETY CONTROL SYSTEM OF ENTIRE INDUSTRY CHAIN

By using proper tools for the management of soil, water, and feed, and through comprehensive risk assessments of ingredients, equipment & pipeline, processing technologies, and other relevant factors, an early warning mechanism for quality and safety-related risks can be developed based on a large database. Meanwhile, to establish a quality control system "from grass to glass", a traceability system based on quality management and operating conditions via Internet should be set up.

## 7.3 ADJUSTING PRODUCT STRUCTURE TO SPEED UP THE UPGRADING OF THE DAIRY INDUSTRY

The dairy product structure has experienced an evolution from regular milk powder, to sterilized liquid milk, fermented milk, formula, and now functional dairy products. Competition among traditional liquid milk products is increasing, and as a result the profits of such products are quite low and the consumption potential is weakening. Following are some of the development directions for dairy products in China.

### 7.3.1 Formula Milk Powder

With the easing of the Chinese two-child policy and the pressure of "aging", demand for functional formula milk powder suitable for both infants and the elderly is increasing.

### 7.3.2 Cheese

Given increased public awareness of the Western food culture, the demand for cheese has grown rapidly in China. In the catering industry, the demand for mozzarella and cheddar cheese is increasing. Meanwhile, consumers demand for fresh cheese and processed cheese is on the rise.

### 7.3.3 Yogurt

At present, yogurt in China only accounts for 15% of the entire dairy market; as a special category, lactobacillus milk drinks account for less than 5%. Recently, the proportion of yogurt consumption has been increasing, so there is great development potential for yogurt in China.

## 7.4 FURTHER DEVELOPMENT AND PROMOTION OF DAIRY PROCESSING TECHNOLOGY

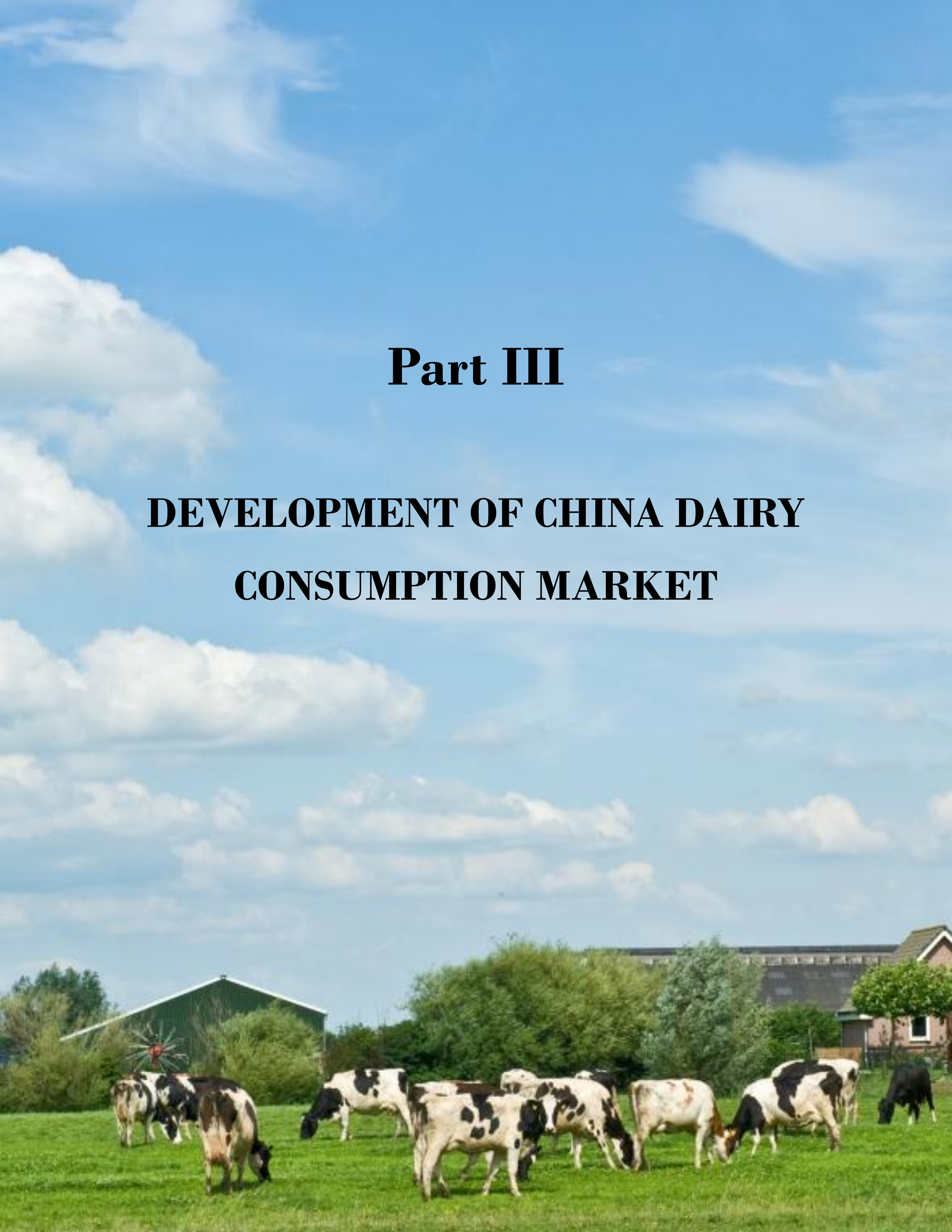
Currently, there is relatively little research and development involving new dairy processing technologies in China. Innovation and application of new technologies, such as non-thermal sterilization technology, including membrane filtration, mixing and drying technology for milk powder, whey separation, and melting and cooling technology for processed cheese, all are in high demand.

## 7.5 GIVING FULL ATTENTION TO THE ADVANTAGES OF MILK SOURCES IN THE NORTH, WHILE DEVELOPING THE LOCAL DAIRY INDUSTRY IN THE SOUTH

The mismatch between the regional supply and consumption of milk is quite significant. The milk resources in the north are relatively abundant, however the consumption of milk products is biggest in the south and coastal area (economically developed area) where milk supplies are rare. If there is no instant UHT technology for milk processing suitable for room temperature storage, it is difficult to transport the milk products from high quality milk source locations to the southern milk consumption markets. Cold milk is more suitable for the local markets, nearby processing, production and consumption, and more dependent on cold chain transportation and storage, which highly depends on special sales channels. Accordingly, the distribution of milk and the level of economic development should be considered when establishing dairy processing facilities. For example, in Beijing, Tianjin and Shanghai, pasteurizing milk, yogurt and other low-temperature products should be the focus. In comparison, in the southern industrial zone, local dairy products such as buffalo milk and goat milk should be encouraged.

# Part III

## DEVELOPMENT OF CHINA DAIRY CONSUMPTION MARKET



# CHAPTER 8
# DAIRY IMPORTS AND EXPORTS

## 8.1 CHINESE DAIRY IMPORTS (2001-2013)

### 8.1.1 Dairy Imports Are Substantial and Increasing Rapidly

Starting in the 21st century, Chinese dairy imports experienced a rapid increase. One example is milk powder. From 2001-2013, Chinese imports of milk powder increased from 0.059 million tons to 0.86 million tons, with an annual growth rate of 25.1%. During the same period, total imports in terms of value increased from 115.40 million USD to 3,605.61 million USD, with an annual growth rate reaching 33.2%. This trend accelerated after the melamine incident in 2008. Since then, the imports of milk powder have increased by more than 50% every year in value terms. In 2009, the rate of increase reached 145% (see *Figure 8.1*).

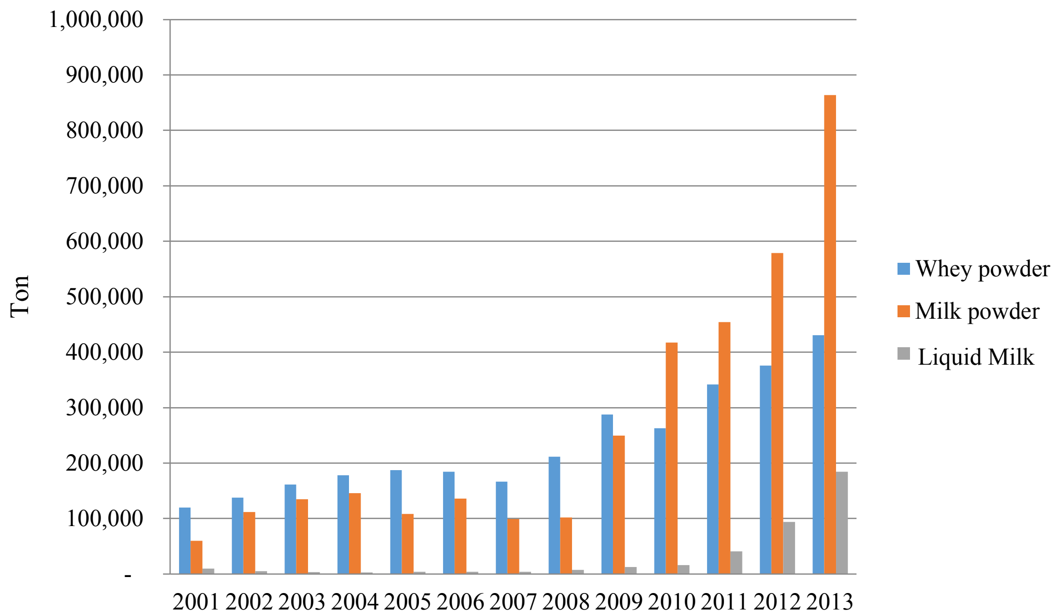



**Figure 8.1 Imports of Major Dairy Products to China**

### 8.1.2 After WTO Entry, Major Source Countries Are Stable and Highly Concentrated

Before WTO entry, China limited the quantity of imports and the source countries by using tariff quotas and high tariff rates. In this period, there were a large number of exporting countries, all supplying similar proportions of the major dairy products. After WTO entry, the number of exporting countries decreased and there was an increase in product concentration. New Zealand, Australia, the US and France remained the top four source countries of Chinese dairy imports. With rare exceptions, the total dairy imports from these four countries accounted for more than 80% of dairy imports from 2001 to 2013. New Zealand is always number 1 on this list (see *Table 8.1*), especially after the validation of "The Free Trade Agreement between China and New Zealand" in 2008. From 2010, dairy imports from New Zealand exceeded 60% of total imports into China. The market concentration of dairy imports increases year-on-year.

The growing concentration of dairy import source countries may help reduce procurement costs, but the influence of dairy prices on the international market may be amplified, thus increasing the risk of China being subjected to such things as price fluctuations in other countries. If international dairy prices increase sharply, the domestic dairy companies that use imported products as materials will be pressured to greatly increase their production costs. Since there are only four million people in New Zealand and its domestic market is relatively small, the increase in trade between New Zealand and China will not dramatically impact China's market. It is expected that after subsequent free trade agreements are concluded between China and countries, such as Australia, around 2015, dairy imports from these countries will further increase. That will lead to more competition among China's domestic dairy companies.

**Table 8.1 Proportion of dairy import value by source country(%)**

| | New Zealand | Australia | US | France | Total |
|---|---|---|---|---|---|
| 2001 | 40.1 | 19.1 | 12.2 | 13.7 | 85.1 |
| 2002 | 40.5 | 24.1 | 10.1 | 14.4 | 89.0 |
| 2003 | 48.4 | 13.8 | 9.3 | 13.8 | 85.3 |
| 2004 | 52.4 | 11.0 | 10.1 | 9.8 | 83.3 |
| 2005 | 47.9 | 9.6 | 14.7 | 11.2 | 83.5 |
| 2006 | 47.8 | 7.8 | 16.3 | 11.6 | 83.5 |
| 2007 | 37.8 | 9.2 | 15.4 | 16.0 | 78.5 |
| 2008 | 33.9 | 14.5 | 19.3 | 15.2 | 83.0 |
| 2009 | 56.3 | 5.7 | 10.6 | 10.9 | 83.5 |
| 2010 | 66.5 | 5.6 | 9.4 | 4.8 | 86.3 |
| 2011 | 62.3 | 4.2 | 11.5 | 5.6 | 83.6 |
| 2012 | 62.7 | 3.2 | 9.8 | 6.7 | 82.4 |
| 2013 | 63.3 | 3.5 | 10.6 | 5.2 | 82.6 |

### 8.1.3 Different Trends for Main Import Products, Evident Advantages in Source Countries

One of the main dairy products imported into China is whole milk powder. In 2001, China imported only 0.0593 million tons of milk powder. Then, as domestic milk powder output increased in the years thereafter, the growth rate of milk powder imports continued to decline. There was even negative growth in 2005 and 2007. This trend continued until 2008, when milk powder imports were as low as 0.1018 million tons (see *Attachment B: Table B1 – Table B3*). However, the trend reversed after the melamine incident in 2008. Consumers pervasively questioned the quality of domestically produced milk powder and turned to the imported milk powder instead. Since then, imports of milk powder have increased substantially (see *Figure 8.2*). In 2013, milk powder imports reached a record high of 0.8637 million tons, up 49.15% from 2012.

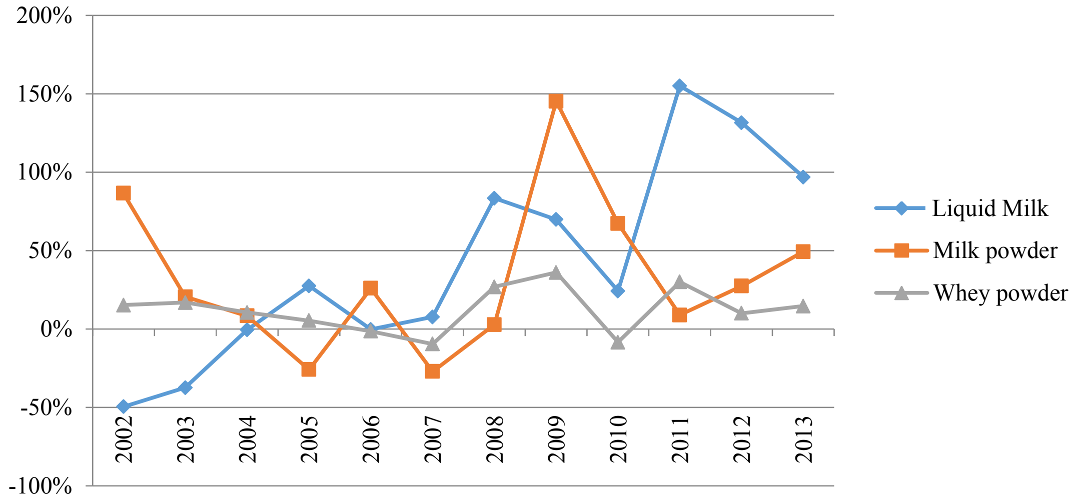



**Figure 8.2 Import growth rate of major dairy products to China**

Of the major source countries, New Zealand provides more than 60% of China's imported milk powder. This is partly due to the low production costs in New Zealand's dairy industry. Its dairy production sector applies an advanced, effective and low-cost grazing and production system, so the cost of feed only accounts for 15% of milk cost, which is very competitive in the international market. In addition, the free trade agreement signed by China and New Zealand in 2008 led to a significant increase in the import quota from New Zealand and a reduction in import tariffs. This strengthened the leading role of New Zealand in the milk powder import market. Specifically, China imported 0.8637 million tons of milk powder in 2013, 80.35% of which was imported from New Zealand. This increases the dependence of China's market on New Zealand milk powder, whose price largely determines the milk powder price in China. For instance, there was a reduction in production of New Zealand milk powder in 2013, which resulted in a drastic rise in the price of imported milk powder, from 3,364.41 USD/ton in 2012 to 4,195.53 USD/ton in 2013, an increase of 24.70%.

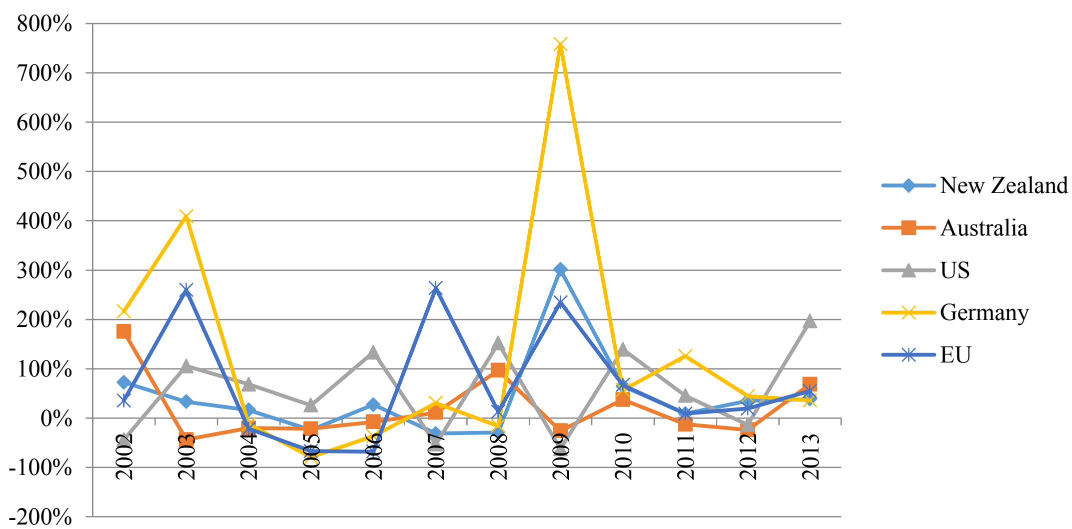



**Figure 8.3 Import growth rate of milk powder by source country**

China does not import large amounts of liquid milk, but the rate has been rapidly increasing in recent years. In 2001, imports of liquid milk totaled only 9,600 tons but in 2013, that had increased to

0.1948 million tons. The growth rate was as high as 155.03% in 2011. Importing liquid milk helps break the monopoly of domestic dairy companies to some extent. The US and the EU are large players in China's liquid milk import market. For instance, liquid milk imports from the US increased by 651.39% in 2011. Since that year, imports from Germany continue to increase at a rate of over 50% (see *Figure 8.4*).

