

The Development of Dairy Industry and the Improvement of Grasslands in North China

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Abstract

Recently the dairy husbandry in China reveals profound progress; the trend of which principally localizes in northern agricultural and grassland areas. Steady progress of people's income accelerates the rise of dairy husbandry, accompanying the tendency of farming conversion from traditional crop cultivation to dairy husbandry. With the rapid development of dairy production, forage supply is getting starved, and serious degradation of natural grasslands, which had been long applied properly for traditional pastorals before becomes apparent in each place. For the resolution, various organizations have been concentrating on (1) efficient utilization of maize residues, (2) renovation of degraded grasslands, and (3) expansion of cultivation of silage maize, improved forages, and fodder root crops. The situation that the annual increasing rate in cow number averages 15-20% brings various problems in turn. The fact indicates how to balance cattle feeding number, milk processing capacity, and forage productivity each other is one of the most important subjects for the development of each dairy husbandry.

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In recent years, dairy husbandry in China has shown profound progress. Because of the steady increase in people's incomes, there has been a rapid rise of the sector, and an accompanying tendency to convert farm from traditional crop cultivation to dairy cattle feeding. The trend results in serious starvation of milk cows together with drastic shortage of forages that animals demand.

By the end of 2004, the total number of cows has approached to nine million heads in all of China, and the total milk production reached 17 million tons (Table 1). The rapid development was most prominent in Northern areas and big city areas such as Beijing, Tianjin and Shanghai. When jumping to a conclusion, Northeast, North and Northwest China has become the main regions of milk production, although cities like Beijing, Shanghai and Tianjin still own the largest number of cows. In particular, the dairy husbandry sector of Heilongjiang is now the most distinguished among the developing north. Heilongjiang Province, Inner Mongolia

and Xinjiang Province are the areas with the largest number of cows (ca. 36% of the cows in China are fed in these areas). Over 50% of China's cows are fed in agricultural areas and conjunct areas of agricultural and pastoral areas in so-called 'Three Norths'. In Heilongjiang Province, Hebei Province and Inner Mongolia Province, the total milk yield was over 5 million tons which accounts for 38% of the total production in the whole country in 2004. The milk yield of Shandong, Xinjiang, Shaanxi, and Shanxi Provinces accounted for 26% of the total production, as well.

With this situation, the Ministry of Agriculture (MOA) of China decided to establish Northeast Area, North China Area, and the neighboring areas of Beijing, Tianjin and Shanghai as the milk production centers of China in the 'Advantageous Cow Milk Production Area Development Plan 2003-2007'. The reason why these three areas were selected for the rapid development program is that their natural conditions, markets, the scale of industrialization, and the environmental

Table 1. The generalization of milk production in China and Japan

Country	No. inhabitants	No. milking cows	Milk yield (ton)	Per-capita milk
China*	1,302,307,000	6,873,000('02)	13,000,000 ('02)***	11.0kg 15.7kg(in cities) 1.19kg(in country)
Japan**	126,688,364	936,000('03)	8,400,000 ton('03)	92.8kg

* China Statistical Year Book, 2002

** Statistics from the Ministry of Agriculture, Forestry and Fisheries of Japan, 2003

*** Heilongjiang: 2,358,000 tons (18.1%), Inner Mongolia: 1,652,000 (12.7%), Hebei:1,369,000 (10.5%)

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quality are excellent for satisfying the rapid increase of national demand.

The suburban pastures in Beijing-Tianjin-Shanghai Areas, on the other hand, have held their own reasonable characteristics in the recent progress of dairy industry with milk processing plants; the regions are situated in quite advantageous position being easily conformable to the consuming demand of the cities and the suburbs. However, the metropolitan milk processing industry has been in the predicament from the beginning, because of the ever rising rent, expensive labor and the serious contamination caused by excrement of cows. As a result, each milk company has to adjust the development strategy for the future. Therefore, large milk production enterprises are beginning to recognize that the most advantageous regions for cows are the agricultural plains and the half-agricultural and half-pastoral regions in Northeast Area and North China Area, and are, no longer those natural grasslands where traditionally animal grazing has been popular or suburban farms where the pressures of the environment and costs are increasing.

I . The Outline of Current Status of the Dairy Industry and Milk Consumption

1. The status of milk products: In 2004, there were approximately 1,600 milk processing enterprises in China, including ca. 500 enterprises whose retail income was over 5 million RMB. The total economic value of milk products was 34 billion RMB with an increase of 25%, compared with 2003, and the total profit was ca. 2 billion RMB with an increase of 15.2%. The enterprises with the largest retail income increased by 53.7% in 2003, as compared with that of 2002.

Recently, the merger and the integration of milk processing enterprises are speeding up, and the level of the technology of milk processing is rising. The total yield of dairy production was 9.3 million tons and the fluid milk was 3,550,000 tons in 2004. However, several problems still exist in the dairy industry of China. For instance, the powder milk is not so competitive to foreign products even though the production of powder milk was over the level of 600,000

tons in 2004 (Table 2). Besides, the main problems existing in the dairy manufacturing industries are: **(a)** the quality of raw milk can not be assured effectively (the quality of fresh milk, which influences the quality of dairy products, is low), **(b)** most milk processing enterprises are small and use a low level technology, and **(c)** the variety of products is quite limited.

Therefore, according to the development program of the Chinese food industry from 2000 to 2005, the emphasis of the milk industry is to **(a)** adjust the