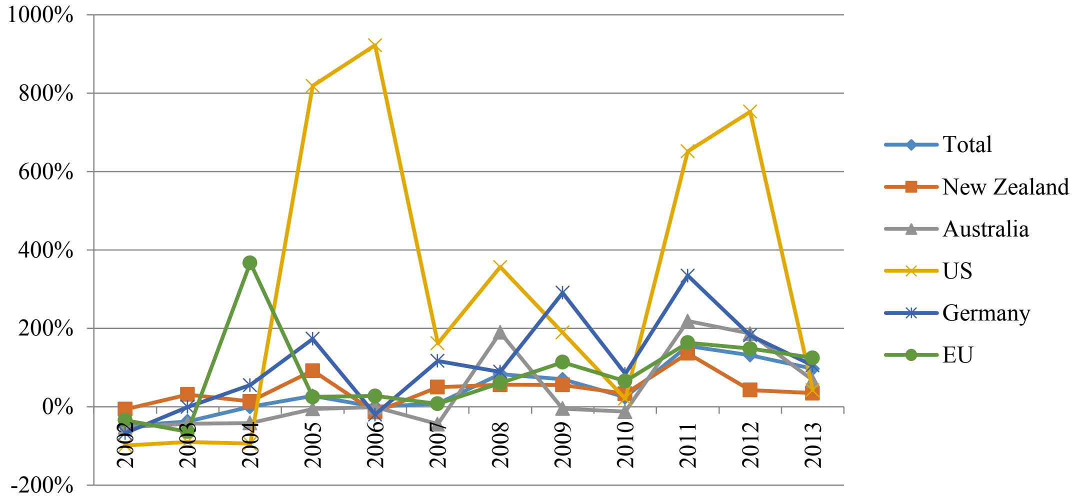



**Figure8.4 Import growth rate of liquid milk by source country**

Unlike the accelerated increase in imports of milk powder and liquid milk, imports of whey powder to China are comparatively stable. Whey powder is mainly used for feed and food processing. *Figure 8.5* shows that, despite a fluctuation in the exports of whey powder from the US and the EU, imports into China have maintained a steady growth. This is due to consistent demand for whey powder in China's market.

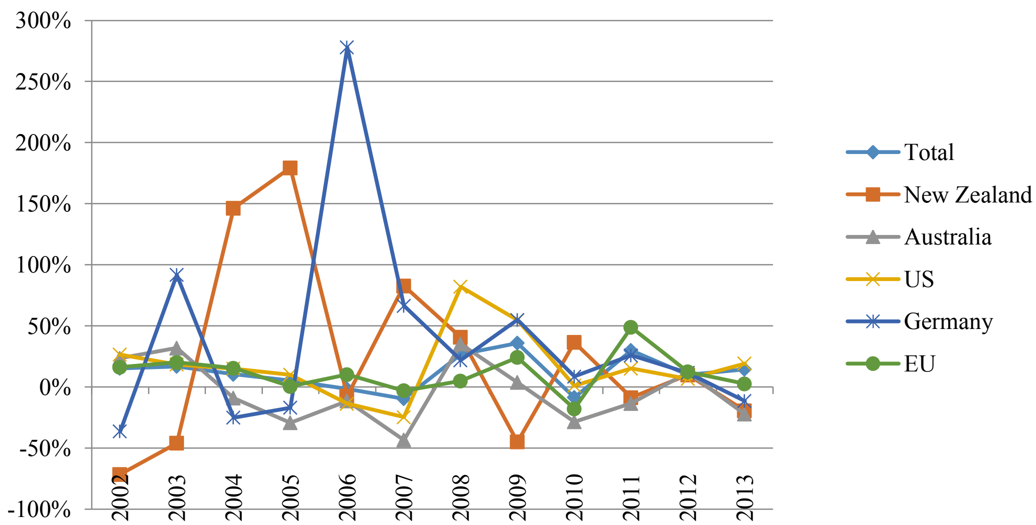



**Figure8.5 Import growth rate of whey protein powder by source country**

## 8.1.4. Import Price Grows Gradually

Prior to 2002, China imposed high import tariffs on dairy products. The import tariffs for liquid milk and milk powder were 25%, and were up to 50% for butter and cheese. After tariff cuts from 2002 through 2004, tariff rates for dairy products were lowered to a minimum level as China had promised upon entry into the WTO. The tariff for liquid milk dropped from 25% in 2001 to 15% in 2005, milk powder from 25% to 10%, and cheese from 50% to 12%, all of which were far below the global average tariff of 100%. The successive declines in import costs helped stabilize prices for imported dairy products, under the condition of strongly growing domestic demand and continuously increasing production costs. There was only a slight increasing trend (see *Figure 8.6*). Compared to the prices of domestic dairy products, prices of imported products (specifically milk powder products) increased only slightly, despite the fluctuation and growth trend. To sum up, domestic dairy products in China have had no competitive advantage since 2009.

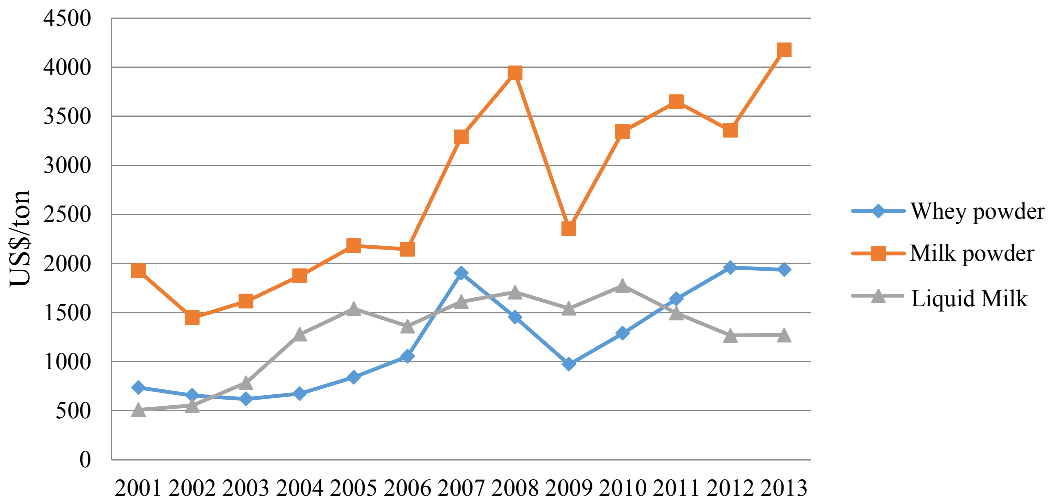



**Figure 8.6 Prices of major dairy products imported into China**

## 8.2 CHINA'S DAIRY EXPORTS (2001-2013)

### 8.2.1 China's Dairy Exports Are Limited

Dairy exports from China remain low (see *Figure 8.7*). The melamine incident in 2008 was the watershed in China's dairy export. Before 2008, dairy exports increased steadily along with the rapid growth of the domestic dairy industry. From 2001 to 2008, the growth rate of China dairy exports averaged 14.88% in quantity and 32.96% in value. Along with the rapid increase in exports, the structure of the exports was also being expeditiously optimized. However, exports were impeded after 2008. From 2009 to 2013, the average growth rate of dairy exports fell to 0.59% in quantity and 1.12% in value, with a slow pick-up trend. Comparing import value with sum of export, the former was 4.53 times the latter in 2001 while it was 43.01 times in 2013.

### 8.2.2 Monotonous Export Varieties and Destination Countries

The main Chinese dairy exports are skimmed milk powder and liquid milk. The export of whey powder is very limited because the production of cheese is small and, hence, so is its byproduct. In 2003, 2006 and 2012, there was no exports of whey powder; in 2013, whey powder exports reached a high of 632.96 tons. China's liquid milk is mainly exported to Hong Kong, Macau, and Southeast Asia, for technology-related reasons. Despite the ease of storage and transportation for milk powder, and the more extensive exporting areas compared to fresh milk, the destination countries are exceedingly concentrated and its demand is highly variable. One example is China's exports to Venezuela, which accounted for almost 50% of all exports in 2008 but fell to zero in 2010. Because of the unstable political environment in these countries and regions, and the possible civil reforms, China's dairy exports were directly jeopardized by increasing export risks.

### 8.2.3 Export Price

There are no data on the price level of whey powder exports, because the volume is low and even down to zero in several years. Between 2001 and 2013, the export price of liquid milk remained stable.

Compared to imported products in the same category, the export price was constant but at a lower level on average. In terms of milk powder, China's exported milk powder experienced larger price variations than imported milk powder, but the variation cycle was different. Specifically, the price of imported milk powder decreased by 40.34% in 2009, but increased in other years. On the contrary, that of exported milk powder decreased by 21.26% in 2009, and declined by a further 12.21% in 2010 (see *Figure 8.8*). Overall, the price of exported domestic milk powder was generally higher than that of imported milk powder, which may reflect the fact that China's exported milk powder is a high-end product.

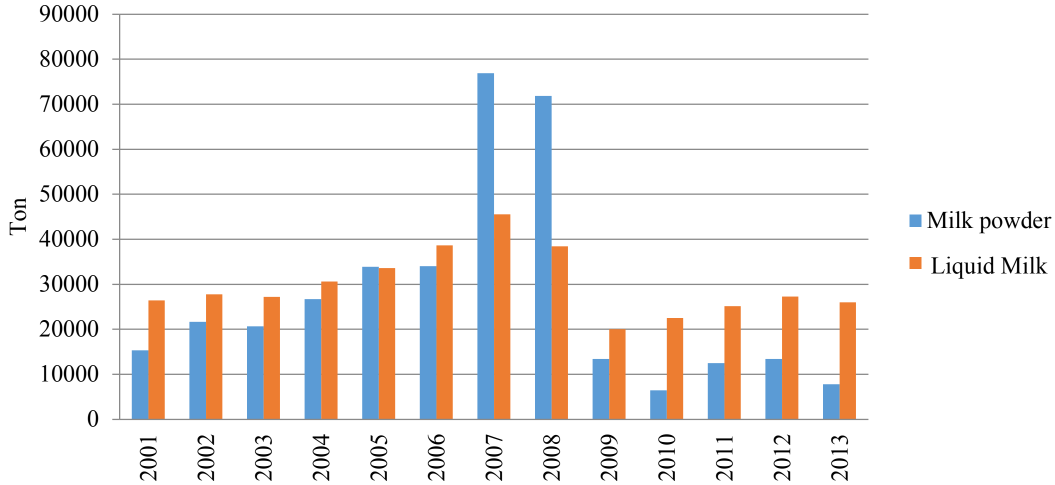



**Figure 8.7 Chinese exports of major dairy products**

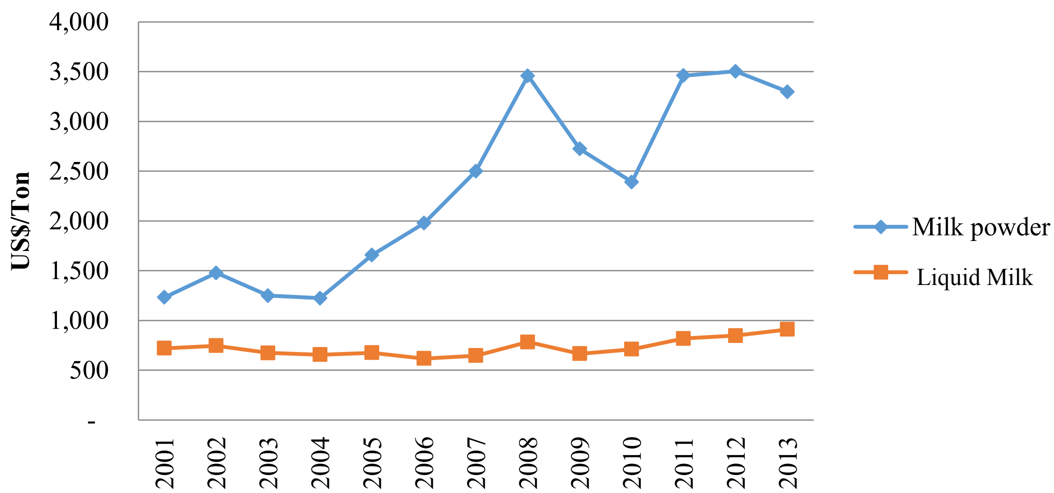



**Figure 8.8 Prices of major dairy products exported by China**

## 8.3 OUTLOOK FOR DAIRY IMPORTS AND EXPORTS IN CHINA

Generally speaking, there has always been a trade deficit in China's dairy market as it is a net importer of dairy products. After WTO entry, the import of dairy products greatly increased due to the lowered tariffs. From 1995 to 2012, the import value of dairy products increased from 0.058 billion dollars to 3.213 billion dollars, with an annual growth rate of 26.6%; meanwhile, the export value increased from 0.027 billion dollars to 0.082 billion dollars, with a low annual rate of 6.8%. The unfavorable balance rose from 0.031 billion dollars in 1995 to 3.131 billion dollars in 2012. It is anticipated that China will continue to be a net importer of dairy products in the coming years.

# CHAPTER 9
# DAIRY CONSUMPTION IN CHINA

The data on dairy consumption in China is highly scattered, and often inconsistently measured. Moreover, most data are at national or provincial level, which makes the analysis of dairy consumption and market development at micro level extremely difficult. To overcome the issue of scanty data, the Sino-Dutch Dairy Development Center (SDDDC) at China Agricultural University recently launched a consumer survey. The survey was conducted through telephone interviews. An effective sample size is 941 families, covering all the provinces, municipality cities and autonomous regions in China, except Ningxia autonomous region, Hong Kong and Macau. The sampling and organizational methods of the survey are presented in *Attachments A*. In this section, we mainly focus on the discussion of current dairy consumption, its influencing factors and the market trends based on this survey data. The data source for all figures and tables is our survey, if not stated otherwise.

## 9.1 MILK CONSUMPTION IN CHINA, PAST AND PRESENT

Since 2010, the percentage of milk consumers, consumption frequency, and per capita consumption of milk have all increased significantly, but per capita consumption at one time largely remains at a single bag (approximately 250 grams) with no obvious change. The survey shows that in 2014, 45% of consumers consumed milk at least 3-4 times per week, which is an increase of 7% compared to 2010. Meanwhile, only 12% of the consumers surveyed did not consume milk at all in 2014, compared to 16% in 2010 (see *Figure 9.1*). As for consumption per time, above 90% of consumers consume 250 grams, while 6-7% consumers consume two bags (approximately 500 grams) per time. There was no significant change in consumption per time from 2010 to 2014 ((see *Figure 9.2*). However, because of the increases in consumption frequency and number of milk consumers, per capita milk consumption has increased from 31 kilograms per capita in 2010 to 35 kilograms per capita in 2014, a rise of about 16% (see *Figure 9.3*).

There are significant regional differences in milk consumption. Firstly, milk consumption differs markedly between rural and urban areas. On the basis of the registered residence, the proportion of milk consumers and milk consumption frequency in urban areas are both much higher than that in rural areas (see *Figure 9.4*). In 2014, 53% of urban consumers in the sample consumed milk at least 3-4 times per week, compared to only 27% of rural residents. In the same period, the percent of urban consumers that did not consume milk was less than 10%, which is far below the 18% of rural non-consumers. The rural-urban gap in milk consumption percentage and consumption frequency was more evident in 2010. Similarly, when comparing per capita milk consumption in 2014, rural per capita consumption of milk was about 60% of urban per capita consumption. Yet over the period from 2010 to 2014, both rural and urban per capita milk consumption increased significantly (see *Figure 9.5*). Per capita consumption per year increased from 36 kilograms to 40 kilograms in urban areas and from 19 kilograms to 24 kilograms in rural areas, the latter having a wider margin.

Secondly, per capita milk consumption has significant regional discrepancy. In general, Northeast and North China (not including Shandong Province and Hebei Province) had a higher level of per capita milk consumption. Specifically, Heilongjiang Province and Inner Mongolia autonomous region ranked as the top two of all provinces in 2014, with per capita milk consumption of 44 kilograms and 43 kilograms per year, respectively. In contrast, Yunnan Province, Guizhou Province, Guangxi autonomous region in the Southwest, Shandong Province, Anhui Province in East China, and Gansu Province and Xinjiang autonomous region in the Northwest all had lower consumption levels. This may be due to the consumption of substitutes, such as ewe's milk or mare's milk, etc. (see *Figure 9.6*).

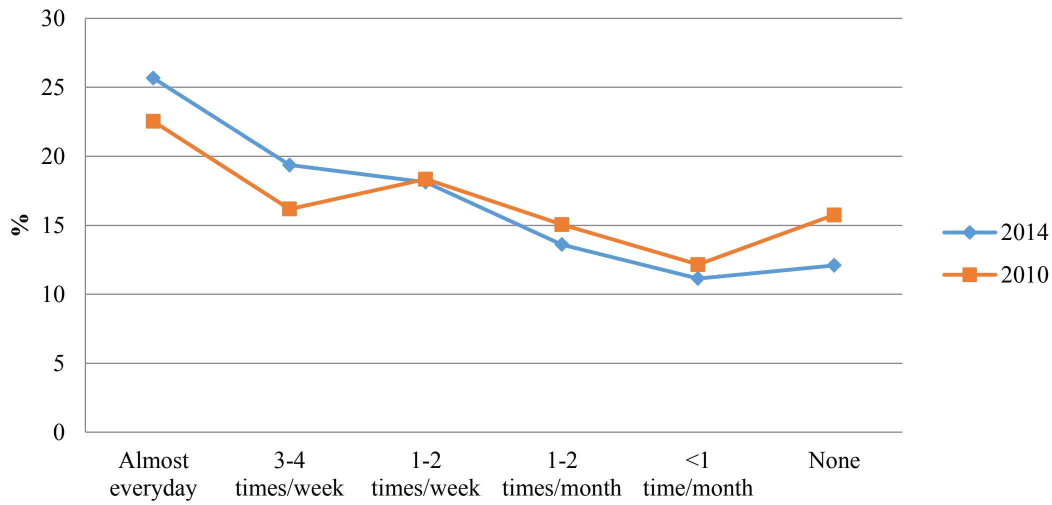
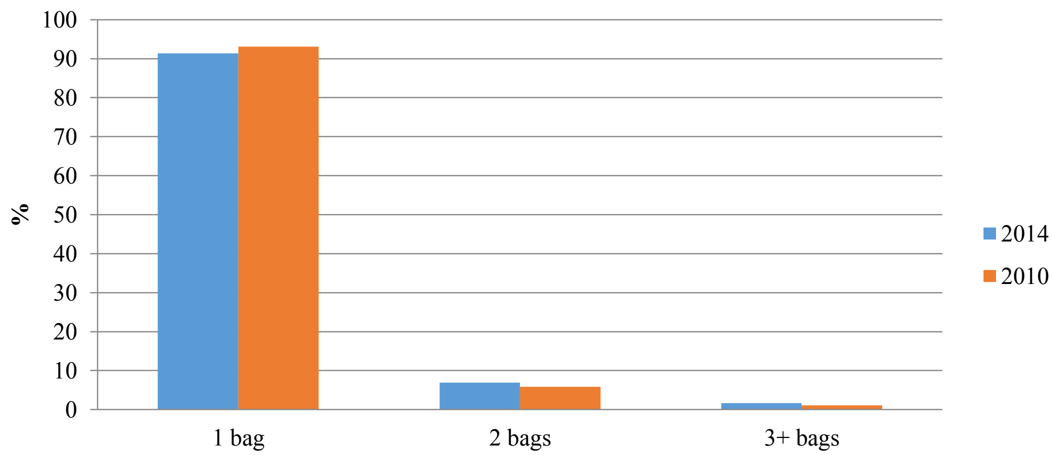



**Figure 9.1 Consumption frequency of liquid milk**




**1 bag=250g**

**Figure 9.2 Liquid milk quantity consumed per time**

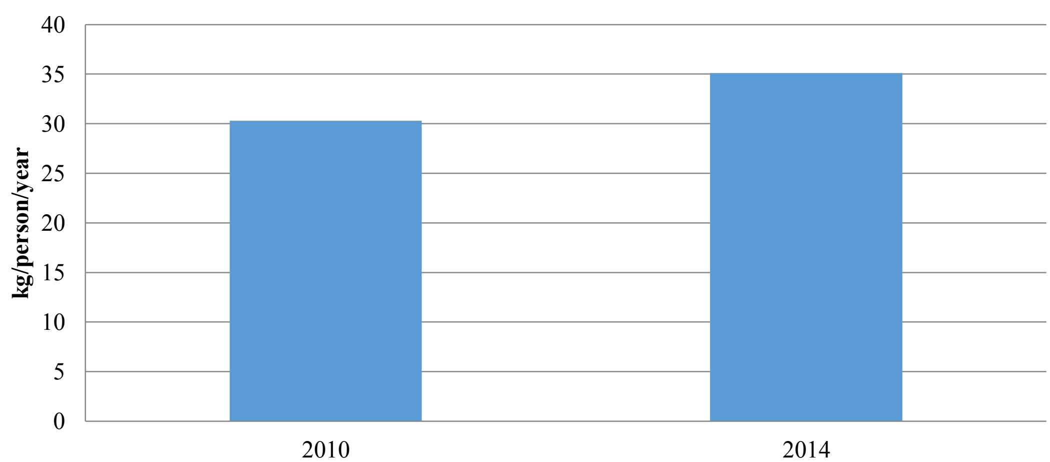



**Figure 9.3 Yearly per capita liquid milk consumption**

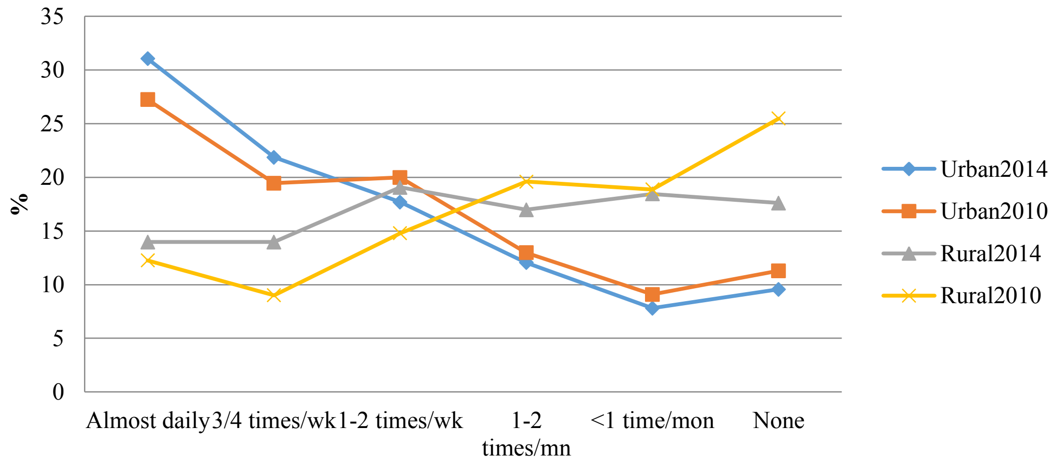



**Figure 9.4 Frequency of liquid milk consumption by Hukou Registration**

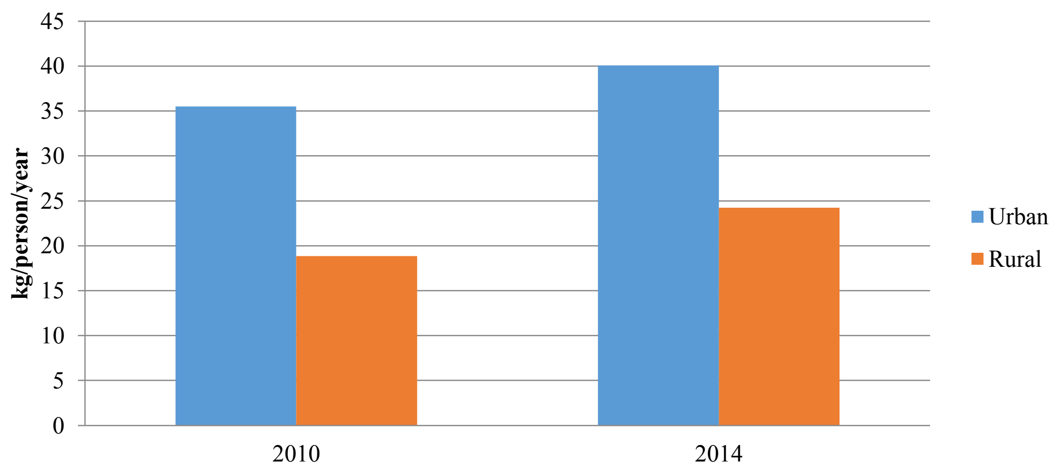



**Figure 9.5 Yearly per capita liquid milk consumption by Hukou Registration**

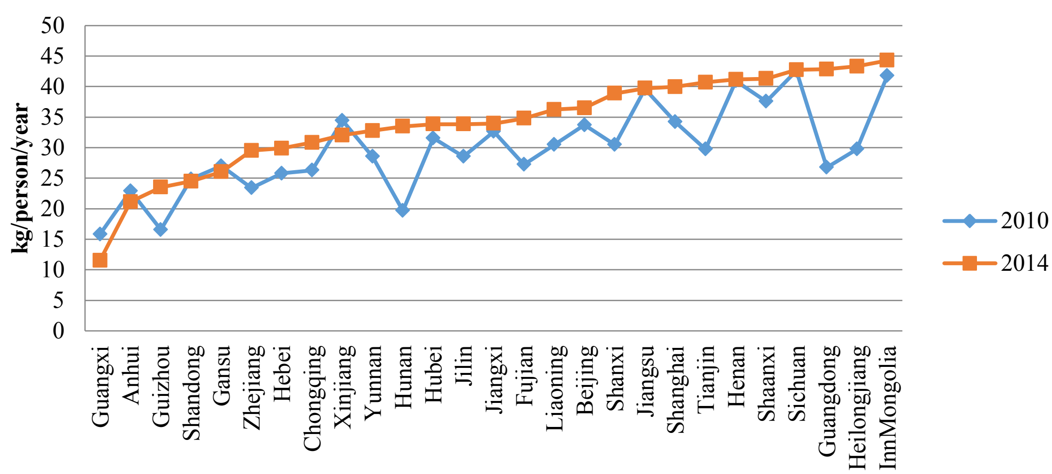
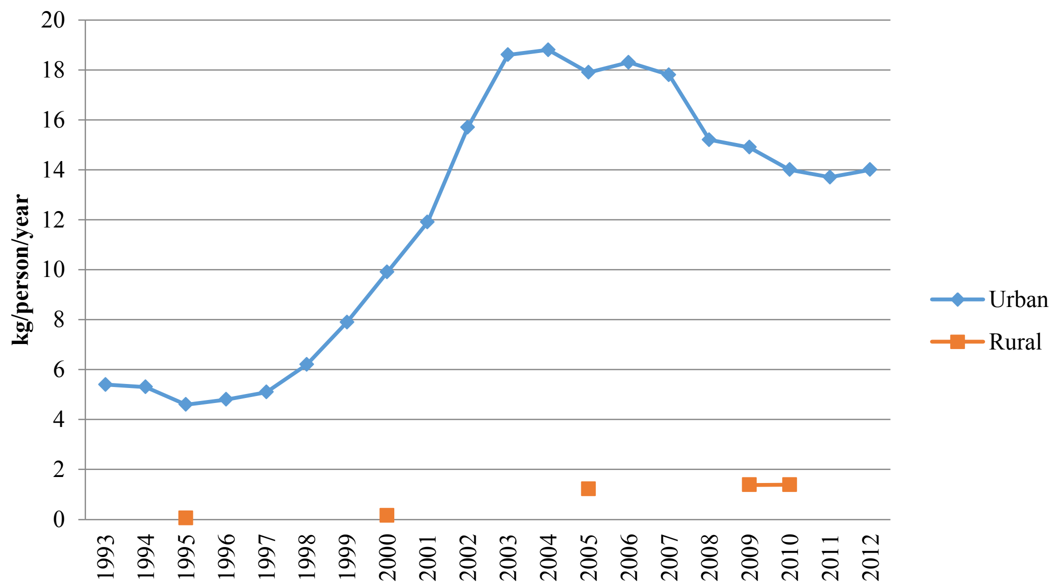



**Figure 9.6 Yearly per capita liquid milk consumption by province**

One caveat is that the per capita consumption of liquid milk from our survey data is far above the level reported by the National Bureau of Statistics of China (NBSC). According to the NBSC (see *Figure 9.7*), the annual per capita consumption of fresh milk among urban families was only about 5 kilograms before 1997, whereas the rural consumption in the corresponding period was close to zero. The urban per capita consumption of fresh milk increased rapidly from 1997 to 2003, reaching 18.6 kilograms per year, and then decreased. In 2012, urban per capita consumption dropped to 14 kilograms or so, which was the equivalent level of 10 years before (2002). Despite the notable incompleteness of the rural data, we can still see a modest trend from *Figure 9.7* indicating that rural per capita consumption of fresh milk has experienced some growth since 2000. Yet the growth was rather slow, and annual per capita consumption was still less than 2 kilograms in 2010. Compared with *Figure 9.5* we can tell that the per capita milk consumption level reported by NBSC is far below our survey results. There may be multiple explanations for this. First, there is criticism of NBSC's food consumption data and statistics, namely that they are severely underestimated, which is related to NBSC's sampling and survey methods. Second, our survey sample represents a somewhat special group (e.g. households whose head is around 40-45 years old, with children or friends and relatives' children in college). This group of consumers might have different milk consumption behavior than the population. We need further investigation to test the latter two hypotheses.




**Data source: National Bureau of Statistics of China**

**Figure 9.7 Yearly per capita liquid milk consumption reported by NBSC**

Ultra-heat treated (UHT) milk has a larger market share than pasteurized milk, especially in rural areas. Our survey shows that about 65% of the milk that Chinese families purchased and consumed in 2014 was UHT milk, whereas only 35% was pasteurized milk (or fresh milk) (see *Figure 9.8*). UHT milk has a larger share (73%) in rural areas, considerably exceeding the share in urban areas (62%). This probably has to do with the lower incidence of refrigerators in rural areas and the longer distance to supermarkets (see *Attachment A*).

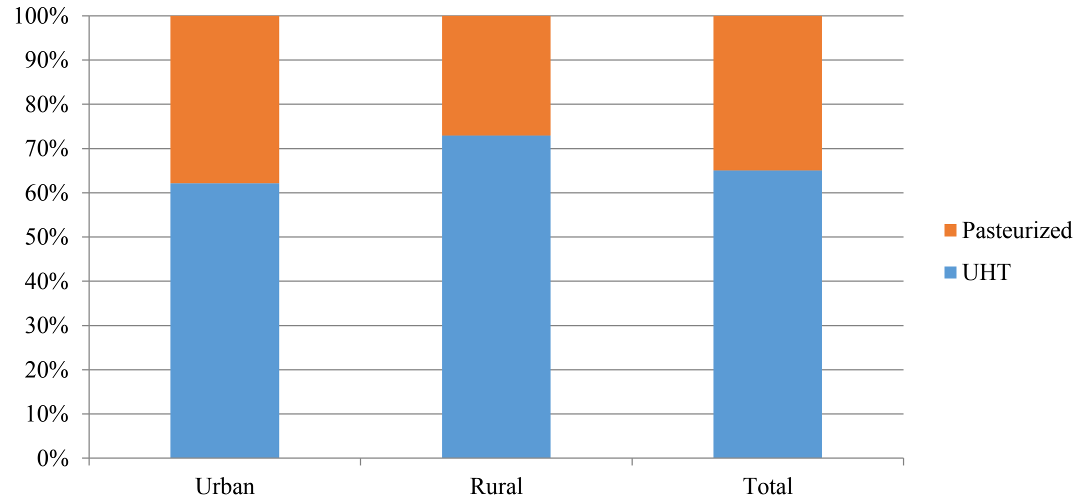



**Figure9.8 UHT versus pasteurized milk**

## 9.2 THE CONSUMPTION OF YOGURT, MILK POWDER AND CHEESE

Yogurt is a popular dairy product in China, but there is a significant divergence between rural and urban areas. Our survey shows that among the total of 3,051 individual consumers, only less than 20% claim to never consume yogurt while about 55% of consumers eat it at least once per week and 30% 3-4 times or more per week on average (see *Figure 9.9*). However, the consumption of yogurt is much higher in urban areas than in rural areas when comparing the proportion of yogurt consumers and consumption frequency (see *Figure 9.10*). The proportion of consumers that do not consume yogurt is above 30% in rural areas.

Unlike milk and yogurt, only a very small portion of consumers use milk powder and cheese, and their consumption frequencies are quite low. As shown in *Figure 9.9*, consumers who never consume milk powder or cheese total 67% and 72%, respectively. And respectively 14% and 13% of consumers claim to consume these two dairy products less than once per month. There is no significant difference between rural and urban areas in the lower portion of consumption proportion and frequency of milk powder and cheese.

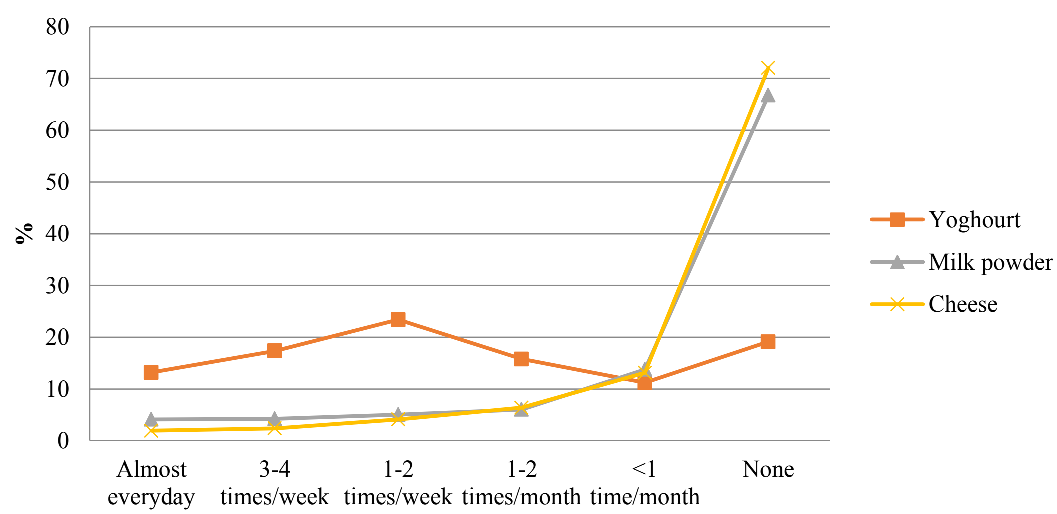



**Figure 9.9 Consumption frequency of yogurt, milk powder, and cheese**

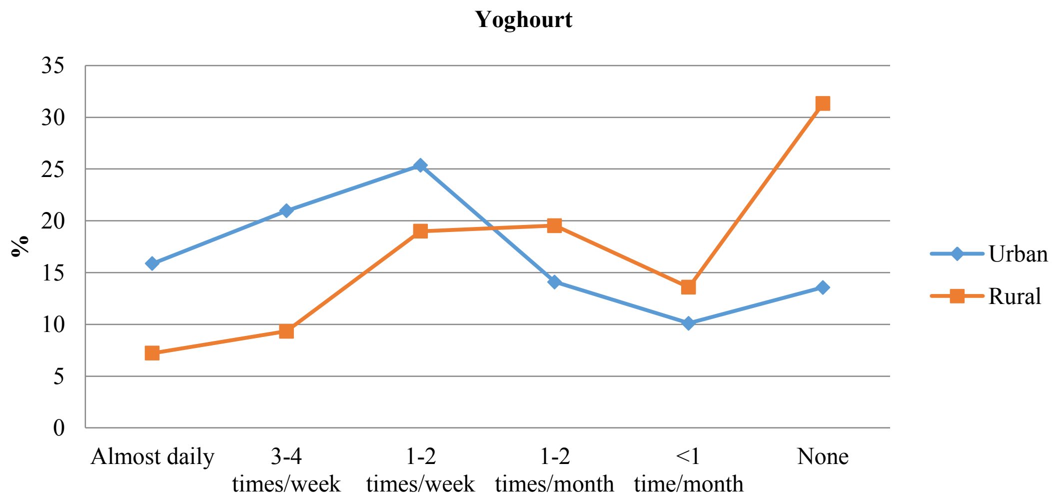



**Figure 9.10 Consumption frequency of yogurt, urban vs. rural**

## 9.3 PURCHASING BEHAVIOR AND WILLINGNESS OF FAMILIES FOR DAIRY PRODUCTS

Supermarkets are the primary venue where Chinese consumers purchase dairy products. Our survey shows that more than 70% of consumers primarily purchase milk, yogurt, milk powder, and cheese in supermarkets (see *Figure 9.11*). In addition, nearly 20% of families surveyed purchase milk and yogurt in convenience stores, which are also where 10% and 8% of the sample families purchase milk powder and cheese, respectively. It is worth noting that a small but expanding proportion of surveyed households purchase milk powder and cheese online (about 3-4%). This is closely related to the rapid development of electronic commerce and logistic systems in China. It would be interesting to analyze the roles this channel will play in dairy retail in the future.

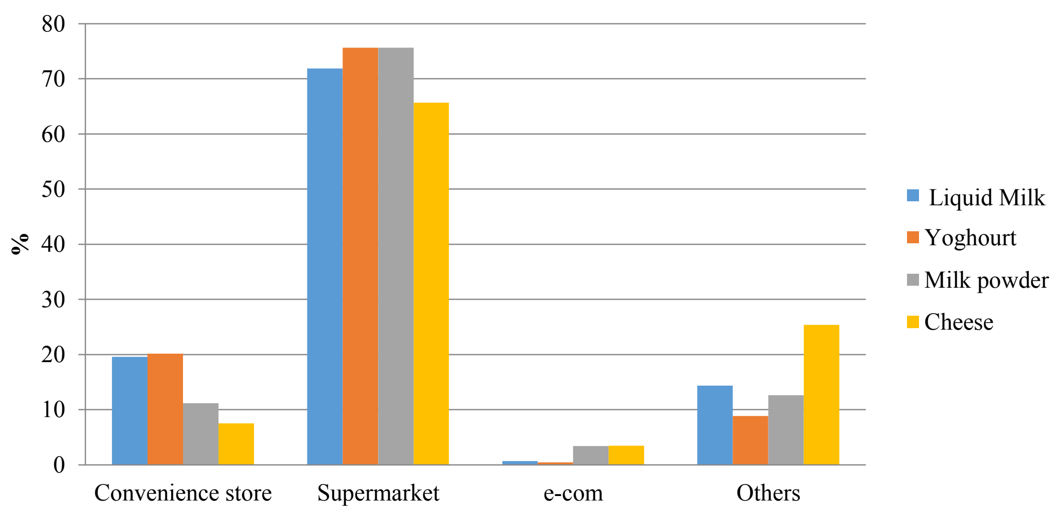



**Figure 9.11 Primary shopping venues for milk products**

Package /shelf-life date, brand, and safety certification are the three most frequently cited factors consumers consider when making their milk purchase decisions. *Figure 9.12* shows that over 90% of surveyed families rank package/shelf-life date as one of the three top determinants, while 62% and 57%

list brand and safety certification as top-three factors. About 40% of respondents said price is one of the three leading factors.

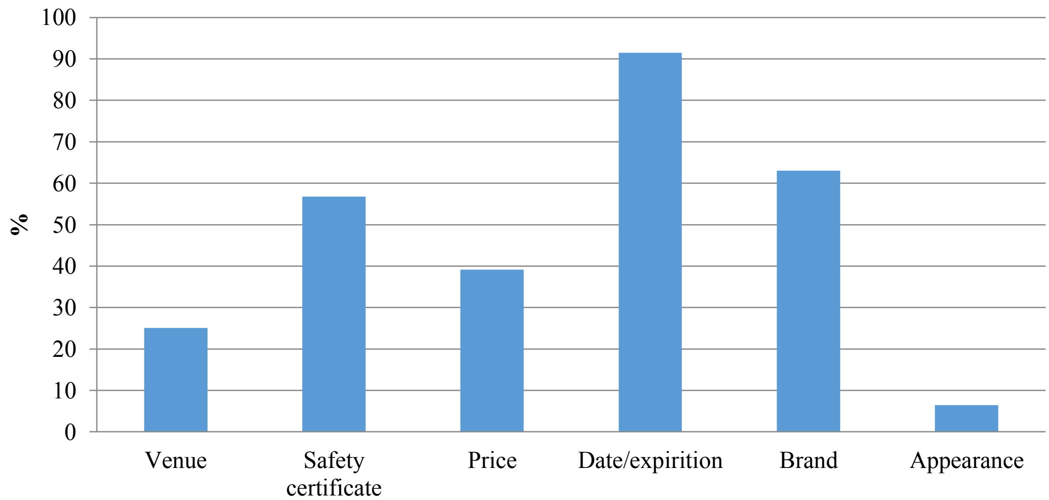



**Figure 9.12 Top factors in determining liquid milk purchase decision**

Most consumers prefer domestically produced to imported milk powder, all things being equal. Our survey shows that about one-third of consumers tend to choose imported brands when making milk powder purchasing plans (see *Figure 9.13*). Information transparency for imported brands is the most crucial reason for choosing imported milk powder. Among those who prefer imported brands, 73% consider them to be more trustworthy; 9% choose imported brands for price reasons and 9% due to better taste (see *Figure 9.14*). Comparatively, lower price was the main reason most consumers choose to purchase domestic milk powder.

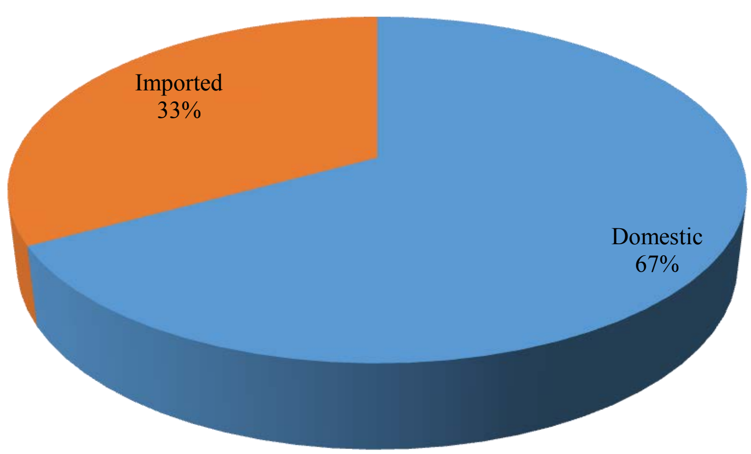



**Figure9.13 Preferred places of origin for milk powder**

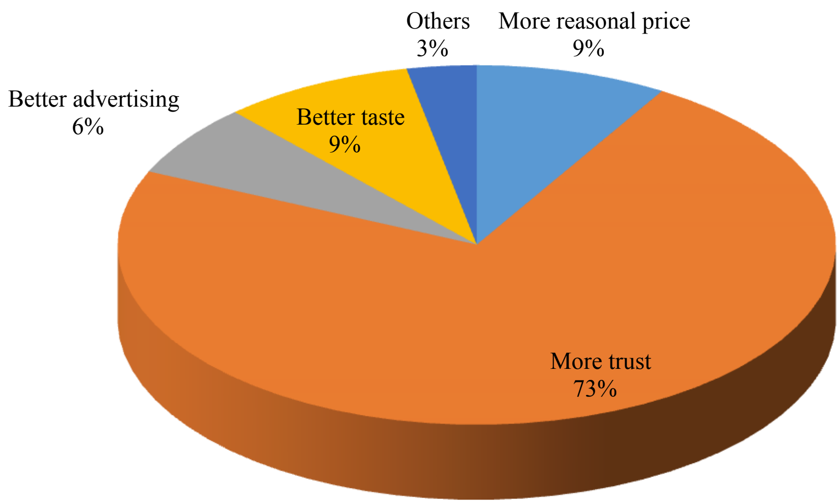



**Figure 9.14 Major reasons for preferring imported to domestically produced milk powder**

## 9.4 THE MAIN DETERMINANTS AND FUTURE TRENDS FOR DAIRY CONSUMPTION

### 9.4.1 The Major Driver for Dairy Consumption is Income Growth, Which Will Have Multifaceted Effects on Future Trends of Dairy Consumption in China.

Income growth has significantly increased the frequency and quantity of dairy product consumption, and will continue to be the major driving factor, especially in rural areas. As indicated by our survey, per capita milk consumption in urban areas is increasing in a sustained manner along with the rising disposable income level of urban families. Per capita milk consumption jumps from 33 kilograms per year to 47 kilograms per year when family monthly disposable income increases from below 4,000 yuan to above 14,000 yuan (see *Figure 9.15*). In rural households, per capita milk consumption remains around 20-30 kilograms per year until income attains the highest group level of 14,000 yuan/month. After it reaches or exceeds 14,000 yuan, milk consumption per capita is the same in rural and urban areas for the same income groups. A similar relationship exists between consumption frequency and income. Take the example of milk. Nearly 40% of consumers in the highest income group (14,000 yuan/month and above) consume milk almost every day. This percentage drops to below 20% for the lowest income group (below 4,000 yuan/month) (see *Figure 9.16*). The results are similar for yogurt (see *Figure 9.17*). This implies that income may still be the most restraining factor in current dairy consumption in China's rural areas. However, given the expected income growth in rural China in the future, demand for dairy products from rural residents may rise significantly.

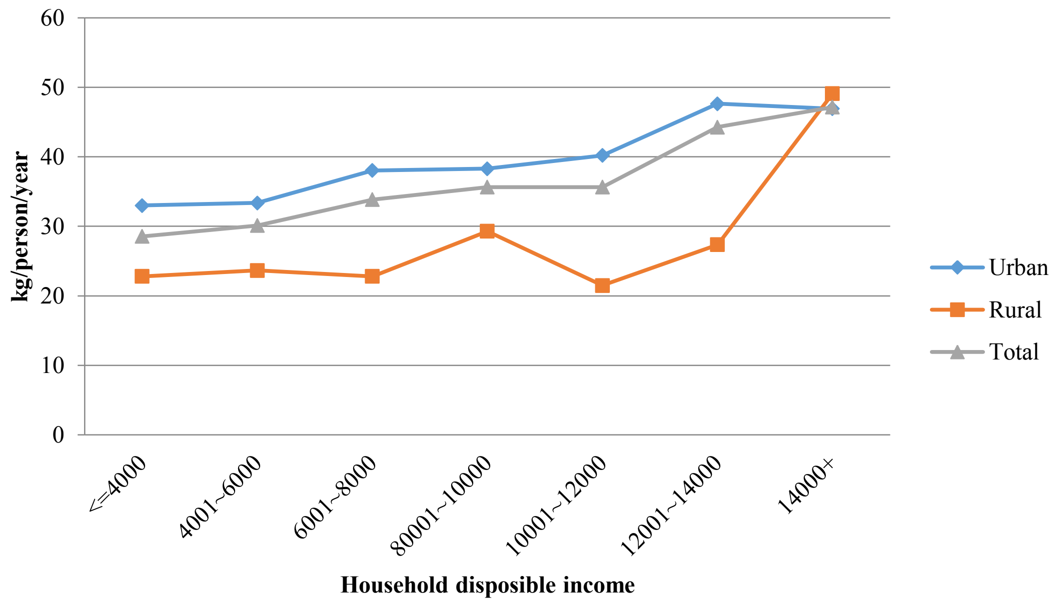



**Figure9.15 Yearly per capita liquid milk consumption by income**

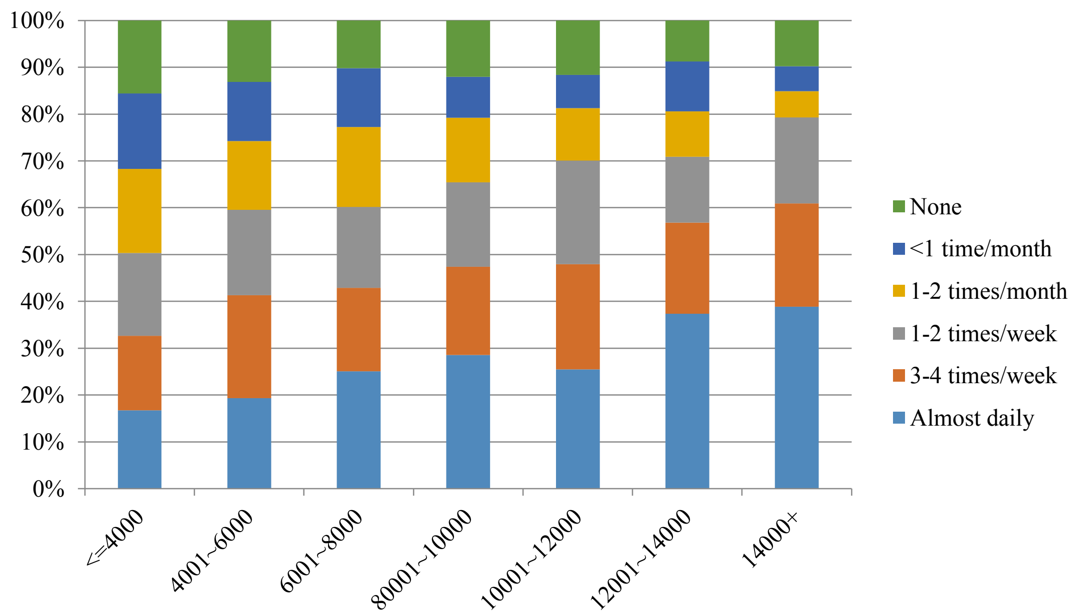



**Figure9.16 Liquid milk consumption frequency by income**

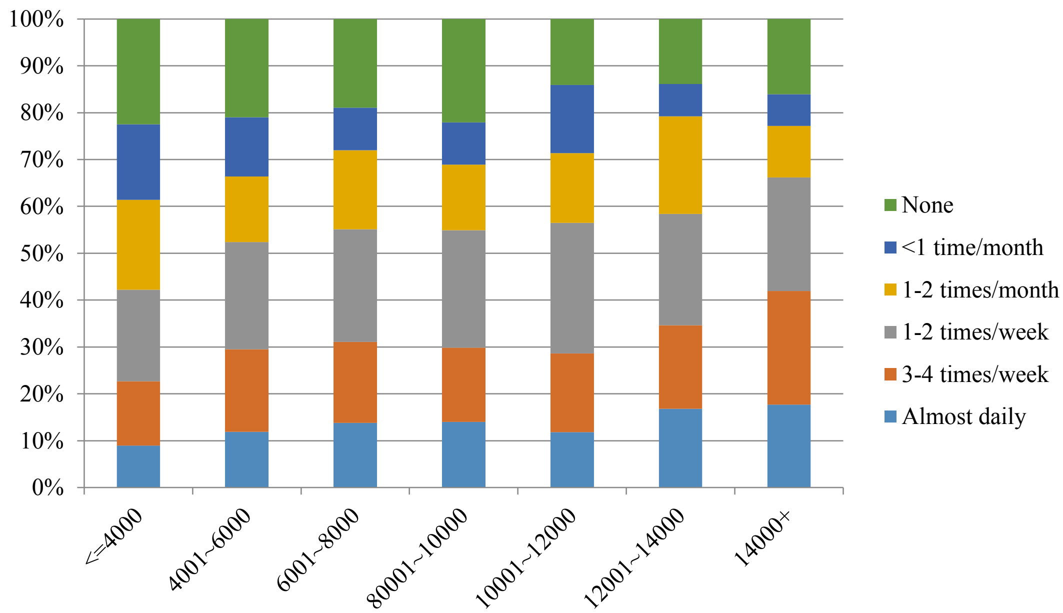



**Figure 9.17 Yogurt consumption frequency by income**

An increase in income may lead to a significant decrease in the share of UHT milk consumption and a significant rise in the share of pasteurized milk consumption. *Figure 9.18* shows that when a household's monthly disposable income is below 10,000 yuan, UHT milk maintains the leading proportion (two-thirds) of household consumption whereas pasteurized milk accounts for one-third. The share of UHT milk swiftly decreases when income exceeds 10,000 yuan. In the group with monthly incomes of or above 14,000 yuan (approximately 4,800 yuan/month per capita), the proportion of UHT milk consumption drops to half. This means that given the expected rise in income, the market share of UHT milk will decrease significantly and that of pasteurized milk will have an opposite trend.

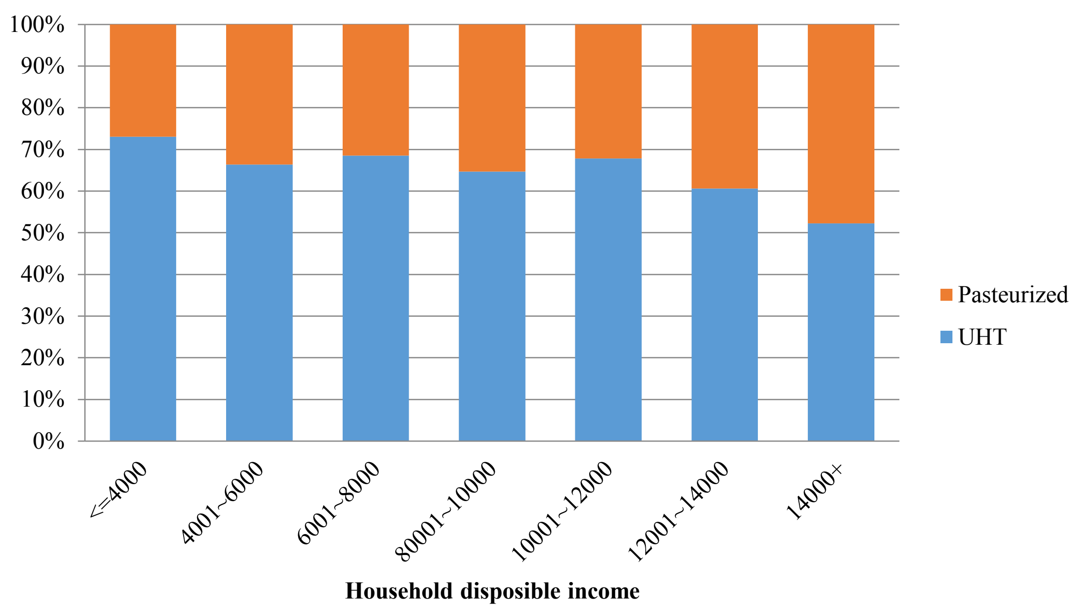



**Figure 9.18 Shares of UHT and pasteurized milk by income**

Demand for imported brands of milk powder significantly increase with income. *Figure 9.19* shows that only 20% of households tend to purchase imported milk powder when the household monthly disposable income is below 4,000 yuan (or monthly per capita income below 1,300 yuan). This proportion rises to 33% when monthly household income reaches 10,000 yuan (or 3,300 yuan per capita). This increasing trend speeds up when income climbs further. For the highest income group, the share of consumers willing to purchase imported milk powder reaches 55%, exceeding the share of domestic brand buyers. This implies that the relatively high price of imported brands and the comparatively low income level may be the main explanations for the low demand for imported milk powder. Therefore, market demand for imported milk powder is likely to go up quickly given the expectation of increasing incomes and purchasing power among Chinese consumers.

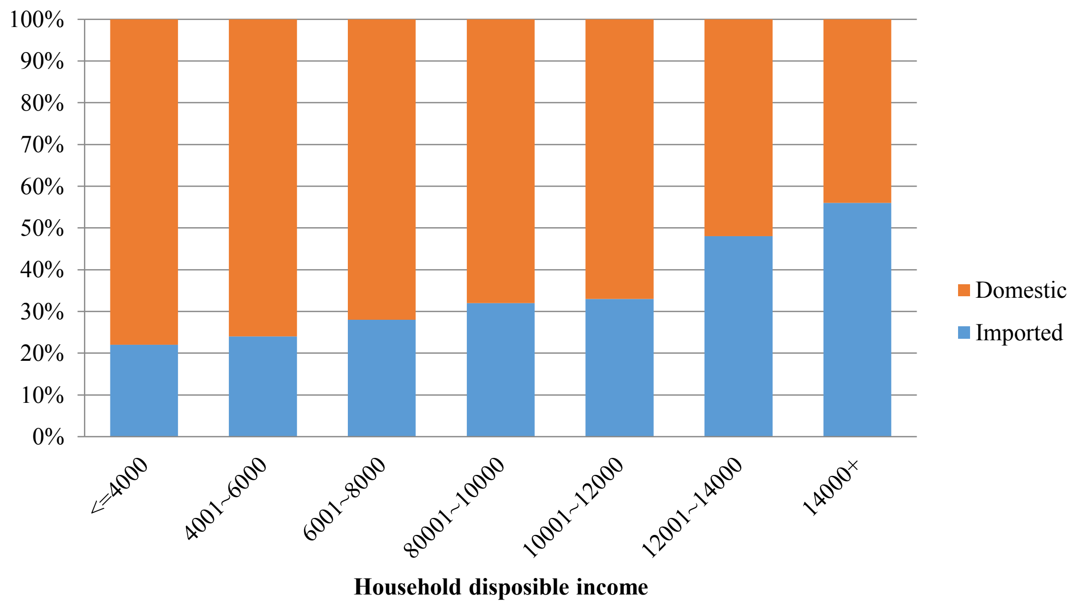



**Figure 9.19 Comparison of consumers' willingness to choose between imported and domestic milk powder**

## 9.4.2 Urbanization And Lifestyle Change May Be Another Boosting Factor For Milk Consumption.

In order to show the influence of urbanization on milk consumption, we divided the sampling individuals into four groups according to their registered residence and actual residence. The four groups are: registered in rural and residing in rural (RR), registered in rural but residing in urban (RU), registered in urban but residing in rural (UR), and registered in urban and residing in urban (UU). We find that per capita milk consumption is lowest in the RR group, followed by the RU group and the UR group. The highest consumption group is UU (see *Figure 9.20*). This stepwise comparison could be interpreted as rural migrants consuming more milk than rural residents, but not as much as urban residents. Meanwhile, after urban residents migrate to rural areas, their milk consumption decreases compared to when they lived in urban areas, yet is still higher than the consumption of original rural residents. In light of China's rapid urbanization, the share of the urban population will increase from the current 53% to above 75% in 2050, which may bring about a large increase in milk demand. However, our report cannot yet determine whether the consumption differences of the four consumer groups are entirely caused by urbanization. Clarification depends on further analysis of the survey data.

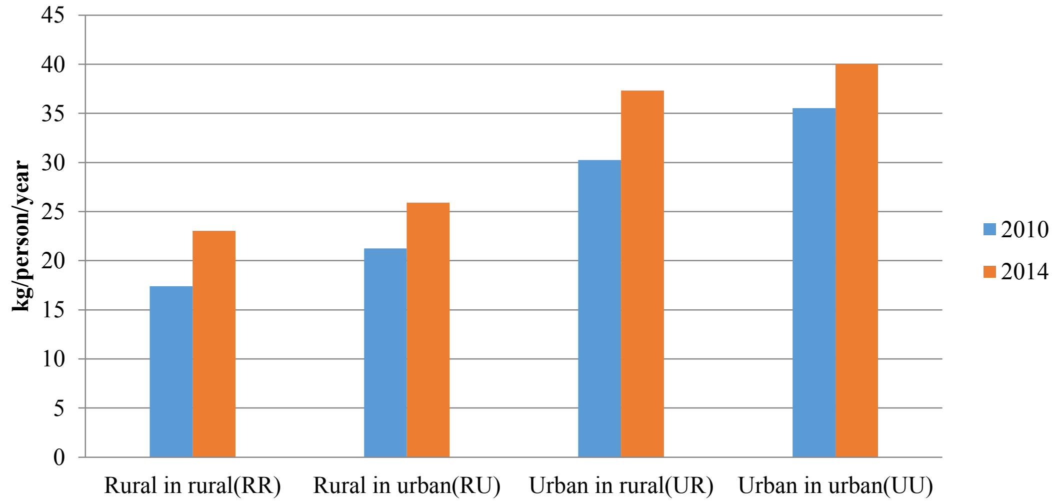



**Figure 9.20 Yearly per capita liquid milk consumption by residence**

### 9.4.3 Growth of Market Significantly Advances Milk Consumption.

The survey also shows that per capita milk consumption is much higher for families located close to supermarkets (with at least one supermarket within a radius of one kilometer) than those farther away, with each category respectively consuming 39 kilograms and 24 kilograms, per capita per year, on average (see *Figure 9.21*). Similarly, families consume 40 kilograms of milk per capita per year if they live within one kilometer of a Western-style fast food restaurant, which is 13 kilograms more than other families (see *Figure 9.22*). Moreover, families with members who have visited Western countries consume 47 kilograms of milk per capita per year, 16 kilograms more than families without such experiences (see *Figure 9.23*). These results indicate that the growth of the retail market and enhanced consumer awareness have significant positive effects on milk consumption.

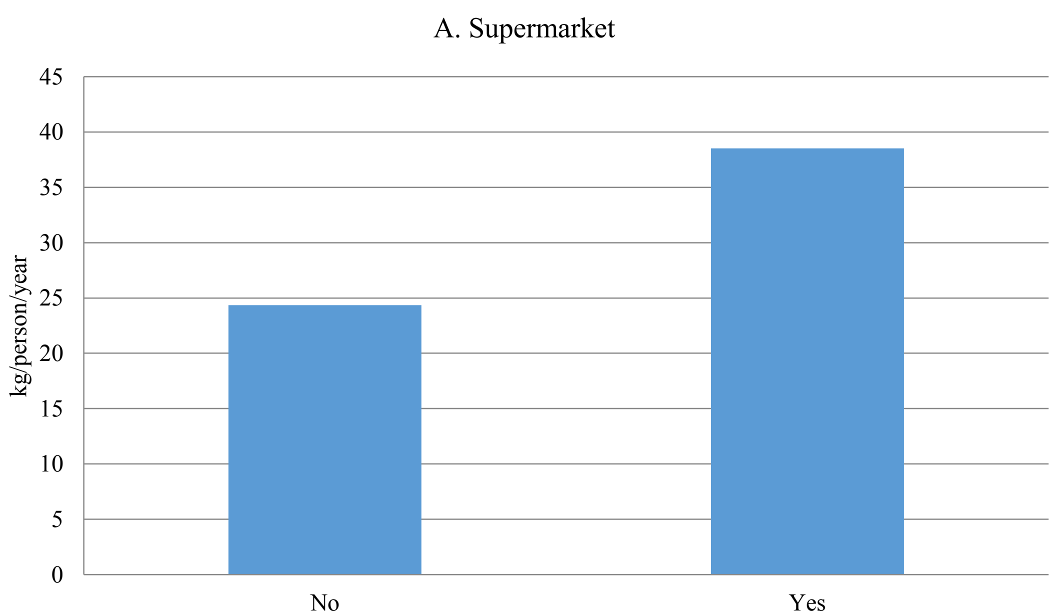



**Figure 9.21 Effect of supermarkets on fluid milk consumption**

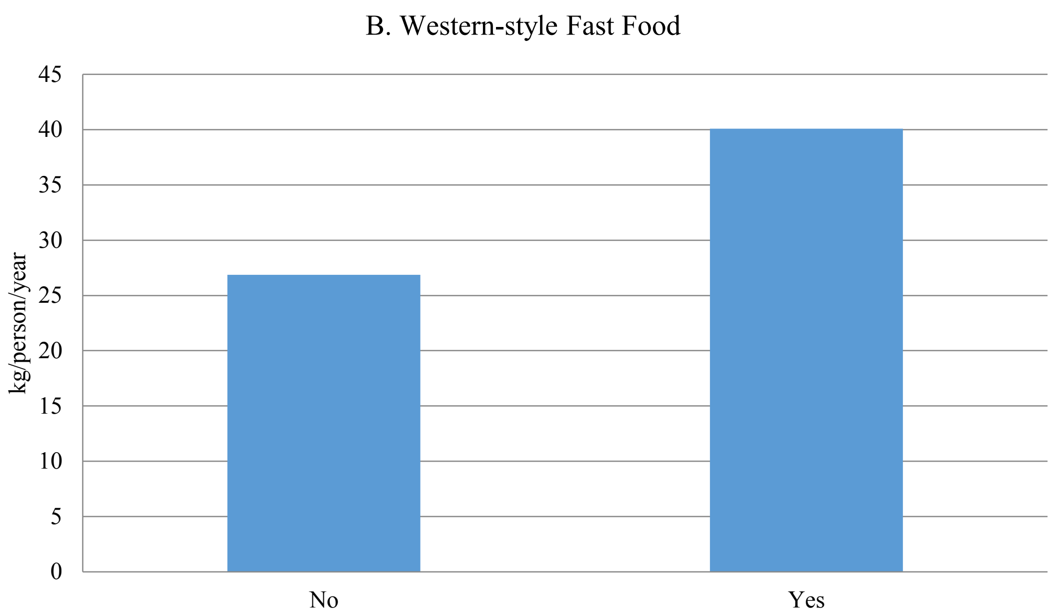



**Figure 9.22 Effect of Western-style fast food restaurants on liquid milk consumption**

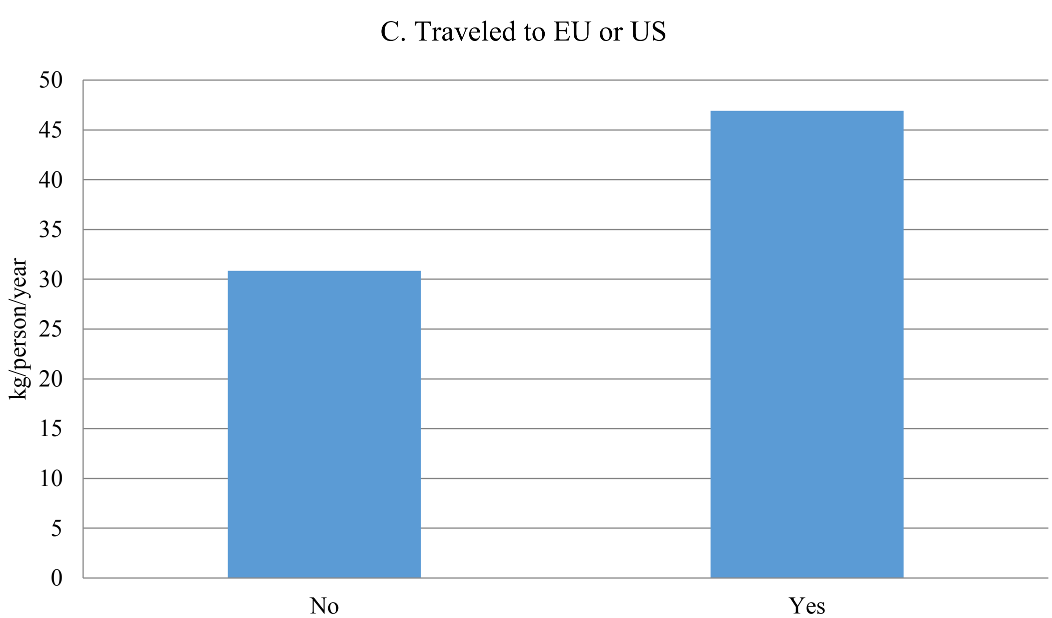



**Figure 9.23 Effect of Western country visits on liquid milk consumption**

# CHAPTER 10
# SUMMARY OF CHINA DAIRY CONSUMPTION

In this part, we studied the imports and exports of dairy products to and from China, and domestic consumption of major dairy products. The primary driving forces for dairy consumption and the future trends were also empirically discussed.

Over the last five to ten years, Chinese imports of dairy products, especially infant formula, rose steadily compared to the very low and slow growth of dairy exports during the same period. Moreover, the top source countries are stable, with high concentration after WTO entry. New Zealand, Australia, the US and France remained the top four source countries of China dairy imports. Meanwhile, the variety and destinations of China dairy exports are rather stable.

China dairy imports may continue to grow in the future, given the limited domestic supply capacity, the rising demand and consumers' concerns about domestic milk safety. Still, it is difficult to make more specific forecasts about the amount and structures of imports without a better understanding of China's domestic milk demand and supply, R&D, and the dynamic changes involved in these aspects. As for milk powder, it is relatively clear that imports will continue to retain a remarkable proportion of the total milk powder supply in China's market, given the rising incomes and purchasing power of Chinese consumers in a long term. Source countries and import structures are largely determined by the landed cost of foreign products and their marketing strategies. In recent years, there has been public concern over food safety management from the Chinese government and social circles. However, how the significant efforts made by the Chinese government in managing food safety will affect consumers' choices between domestically produced milk powders and imported alternatives remains unknown. Further investigation of consumer preferences and purchasing behavior is needed.

Regarding domestic dairy consumption, our major findings are as follows. First, liquid milk and yogurt are the two most important dairy products in China, with consumer purchases largely exceeding those of milk powder and cheese. Second, annual per capita liquid milk consumption has risen significantly over the last five years, reaching 40kg/person in urban areas and 24kg/person in rural areas of China in 2014. These numbers are far greater than the levels reported by the NBSC (15kg/person in urban and less than 2kg/person in rural areas). The reason for such a remarkable gap between our survey and the NBSC remains unclear at the time of submitting this report. Third, UHT milk accounts for nearly two-thirds of the total household liquid milk consumption, but its share is declining as incomes increase. Fourth, regional differences, especially the disparity between urban and rural areas, remain significant. Fifth, milk consumption is closely related to income, market development and lifestyles, suggesting that in future, per capita consumption of dairy products will continue to grow with the rising income, rapid urbanization, and the further development of the retail market.

Ultimately, to better understand our results, it is worth highlighting three differences between our survey sample and the general population. First, the sample distribution across provinces is inconsistent with the provincial population ratio (see *Figure A1*). Second, the ages of the heads of the households surveyed mainly ranged from 40 to 45 (see *Figure A2*). Third, the proportion of households in the sample with college students is significantly higher than that of the general population (see *Attached Table A)*. All of our results for dairy consumption are based on this specific sample. As a result, we cannot simply generalize our results from this report to the national population. Further investigation of the representativeness of our sample is needed.

# Part IV

## TECHNOLOGICAL DEVELOPMENT COUNTERMEASURES FOR CHINA DAIRY INDUSTRY

# CHAPTER 11
# INTRODUCTION TO THE TECHNOLOGICAL DEVELOPMENT FOR CHINA DAIRY INDUSTRY

## 11.1 TECHNOLOGICAL DEVELOPMENT OF THE FODDER GRASS INDUSTRY

### 11.1.1 Development and Utilization of Fodder Grass Variety Resources

Since 1986, more than 220 quality fodder grass varieties have been evaluated and registered by the National Fodder Grass Breeds Certification Committee in China, including 36 alfalfa varieties and 10 feed maize varieties , most of which have been selected and bred through traditional methods. At present, most of the quality fodder grass varieties have not been promoted for production. For those that have, the production of the breeder seeds has been neglected, leading to the degeneration or disappearance of many quality varieties under extensive production management conditions. There is a huge gap between the general technological level of China's industry, marked by low fodder grass seed yield and poor field management, and that of developed countries such as the United States.

### 11.1.2 Fodder Grass Cultivation and Management Technologies

China has a long history of fodder grass cultivation, but the industrialization of its fodder grass cultivation is still at an early stage, and the country lags behind in terms of cultivation management and technology research and development. Alfalfa is one example, where output in China is about 4.5-7.5 tons/ha, which is much less than that in the United States (12 tons/ha). Meanwhile, due to the lack of technological support, the quality of alfalfa produced in China is also low and cannot meet the Class I grass product standard with the crude protein content of less than 15%.

### 11.1.3 Fodder Grass Processing Technologies

China is in the monsoon climatic region, and the forage grasses are harvested and processed during the rainy season, which creates serious difficulties for hay drying. The field operation loss rate of alfalfa hay is generally 15-30%, and sometimes reaches more than 50%. In the past 10 years, China has made significant efforts to develop and research fodder grass processing technologies, and has made great strides, such as new technologies related to the application of microorganism silage additives, natural lactic acid bacteria inoculants (Fermented Green Juice) and the new alfalfa leaf protein extraction technology. At present, China is focusing on developing the key technologies and supporting technical systems for the efficient production of high-quality forage grasses in different regions.

## 11.2 DEVELOPMENT OF FEED AND NUTRITION TECHNOLOGIES

### 11.2.1 Establishment and Amendments of Chinese Dairy Cattle Requirement and Feeding Standard

Before 1979, the cows in China were fed mainly in accordance with the standards of the former Soviet Union, and China did not have its own dairy cattle requirement and feeding standard. After 1979, China began to study feeding standards that could meet the conditions of the country, and issued three versions of the Chinese Dairy Cattle Requirement and Feeding Standard in 1986, 2000 and 2004, respectively. In the latest version, the related indexes of the previous two versions in terms of evaluating the nutritive values of cow forages were used, including Dairy Cow Energy Unit (NND), crude protein and digestible crude protein. Meanwhile, such evaluation parameters as rumen degraded protein (RDP) and microbial protein (MCP) are also used in the new version to clearly define the intestine digestible crude protein (IDCP) and specify it evaluation method. At present, China working on the amendment of the third version of the standard.

### 11.2.2 Application of Straw Ensiling and Ammonization Technologies

Since the 1950s, China has been promoting silage-making and conducting scientific research into ensiling technologies. Since the 1970s, silage-making technologies have been widely used throughout the country. Since 2000, China has focused on planting, harvesting and applying whole-plant corn silage based on the continuous improvement of corn silages.

In the area of ammonization technologies of coarse fodders, in 1986 the first straw ammonization equipment of its kind in China was successfully developed. In the 1990s, due to the promotion and wide application of silage technologies and microorganism silage technologies, the scope of the application of ammoniated straws was reduced. At present, ammoniated straws are rarely used in China’s dairy industry, and ammonization technology is only used in some beef farms.

### 11.2.3 Application of Total Mixed Ration (TMR) Technology

TMR technology was introduced in China in the 1980s, and has been widely used in the country since the 1990s. As of the end of 2012, there were more than 5,400 TMR feeding facilities in China, and about 3.3 million cows – or 30% of the total – were fed with TMR fodder. During the promotion of TMR technology, a series of related nutrition research projects were conducted in China.

### 11.2.4 Application of Alfalfa

From the 1950s to the 1980s, China started planting and processing alfalfa and corn silage. After 1999, American-quality alfalfa hay was brought into China. The advanced planting, harvesting, processing and quality of the alfalfa provided a number of technical models and standards for the development of the Chinese alfalfa industry. The application of alfalfa developed rapidly. In recent years, the amount of the imported alfalfa has been increasing, reaching 755,600 tons in 2013, which is 839.5 times the amount imported in 2002 (900 tons).

### 11.2.5 Application of Industrial Feed

In 2012, China's animal feed production reached 194 million tons, with ruminant animal feed accounting for 4%. In the 1990s, gelatinized starch urea was successfully developed in China, which is added to cow fodder as a high-protein supplement, and can improve the protein content of concentrated fodder by 2.3-3.8 percentage points.

## 11.3 DEVELOPMENT OF DAIRY BREEDING AND REPRODUC-TION TECHNOLOGIES

### 11.3.1 Breeding of Cattle Varieties in China

***Breeding of the Chinese Holstein cow***

In 1985, the Chinese Black and White Cow was created, which was the first type of cattle bred independently in China. In 1992, with the approval of the Ministry of Agriculture, it was renamed the Chinese Holstein. At present, more than 80% of the cattle raised in China are hybridized and improved Chinese Holstein cows.

After the successful breeding of the Chinese Holstein, the high production and core herds were selected and raised in many cities in China. At the end of 2012, the total number of Chinese Holstein in China reached 6 million, with an average milk output of 6,000 kg. The average milk output of the core herd cows exceeded 8,000 kg, with a milk-fat ratio of more than 3.5%.

***Breeding of dual-purpose cattle in China***

After several years of efforts, several dual-purpose cattle varieties were bred in China, including Xinjiang brown cattle (1985), Chinese Grassland Red cattle (1985), Inner Mongolia San-he cattle (1986), Chinese Simmental cattle (2002) and Shu Xuan Hua cattle (2012).

### 11.3.2 Research Progress of the Cow Stock Breeding Technical System in China

***Breed Registration***

In 2003, China revised the *Implementation Plan for Registration of Chinese Holstein*, introduced the advanced cow information management platform from the Netherlands and independently developed cow data and information collection and reporting software. As of 2011, about 900,000 cows on more than 2,000 farms in China were registered, and the country’s cow registration efforts were becoming more standardized and mature.

***Dairy Herd Improvement (DHI)***

Dairy Herd Improvement (DHI) has only been used since 2000. By the end of 2011, 22 DHI Centers had been established in China, and more than 300,000 cows were subject to DHI measurement every year. Since 2008, the breeding value and inheritance evaluation of the joint progeny test for bulls in China has been conducted for four consecutive years. At the same time, the DHI centers have provided consulting services and recommendations for the scientific and healthy breeding and management of herds through *DHI Report Interpretation*, thus actively working to improve the benefits for dairy farming.

***Type Classification***

In the 1980s, China initiated type classification and gradually established the body linear scoring system. In 2006, *the Type Classification Linear Verification Procedure for Chinese Holstein* was officially implemented, specifying the major methods, characteristics and scoring criteria for the type classification of Chinese Holstein. At present, the type classification information used in the breeding bull inheritance evaluation is all derived from the results of the linear evaluation. In 2011, a total of around 10,000 cows were evaluated in China.

***Progeny Test***

Since 1983, China has organized the young breeding bull joint progeny test. *The Chinese Joint Progeny Test Procedure for Young Chinese Holstein Bulls* was created and implemented in 2007, specifying that the frozen semen of dairy breeding bulls without progeny test results would no longer be marketed after 2012.

***Breeding Bull Inheritance Evaluation***

In 2007, the China Performance Index (CPI) formula for Chinese cattle was introduced in line with the breeding target for the Chinese Holstein, and the joint inheritance evaluation of bulls was realized for the first time. At present, the test day model TDM-BLUP method and the recorded test day data of individual cows are used to estimate the character and breeding value. At present, 54.1% of all breeding bulls have accepted the inheritance evaluation account.

***Reproduction Technology and Artificial Insemination***

China successfully froze bull semen using dry ice in 1958 and using liquid nitrogen in 1965. As of the end of 2011, the number of the bulls from which semen was being collected totaled 2,908, including 1,384 Holstein cows, and 53.36 million doses of quality frozen semen was produced annually, including 27.92 million doses of quality frozen semen from Holstein cows.

In terms of artificial insemination, the integrated technologies that can be used to control semen transmission time and position (deep semen transmission method) have been developed specifically for ordinary frozen semen and sexing semen. For cow estrus detection, the external observation method, estrus test method, vaginal inspection method and rectum inspection method are widely used. Many large-scale cow farms have used the ultrasonic diagnosis method and pedometer method since 2000. Meanwhile, research began in 1976 into estrus induction and estrus synchronization, and mature methods for estrus induction and ovulation have been developed. In addition, various commercial hormone products have also been developed. To diagnose pregnancy, most farms in China are still using the rectum inspection method, and only a few large farms have started using the B ultrasonic method.

***Embryo Transfer Technology and MOET Breeding System***

Embryo transfer technology has witnessed rapid development. The technology was successfully developed in 1978, and since the 1990s, the MOET breeding system has been used in China to breed high-yielding dairy cattle. Until today, the superovulation, embryo transfer, embryo freezing and storage technologies in China have been used for cattle breeding and production. In addition, the technologies related to the production of in-vitro embryos, embryo sex determination, XY sperm separation and sex-controlled embryo production in China are all close to the leading level in the world.

### 11.3.3 Establishment of Technical Platform for Cattle Whole Genomic Selection

Since 2008, China has been researching whole genomic selection and the establishment of reference groups. At present, a reference group whole genome measurement database, including more than 5,000 Holstein bulls and cows has been established, and a technical platform for cow genome selection has been independently established in China. In 2012, the Animal Husbandry Department of the Ministry of Agriculture officially requested that all young Holstein bulls be subject to the whole genomic test and inheritance evaluation.

### 11.3.4 Research into Transgenic Technologies

China has been conducting research into transgenic cows for years. Recently, China has developed a series of transgenic cows that can produce humanized milk, including cows with human lactoferrin and whey albumin, and transgenic cows with the human CD20 monoclonal antibody. Since 2011, further research has been carried out into the feeding technologies and safety evaluation of transgenic cows.

## 11.4 DEVELOPMENT OF COW DISEASE CONTROL TECHNOLOGIES

### 11.4.1 Eradication of Infectious Diseases

***Cattle Plague***

In 1952, China successfully developed the lapinized attenuated vaccine, which played a key role in controlling and eliminating cattle plague. Cattle plagues were completely eliminated throughout China from 1956, and the vaccine was used for several years afterward to ensure eradication was permanent.

***Brucellosis***

In 1957, investigation and prevention of brucellosis began in China, with vaccines as the major prevention and control measure. In the 1980s, a survey of the distribution and epidemic patterns of brucellosis in various areas of China was completed, and significant achievements were made in terms of disease control and prevention. In the middle and late 1990s, the number of cases of brucellosis increased somewhat, as was the case nearly all over the world. At present, various antibody detection technologies, namely brucellosis ELISA, fluorescene polarization, alexin desmoenzyme ELISA and pathogen detection technologies such as polymerase chain reaction (PCR), have entered the clinical application stage, and studies of labeled vaccines have been widely conducted.

***Tuberculosis***

In 1957, efforts to prevent and heal cows suffering from tuberculosis were started with a measure combining tuberculin intracutaneous test diagnosis and integrated control. In 2011, the cow tuberculosis-γ－interferon ELISA diagnostic kit was introduced in China, which could more accurately detect tuberculosis, accelerate its elimination and reduce the losses caused by the disease. At present, tuberculosis among cows has been essentially eliminated in some areas (such as Beijing and Shanghai), and well controlled in other areas.

***Foot-and-Mouth Disease***

China has now independently developed O-type, Asian I type and A-type vaccines against the various serotypes of foot-and-mouth disease found throughout the country. Currently, the production processes for the foot-and-mouth disease inactivated vaccines are well developed, and the products comply with international standards. In 2011, the first RNAi transgenic clone cow with foot-and-mouth disease virus (FMDV) resistance was successfully bred in China, providing a new mode for controlling and preventing the disease.

### 11.4.2 Mastitis Control Technologies

In China, instead of antibiotic therapy, the integrated control method is widely used to control invisible mastitis and reduce the positive rate. In recent years, based on the advantages of traditional Chinese veterinary science in disease control such as the non-resistance, non-residue and non-drug-tolerance, China has begun to research and develop traditional Chinese veterinary medicines to control cow mastitis.

### 11.4.3 Hoof Disease Control Technologies

Cow hoof diseases occur frequently in China, and the related control technologies have also witnessed constant improvement and development. Research into the pathology of cow laminitis caused by histamine diphospate has led to the exploration of the control mechanism of hoof disease. Various hoof disease control technologies have been continually improved, such as the use of copper sulfate and methanol to bathe hoofs; improving the barn environment; regularly checking and trimming hoofs; controlling the ratio of concentrate; and ensuring the stability of the rumen environment. Meanwhile, other methods, such as the burning method, mist spraying method, and the addition of zinc elements into the ration, have demonstrated certain good effects in controlling cow hoof disease.

### 11.4.4 Nutritional Metabolic Disease Control Technologies

***Ketosis***

Cow ketosis in China is controlled using the following measures:

a). Strengthen the breeding feeding management, supply balanced daily rations, pay attention to the quality of fodder, divide cows into different groups according to their physical stages of management, and ensure that the cows are neither too fat nor too thin;

b). Adjust the composition of daily rations by increasing the content of precursors that can produce glucose; and 1c. Establish a herd ketosis monitoring system to regularly detect ketosis and identify diseased cows in a timely manner. In China, cow ketosis is mainly controlled by improving the concentration of glucose precursors in the diet, so as to increase the glucose level and reduce physical mobilization.

***Rumen Acidosis***

In China, the primary measures used to prevent rumen acidosis include: ensuring a rational combination of daily rations, increasing the ratio of quality forage in daily rations and adding buffer agents to the daily rations. In 2005, *the Technical Regulations for Controlling Cow Nutrition Metabolic Diseases* (DB13/T694-2005) was issued, marking the standardization of cow nutrition metabolic disease control technologies, and providing a technical reference for the dairy farming industry.

### 11.4.5 Reproduction Disease Control Technologies

The major clinical control measures for cow reproduction diseases in China include: biotherapy, hormone therapy, uterus washing and drenching methods, acupuncture therapy, Chinese medicine therapy and operation therapy. In 2011, povidone-iodine effervescent tablets were successfully developed, which can be used to control various genital tract diseases, such as cow kysthitis and endometritis. At present, in addition to the ordinary clinical symptoms diagnosis, measurement of the progesterone in plasma or milk, the immunity infertility diagnosis and ultrasonic image technology are used for the diagnosis of cow reproductive diseases.

### 11.4.6 Parasitic Disease Control Technologies

In recent years, a great deal of research has been conducted in China into controlling cow parasitic diseases, leading to the development of the acetyl amino abamectin injection and acetyl amino abamectin washing agents, which can be used to effectively control the parasitic diseases on dairy farms.

## 11.5 DEVELOPMENT OF TECHNOLOGIES FOR CONTROLLING DAIRY FARMING ENVIRONMENT

### 11.5.1 Research into Integrated Support Technologies for Cow Breeding

Dairy farming in China covers various climatic zones such as the tropical zone, the subtropical zone, the temperate zone and the sub-frigid zone, as well as areas with elevations ranging 0-4,000 meters. The key point of the research into dairy farming support technologies is to develop farm design and environmental improvement support technologies according to the specific characteristics of different areas. In this respect, systematic research has only been conducted for about 10 years, and only a few achievements have so far been realized, such as the cow heat stress study and heat resistance integrated support technical system for the summer season in hot areas of south China. The application of heat resistance feed additives and the adjustment of special ration formula had positive results.

### 11.5.2 Research into Techniques for the Treatment of Dung Disposal Manure

***Compost and Fermentation Technique***

China began researching the high temperature compost technique in 1950. After 2000, the research focus has been on the natural fermentation and microorganism inoculated fermentation technique, as well as the sewage channel designs of the dairy barn, milking parlors and rest areas, and the sewage-rainwater separation techniques. In this regard, the techniques used in China have lagged behind, with poor compost processes and equipment, and there is a great deal of room for the improvement in compost processes.

***Solid-Liquid Separation Technique for Manure Treatment***

In the 1980s, China began to introduce solid-liquid separation equipment and to develop similar equipment. The solid-liquid separation equipment made in China has now been put into use, and the retail prices of such equipment are only 20% to 50% of that of the imported equipment with similar specifications.

***Biogas Technique***

In 1982, the biogas project designed to include the whole mixed fermentation process of jet flow mixing achieved good results. Since the mid-1980s, the cow farm biogas project with the whole mixing fermentation process was successfully applied on some farms. At present, a circular economy chain has been created, with the clean energy biogas projects as the link connecting the animal husbandry industry, the crop farming industry and employee home consumption.

## 11.6 DEVELOPMENT OF TECHNOLOGIES FOR CONTROLLING THE QUALITY OF RAW MILK

At present, the focus of research into technologies for controlling the quality of fresh dairy milk products is on the development of the fresh dairy product test technologies and related equipment. Developments achieved since 2000 include: the resazurin reduction method for rapid detection of total bacterial count, the PCR method for rapid detection of escherichia coli, the LC and cholinesterase, immunodetection methods for rapid detection of pesticides, the immunodetection for rapid detection of penicillin, and the capillary dot chromatographic detection method for rapid detection of various antibiotics. Various products have also been developed, such as the Rapid Detector for Total Bacteria in Raw Milk, the dairy product analytical instrument and the melamine and aflatoxin M1 rapid detection reagent kit.

## 11.7 DEVELOPMENT OF TECHNOLOGIES FOR DAIRY PRODUCT PROCESSING

World-class dairy product packaging processes, the UHT milk production process/line and liquid milk filling process/equipment were introduced to China in the 1990s. Since 2000, the focus of dairy product processing technology research has been on processing technologies for new dairy products, and several achievements have been made in the development of new dairy product packaging equipment.

In recent years, China has developed various functional milk powders for infants, pregnant women and the hyperlipidemia and hypertension groups, such as lead expelling milk powder, milk powder for infants with propiophenone disease and linoleic acid fortified milk powders. China initially established the lactic acid bacteria resource library for fermentation dairy products and 50 fine strains were selected for use in producing dairy products. In addition, the process and production lines using enzyme hydrolysis technologies to produce infant milk replacer and antihypertensive peptides, and using membrane filtration technologies to produce ESL milks are becoming mature.

# CHAPTER 12
# MAJOR SCIENTIFIC BOTTLENECKS IN THE DEVELOPMENT OF THE DAIRY INDUSTRY

## 12.1 DAIRY FARMING TECHNOLOGY

### 12.1.1 Forage and Feed

The mechanization level is low for planting and harvesting, especially for forage and roughage. The quality of Chinese alfalfa is varied, with small pieces of farm land hardly for planting and harvesting. In particular, there are substantial losses of alfalfa leaves during the drying step unless a flattening device is used during harvest.

The maize silage quality needs to be improved. At present, most of China's dairy farms use corn stalk silage (without corn). Maize silage is used by larger scale dairy farms. Most of the supply comes from advance contacts with neighboring corn farmers due to a shortage of crop land. This causes more competition among bigger dairy farms. Sometimes, milk lines are not good for silage and are still used for silage with low DM (<75%) and starch (<20%). These key parameters are much lower than in the dairy sectors in other developed countries.

The evaluation system of TMR quality is still improving. The use and application are not worth the high cost of TMR equipment by large-scale dairy farms. Form Feed to Feeding is inadequate and complete in systematization with TMR particle, moisture, uniformity, DMI, digestion, health and milk production of dairy cows.

### 12.1.2 Dairy Nutrition and Feed Management

The quality and safety evaluation system is still under construction, especially for ruminant animal feed and roughage. The engineering technology center and biological potency and safety evaluation has been completed for swine and poultry in China. However, it is more difficult to launch a modern ruminant feed system, including commercial feed (supplement, concentrate and premix), fresh and green forage, and other by-products.

Industry standard research and establishment of a ruminant feed evaluation system is behind that of monogastric animals in China. Currently, more new ruminant products are coming onto the market and further progress is being made on research into ruminant feed and additives. It is desirable and even urgent to complete and update the ruminant feed standard system.

The database of common feed resources should be improved and updated, particularly for China's top dairy regions. The daily ration is mostly based on the formula feed nutritional value database, which was established in 2004. As mentioned above, significant progress in the area of ruminant feed in recent years includes imported DDGS, steam-flaked corn and wheat, oat grass, ryegrass, wheat silage, haylage, full cotton seed and conola meal. Relative nutritional parameters should be supplemented and completed in the current feed database. In addition, China should also update the database parameters for common feed and forages, such as corn, bean meal, cottonseed meal, wheat bran, corn silage, corn stalk silage, sheep grass and corn stalk or stem. More nutritional varieties should be added as well as differences between regions, breeds, planting and processing with harvesting and storage. The national feed database for dairy cows is even more necessary to meet the demands of scale for dairy cows and lower pollution from waste and manure.

Feed management should be improved at cooperative farms and backyard farms, which account for 70-80% of the country's dairy farms. Their extensive management is based on experience and is way behind modern dairy farms with high level of management, TMR and balanced rations.

### 12.1.3 Dairy Breeding and Reproduction

Breeding sires depend on foreign resources. In China, the quantity of breeding bulls selected by progeny testing and genomic testing is lower than in European and American countries. So far, China has not established a system to raise and select elite bulls. As a result, in the past years most breeding bulls used for herd genetic improvement were imported. In China, bulls are also selected using progeny testing and genomic testing, but this is limited by the production level of the testing herd, number of daughters and size of the herd; bull selection numbers and intensity are lower than in other developed countries. In the US, over 1,500 sires are selected by progeny testing and genomic testing, while in China that number is less than 400.

There is a shortage of dairy expos in China. There are annual dairy expos in the European and American countries. These not only include exhibitions of new products and technologies, but also the best places for the breeding companies to select the elite cows. The champion cows, which are evaluated very strictly, are auctioned by the breeding companies for the high genetic donors, and then bred with the top bulls. The offspring are then selected for the next generation of sires.

The dairy fertility rate needs to be improved in China. Currently, the overall rate is low, especially in the south of China. Our survey indicates that on most dairy farms in China, including some large-scale farms, the average fertility rate is less than 90%, the average calving interval is over 430 days, the average conception rate is less than 45%（lower in cows), the average services per conception is more than 1.9, while the culling rate due to reproductive problems is over 13%. The low fertility rate very much affects the rate of natural growth of dairy cattle and is due to the fact that China has invested a lot of money to import dairy cattle (according to incomplete statistics, China imported more than 100,000 dairy cows in 2012). Clearly, the low fertility rate also decreases the economic benefits for dairy farmers in China.

### 12.1.4 Cow Disease Control

The main contagious diseases from dairy are a danger to public health and safety. Perlsucht, brucellosis and FMD are the major zoonosis in the dairy farming industry in China. The major issues in controlling such diseases are that the proportion of small and non-standardized dairy farms is too high, and their cows are not provided with the necessary disease control conditions and regular inspections. In addition, the efficiency of the vaccines and disease detection kits that are independently developed in China require further improvement, and the side effects of the vaccines must be further reduced. Recently, several cases of IBR and BVD were detected at dairy farms. The relevant vaccines are urgently needed as soon as possible with lessons learned from developed countries on decreasing morbidity. Mastitis, reproductive disturbances, hoof disease and nutritional metabolic diseases are common issues in dairy farming in China. Most of the drugs/vaccines used to control cattle disease are imported due to the slow progress in developing them nationally. The issue of high drug residues in raw milk has still not been solved, and the high-quality traditional Chinese medicines with good performance rates are in short supply. In addition, the lack of standardized and modern feeding management conditions, and the low level of awareness among farmers about maintaining the health of their cows are major causes leading to the frequent occurrence of disease.

### 12.1.5 Dairy Farming Environment Control

There is less focus and investment on environmental control of scale farms. New *official regulations on large-scale livestock farm pollution control* is recently on implementation, which makes the newly built dairy farms feel lots of pressures about the environment control. In the past, most dairy farmers were backyard farmers with 3-10 cows. Fermenting and composting manure to use as fertilizer for crops is a virtuous circle and an environmentally-friendly approach. However, as the size of farms expands, it becomes more difficult to discharge and dispose of the waste and manure. And not enough land is used for manure collection and treatment. More and more manure from bigger scale dairy farms has been discharged onto public land, and is polluting the environment. Therefore, more and further research and development of technologies are essential to tackle the manure situation.

Tools and technology research and development related to the manure issue in China is still in the initial stages. More focus and investment should be devoted to the ability of independent and localization research. At present, most tools for manure processing are imported from developed countries for China’s large-scale dairy farms. These include automation scraping systems, separators and bio-gas devices or relevant equipment. Although domestic research institutes and companies manufacture some relevant products with good results for medium-scale dairy farms, they are often flawed by lower capacity and service life compared with the imported ones.

## 12.2 RAW MILK QUALITY CONTROL

The focus of raw milk quality control efforts is still on testing milk compositions; the GMP and HACCP standards and the critical point control system have not been well-established. Milk product control should be an integrated system covering all links in the chain, from stable to table, or from grass to glass. At present, the system for milk product quality control is incomplete in China, with an underdeveloped tracking system and management rules for key links. A quality risk analysis system based on a large number of data has not been established.

## 12.3 SCIENTIFIC INPUT IN THE DAIRY PROCESSING INDUSTRY

China’s dairy product industry is in the emerging stages, and has been lagging behind the developed countries in terms of technical level and product quality. There are gaps between the new high-level technologies independently developed in China and those coming from the developed countries, such as the membrane separation technique, high-pressure sterilization technology, genetic engineering technology, microcapsule embedding technology, extrusion cooking technology, supercritical fluid extraction technique and digital simulation and computerization technologies.

# CHAPTER 13
# SCIENTIFIC DEVELOPMENT PRIORITIES OF THE DAIRY INDUSTRY

## 13.1 FEEDING + PLANTING MODEL WITH FURTHER DEVELOPMENT OF QUALITY FORAGES AND MAIZE SILAGE

The planting and feeding model is popular in countries with a developed dairy industry. This model is good, as the forage can be used for dairy cows and natural manure used as fertilizer for crops. This means lower feeding costs, higher milk quality and less environmental pollution. The main problem is a lack of land for dairy farms to cultivate. Some experts predict that over 14 million mu will be needed for 16 million cows in 2020. Therefore speeding up of land transfers, increasing financial subsidies, especially for maize silage, are the way forward for the crop + livestock model..

Newly built and expanding farms need to adopt this model, which connects the feeding and planting on farmland with the use of mechanical manure collection, or scraping systems, separator, bio-gas and crop leftovers. The EU Standard (<170kg Nitrogen/ hectare) is a reference parameter for China's standard of animal feeding and manure use for crops..

The roughage base in dairy feeding in China is maize silage plus alfalfa, and is a key issue in high quality/production/efficiency in the dairy farming sector. In considering rations for dairy cows in China, it is important at this time to focus on the integration of land resources, increasing the forage land supply with a demonstration region of alfalfa, and modern mechanization in processing roughage. In addition, the government should support and encourage the planting of high-quality forage, improve the forage supply capability and promote research into increased forage utilization.

## 13.2 KEY TECHNOLOGY RESEARCH AND TRANSFERS IN STANDARDIZATION AND SCALE DAIRY FARMING

The relevant research mainly includes a) the further research of dairy nutrition requirements and a parameter system as a supplement to China's dairy feeding standard, b) requirements and ration formula technology transfers in different dairy farming models and regions, c) a national forage and roughage database.

Establishing a demonstration farm and region, increasing special technology transfers, and realizing standardization management are based on the above points. Therefore these are included in the content below.

1）Dairy barn design of scale farms, ventilation, heat and cold stress control.

2）Dairy cow stall feeding and grouping management.

3) Ration-making and quality evaluation of TMR technology.

4) Milking standardization in milking parlors.

5) Replacement rearing and breeding technology.

## 13.3 ACCELERATE HOLSTEIN HERD GENETIC IMPROVE-MENT AND REPRODUCTION TECHNOLOGY TRANSFERS

### 13.3.1 Construction of Holstein Herd Genetic Improvement system

The registration system for the Chinese Holstein must be improved and promoted, the Dairy Herd Improvement (DHI) technology and the Holstein sire progeny test technical system must be disseminated, and the scope of implementation must be expanded. Meanwhile, the breeding target of the Chinese Holstein shall be further improved, so as to improve the integrated selection indexes for the Chinese Holstein Cows. The breeding herd inheritance assessment technologies, including the DNA test technology and the genome selection technology should be developed.

### 13.3.2 Improvement of Varieties of Dual-Purpose Cattle and Increased Production Performance

In order to promote the healthy and sustainable development of both the dairy and beef industries in China, the milk yield must be improved and the quality of the beef products supply must be increased. Research projects on crossbreeding Chinese Holstein herds with dual-purpose Simmental cattle imported from Europe must be set up, and efforts should be made to establish a brand-new Chinese-style dairy industry, including both dairy and beef production. With the cultivation of dual-purpose cattle varieties and the combination of plant farming and animal husbandry, the profits of dairy cattle farming will be effectively improved, the supply of both high-quality raw milk and beef products will be significantly increased, and the utilization of fodder grass resources will be more efficient.

### 13.3.3 Research and Development of Highly Efficient Artificial Insemination Technology

In treating cattle reproduction diseases, the focus should be on the research and development of oestrus detection technology, estrus synchronization technology and timed insemination technology, as well as hormone therapies. Research into other reproduction technologies is also necessary, such as specialized highly efficient reproduction technologies for the hot southern regions of China, early pregnancy diagnosis technology, dairy cattle reproductive health care planning, etc.

## 13.4 DEVELOPMENT OF KEY TECHNOLOGIES FOR INFECTI-OUS DISEASES PREVENTION AND ERADICATION IN CATTLE

Despite the effective measures taken by local government to prevent and eradicate infectious diseases among dairy cattle, foot and mouth disease, tuberculosis and brucellosis are still the top three infectious diseases plaguing the dairy farming industry in China. The country stretches across a vast area, and the feeding and management levels are significantly different between the dairy farms and farmers in different regions. These differences make it difficult to promote the standardized techniques for disease prevention and eradication.

### 13.4.1 Development of Brucellosis Monitoring Technique for Scaled Dairy Farms

The focus here shall be on monitoring and eradicating brucellosis through the application of immunological diagnostic techniques and multiple IS711 PCR pathogen detection methods.

### 13.4.2 Development of New Rapid methods for Cattle Tuberculosis Diagnosis

New rapid methods of diagnosing dairy cattle tuberculosis are based on selection of active serum markers. We also need to integrate the newly developed methods or introduce new technologies from abroad, so as to develop the integrated key technology system for eradicating cattle tuberculosis.

### 13.4.3 Development of Supporting Technology for a Foot and Mouth Disease Early Warning System

The integration and assembly of supporting technologies for FMD control in scaled dairy farms should be developed and promoted based on *China's construction plan of foot and mouth disease early warning system*.

Multiple FMD vaccine immunization techniques should be promoted to all scaled dairy farms in China, depending on their needs for FMD prevention and the characteristics of the cattle herd. In order to effectively control and prevent FMD, supporting technologies must be developed for dynamic monitoring of FMD vaccine antibody titer, and demo farms are needed to demonstrate the FMD control and prevention technology system.

## 13.5 DEVELOPMENT OF VETERINARY MEDICINES AND PREVENTION OF COMMON DISEASES

### 13.5.1 Development of New Substitutes for Antibiotics and Antiparasitics

With the use of new techniques in modern pharmaceuticals, new types of highly efficient, reliable medicines shall be developed and promoted as substitutes for antibiotics and antiparasitics according to new national standards for raw milk and the demands for clinical diagnosis and treatment of cattle diseases.

### 13.5.2 Development of Chinese Veterinary Techniques for Cattle Disease Prevention

We must develop new technologies and products for clinical diagnosis and treatment of cattle diseases according to Chinese veterinary therapies.

### 13.5.3 Development of New Technologies for Diagnosis and Treatment of Dairy Cattle Reproductive Disorder Syndrome

This reproductive disorder syndrome is the main disease affecting cattle health and dairy farm profits. The mechanism of the syndrome should be studied and new diagnostic criteria, diagnostic methods and treatment technologies should be developed.

## 13.6 ESTABLISHMENT OF DAIRY SAFETY CONTROL SYSTEM FROM GRASS TO GLASS

### 13.6.1 Development of Raw Milk Quality Evaluation and Non-Milk Component Detection Technologies

The development of non-milk component detection technologies are needed, especially technologies for risk assessment and monitoring of microorganisms, pesticides, veterinary drugs, heavy metal residues and other harmful substances. Research should also be conducted into the possibility of establishing a third party inspection system for raw milk quality assessment.

### 13.6.2 Development of Key Technologies for Dairy Product Processing

China is focusing on the development of new dairy product processing technologies, such as fermentation technology, ceramic membrane technology, low-temperature spray drying process and the key technology of cheese products processing. It is also necessary to develop qualified domestic dairy processing equipment for liquid milk processing and packaging, cheese product processing and packaging, low temperature spray drying, etc.

### 13.6.3 Study of Consumption of Chinese Dairy Products

Research will be carried out into predicting changes in dairy product consumption in China over the next 20 years based on a study of dairy product consumption among different income groups (consumers from the typical first-tier cities, second-tier cities, towns and rural regions). These research results will enable us to study the relationship between raw milk production and dairy product supply in China, as well as the external dependence on China’s dairy products.

### 13.6.4 Development of Key Equipment for Environmental Control in Scaled Dairy Farms

The focus here will be on research and development into new technologies for manure and sewage treatment on dairy farms, and the development of the supporting farm environment control system according to the climatic conditions in different areas.

# ATTACHMENT A

### Dairy Consumption Survey Description

In order to better understand milk consumption at a micro-household level, Sino-Dutch Dairy Development Center (SDDDC) recently conducted a consumer survey covering nearly all the provinces, municipality cities and autonomous regions of China. In total, 1,500 individual households were surveyed through telephone calls. After removing the uncompleted surveys or observations with severe missing data, 941 households with 3,051 individual consumers in total were included in this report. The College of Economics and Management (CEM) at China Agricultural University (CAU) led the survey design and the field survey, with assistance from the College of Animal Sciences & Technology (CAST) at CAU.

Nearly 200 undergraduate and graduate students from CEM and CAST were recruited to conduct the survey, each of whom was asked to complete 3-6 surveys by calling their parents, relatives or friends. Every survey taker was required to ask the questions in sequence. A 15-yuan allowance for each questionnaire was provided upon completion as an incentive for participating in the survey. All completed questionnaires were collected and inspected by our trained survey enumerators.

The survey form consisted of two parts. The first part was designed to assess the basic characteristics information of the sample households and individual members. The second part collected dairy consumption-related information. The survey was designed to be as simple as possible in order to avoid any potential biases due to respondents' fatigue or misunderstanding. Every questionnaire could be completed in five minutes, on average. Figure A and Table A present the geographic distribution and the statistical summary of the sample, respectively.

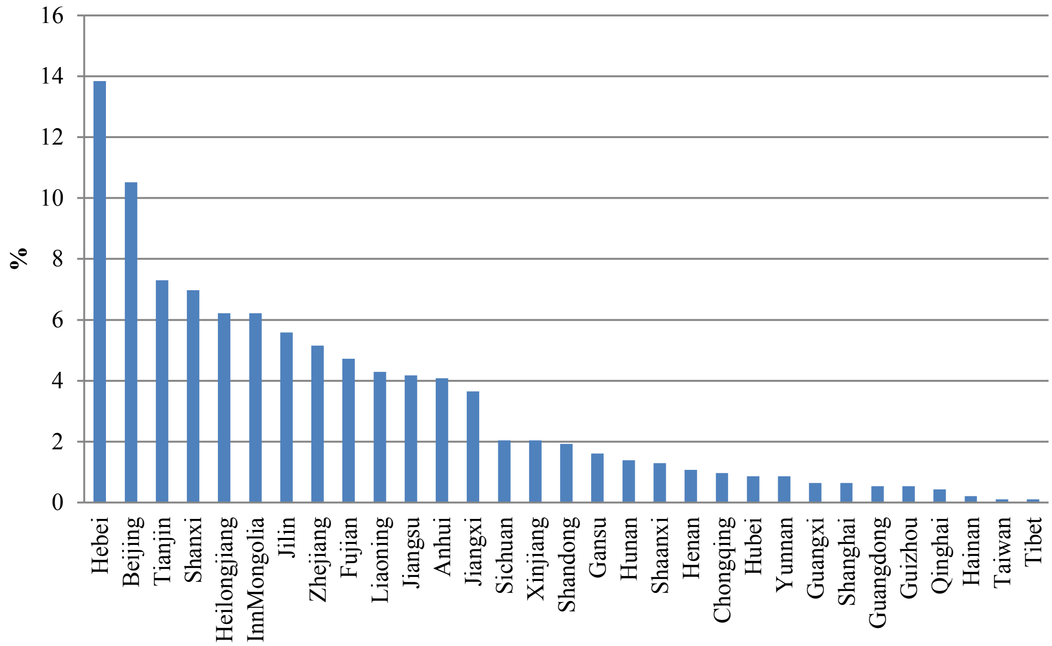



**Figure A1. Sample Geographic Distribution of Samples**

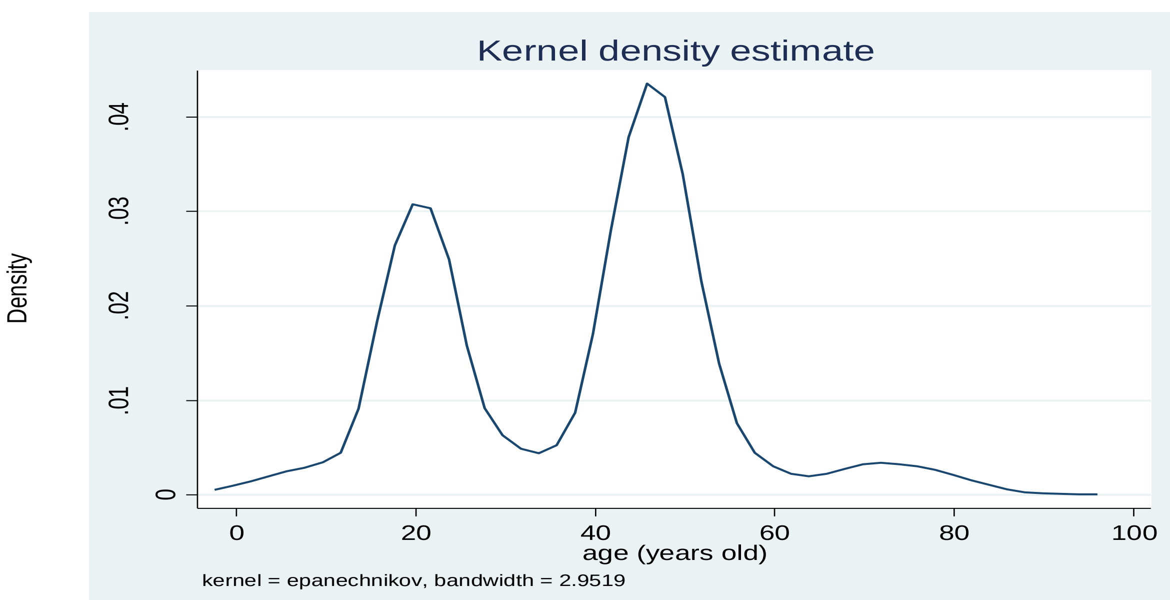



**Figure A2: Age Distribution of Sampled Individuals**

**Table A: Sample Statistical Summary**

| Variables | Unit | Mean | Variables | Unit | Mean |
|---|---|---|---|---|---|
| Household size | person | 3.31 | Education* | | |
| 1 | % | 1.50 | Primary school or below | % | 10.27 |
| 2 | % | 10.20 | Secondary school | % | 15.49 |
| 3 | % | 56.61 | Junior high school | % | 16.97 |
| 4 | % | 21.80 | College or equivalent | % | 52.51 |
| 5 | % | 7.41 | Advanced | % | 4.76 |
| 6+ | % | 2.47 | Registered Residence* | | |
| Gender* | | | Urban | % | 68.53 |
| Male | % | 48.38 | Current Residence* | | |
| Age* | years | 37.65 | Urban | % | 79.94 |
| Monthly income | | | Car ownership | | |
| 2000- | % | 6.47 | Urban | % | 66.20 |
| 2001~4000 | % | 15.10 | Rural | % | 44.40 |
| 4001~6000 | % | 17.48 | Refrigerator ownership | | |
| 6001~8000 | % | 17.69 | Urban | % | 94.90 |
| 80001~10000 | % | 12.62 | Rural | % | 89.90 |
| 10001~12000 | % | 8.95 | Supermarket accessibility | % | 75.80 |
| 12001~14000 | % | 6.90 | Urban | | 86.60 |
| 14001~16000 | % | 4.85 | Rural | | 48.90 |
| 16001~18000 | % | 1.94 | Western-style fast food accessibility | % | 62.09 |
| 18001~20000 | % | 2.16 | | | |
| 20000+ | % | 5.83 | Traveled to US or EU | % | 26.33 |

Note: *All variables marked with an asterisk (*) were measured at individual consumer level. The rest were measured at household level.

# ATTACHMENT B

**Table B1: Import Volume (10k Tons) and Value (10k US$) of Liquid Milk from Major Source Countries (2001-2013)**

| | | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| New Zealand | Volume | 0.06 | 0.06 | 0.08 | 0.09 | 0.17 | 0.15 | 0.22 | 0.34 | 0.53 | 0.7 | 1.66 | 2.37 | 3.19 |
| | Value | 37.52 | 51.32 | 107.46 | 155.55 | 315.33 | 241.29 | 375.1 | 696.4 | 1024.42 | 1541.9 | 3256.66 | 4442.95 | 5648.12 |
| Australia | Volume | 0.75 | 0.35 | 0.2 | 0.12 | 0.11 | 0.11 | 0.06 | 0.17 | 0.16 | 0.14 | 0.45 | 1.3 | 2.17 |
| | Value | 310.15 | 148.22 | 95.75 | 70.79 | 77.4 | 69.21 | 44.78 | 168.59 | 146.55 | 138.09 | 494.53 | 1458.34 | 2498.53 |
| US | Volume | 0.02 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.03 | 0.27 | 0.39 |
| | Value | 27.01 | 1.49 | 0.02 | 0 | 0.16 | 0.57 | 0.54 | 3.74 | 8.05 | 4.55 | 37.2 | 358.22 | 536.19 |
| Germany | Volume | 0.01 | 0 | 0 | 0 | 0.01 | 0.01 | 0.02 | 0.04 | 0.17 | 0.31 | 1.34 | 3.77 | 7.74 |
| | Value | 5.85 | 1.91 | 2.74 | 7.85 | 22.61 | 17.1 | 38.36 | 69.71 | 152.09 | 309.74 | 1134.2 | 3022.6 | 7228.65 |
| EU | Volume | 0.06 | 0.04 | 0.02 | 0.07 | 0.09 | 0.11 | 0.12 | 0.2 | 0.42 | 0.69 | 1.81 | 4.5 | 10.1 |
| | Value | 27.89 | 1.95 | 0.31 | 0.28 | 0.53 | 0.93 | 0.94 | 4.45 | 9.16 | 6.08 | 41.13 | 366.39 | 551.65 |
| Netherlands | Volume | 0 | 0 | 0 | 0.01 | 0 | 0.01 | 0.01 | 0.01 | 0.01 | 0 | 0 | 0.02 | 0.09 |
| | Value | 0.06 | 0.13 | 0.15 | 19.32 | 6.94 | 9.93 | 16.08 | 31.48 | 22.87 | 0 | 1.22 | 16.58 | 65.08 |

**Table B2: Import Volume (10k Tons) and Value (10k US$) of Milk Powder from Major Source Countries (2001-2013)**

| | | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| New Zealand | Volume | 4.1 | 7 | 9.4 | 10.9 | 8.3 | 10.5 | 7.2 | 5.1 | 20.4 | 33.7 | 36.7 | 49.6 | 68.7 |
| | Value | 7740 | 10179 | 15302 | 20416 | 18060 | 22688 | 22390 | 21689 | 47885 | 113649 | 135716 | 167005 | 286971 |
| Australia | Volume | 1.3 | 3.5 | 1.9 | 1.6 | 1.2 | 1.1 | 1.2 | 2.5 | 1.8 | 2.5 | 2.2 | 1.7 | 2.8 |
| | Value | 2553 | 4960 | 3046 | 2943 | 2649 | 2446 | 4598 | 8935 | 4072 | 8733 | 7703 | 5743 | 12572 |
| US | Volume | 0.2 | 0.1 | 0.3 | 0.5 | 0.6 | 1.4 | 0.7 | 1.6 | 0.6 | 1.5 | 2.2 | 1.9 | 5.6 |
| | Value | 510 | 263 | 455 | 912 | 1265 | 2779 | 2667 | 5832 | 1400 | 4294 | 7258 | 5812 | 22360 |
| Germany | Volume | 0 | 0 | 0.2 | 0.2 | 0 | 0 | 0 | 0 | 0.3 | 0.4 | 0.9 | 1.3 | 1.8 |
| | Value | 34 | 59 | 387 | 390 | 96 | 50 | 75 | 89 | 569 | 1231 | 3203 | 4367 | 7123 |
| EU | Volume | 0.3 | 0.4 | 1.6 | 1.3 | 0.4 | 0.1 | 0.5 | 0.5 | 1.8 | 3 | 3.3 | 3.9 | 6.1 |
| | Value | 638 | 626 | 2517 | 2350 | 940 | 336 | 1667 | 2142 | 4713 | 9713 | 11266 | 12604 | 24631 |
| Netherlands | Volume | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.4 | 0.4 | 0.3 | 0.3 | 0.7 |
| | Value | 23 | 15 | 19 | 107 | 11 | 32 | 83 | 82 | 775 | 975 | 615 | 640 | 2078 |

**Table B3: Import Volume (10k Tons) and Value (10k US$) of Whey Powder from Major Source Countries (2001-2013)**

| | | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| New Zealand | Volume | 0.3 | 0.1 | 0 | 0.1 | 0.3 | 0.3 | 0.5 | 0.7 | 0.4 | 0.5 | 0.5 | 0.5 | 0.4 |
| | Value | 576 | 87.8 | 46.8 | 229.2 | 740.7 | 529.2 | 1791.6 | 2062.8 | 949.8 | 2008.2 | 2930.7 | 4013.8 | 3082.2 |
| Australia | Volume | 1.2 | 1.5 | 2 | 1.8 | 1.3 | 1.1 | 0.6 | 0.9 | 0.9 | 0.6 | 0.6 | 0.6 | 0.5 |
| | Value | 1121.7 | 1031.3 | 1268.1 | 1342.3 | 1095 | 1307.7 | 1350.2 | 1369.5 | 810.3 | 948.3 | 1366.5 | 1702.6 | 1384.1 |
| US | Volume | 4 | 5.1 | 6.1 | 7 | 7.7 | 6.6 | 5 | 9.1 | 14 | 14.2 | 16.3 | 17.4 | 20.7 |
| | Value | 2000.4 | 2295.3 | 2515 | 3099.1 | 4609.5 | 5240.4 | 7342.5 | 8113.3 | 8005.6 | 12180.5 | 18962.7 | 21202.1 | 26740.5 |
| Germany | Volume | 0.2 | 0.1 | 0.2 | 0.2 | 0.1 | 0.5 | 0.8 | 1 | 1.5 | 1.6 | 2.1 | 2.3 | 2 |
| | Value | 94.8 | 98.4 | 114.2 | 113.7 | 122.9 | 557.5 | 1484.7 | 1480.5 | 1916 | 2928.8 | 4459.9 | 6303.5 | 5399.7 |
| EU | Volume | 5.2 | 6 | 7.3 | 8.4 | 8.4 | 9.3 | 9 | 9.4 | 11.7 | 9.6 | 14.3 | 16.1 | 16.5 |
| | Value | 4555.5 | 5140.4 | 5826.7 | 6991.1 | 8433.4 | 11142.1 | 18227.7 | 17406 | 16398.6 | 16661 | 28658.8 | 39937.5 | 42922.4 |
| Netherlands | Volume | 0.7 | 0.5 | 0.3 | 1.5 | 1.4 | 0.9 | 1 | 1.2 | 1.4 | 1 | 2.1 | 2.4 | 2.5 |
| | Value | 543.8 | 423.5 | 223.2 | 1286.4 | 1553.1 | 1375.6 | 2321.7 | 2708.2 | 2154.6 | 2105.8 | 4861.2 | 5788.1 | 7557.7 |

# ATTACHMENT C

Table C: **The liquid milk and dairy manufacturing enterprises throughout the country from 2000 to 2012 (Unit: plant)**

| Year / Location | 2000 | 2002 | 2004 | 2005 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|
| Nationwide | 377 | 499 | 636 | 698 | 736 | 815 | 803 | 784 | 644 | 649 |
| Beijing | 17 | 21 | 17 | 19 | 13 | 13 | 14 | 15 | 9 | 8 |
| Tianjin | 10 | 15 | 9 | 15 | 13 | 14 | 12 | 15 | 14 | 14 |
| Hebei | 29 | 46 | 47 | 63 | 63 | 64 | 52 | 39 | 32 | 34 |
| Shanxi | 9 | 16 | 17 | 18 | 20 | 24 | 24 | 20 | 18 | 17 |
| Inner Mongolia | 22 | 30 | 47 | 47 | 63 | 70 | 77 | 80 | 71 | 65 |
| Liaoning | 9 | 12 | 20 | 25 | 20 | 29 | 28 | 23 | 16 | 16 |
| Jilin | 6 | 6 | 6 | 7 | 8 | 7 | 10 | 14 | 14 | 13 |
| Heilongjiang | 50 | 54 | 65 | 72 | 78 | 80 | 77 | 74 | 64 | 65 |
| Shanghai | 12 | 15 | 18 | 16 | 14 | 12 | 9 | 10 | 8 | 8 |
| Jiangsu | 24 | 31 | 34 | 33 | 36 | 36 | 36 | 33 | 25 | 27 |
| Zhejiang | 19 | 37 | 41 | 34 | 29 | 30 | 26 | 25 | 18 | 17 |
| Anhui | 6 | 9 | 8 | 12 | 13 | 14 | 15 | 16 | 11 | 12 |
| Fujian | 10 | 10 | 15 | 13 | 12 | 11 | 13 | 12 | 8 | 9 |
| Jiangxi | 7 | 7 | 10 | 10 | 9 | 8 | 8 | 8 | 8 | 8 |
| Shandong | 19 | 37 | 67 | 81 | 82 | 95 | 101 | 97 | 83 | 79 |
| Henan | 11 | 14 | 23 | 25 | 29 | 53 | 51 | 49 | 45 | 44 |
| Hubei | 10 | 7 | 10 | 14 | 15 | 16 | 17 | 16 | 11 | 10 |
| Hunan | 3 | 7 | 18 | 16 | 15 | 15 | 16 | 18 | 16 | 16 |
| Guangdong | 19 | 15 | 20 | 21 | 24 | 26 | 27 | 28 | 23 | 28 |
| Guangxi | 4 | 5 | 6 | 10 | 11 | 10 | 13 | 13 | 12 | 14 |
| Hainan | 0 | 1 | 3 | 3 | 4 | 4 | 3 | 3 | 0 | 0 |
| Chongqing | 1 | 4 | 5 | 6 | 5 | 7 | 5 | 5 | 0 | 4 |
| Szechwan | 9 | 14 | 22 | 23 | 25 | 26 | 21 | 21 | 17 | 16 |
| Guizhou | 1 | 2 | 4 | 5 | 5 | 5 | 4 | 4 | 0 | 0 |
| Yunnan | 1 | 5 | 8 | 8 | 12 | 10 | 11 | 11 | 12 | 14 |
| Tibet | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Shaanxi | 29 | 36 | 42 | 43 | 47 | 49 | 53 | 53 | 39 | 41 |
| Gansu | 15 | 19 | 20 | 14 | 14 | 20 | 18 | 18 | 12 | 13 |
| Qinghai | 4 | 3 | 4 | 4 | 6 | 7 | 7 | 8 | 4 | 5 |
| Ningxia | 13 | 11 | 16 | 18 | 18 | 21 | 20 | 16 | 16 | 19 |
| Sinkiang | 7 | 9 | 13 | 22 | 32 | 38 | 34 | 39 | 30 | 28 |

**All data in this section is cited from: China Dairy Statistical Abstract of 2013, China Dairy Industry Yearbook of 2012, annual report of each enterprise.**

中荷奶业发展中心

SINO-DUTCH DAIRY DEVELOPMENT CENTRE

中荷奶业发展中心

地址：北京市海淀区天秀路中国农大国际创业园3号楼4010室

电话/传真：010-62720390

邮政编码：100193

Sino-Dutch Dairy Development Centre

Address：Room 4010，Building 3，International Innovation Park of China Agricultural University，No.10th Tianxiu Road，Haidian District，Beijing，P. R. China

Tel/Fax：86-10-62720390

Postal Code：100193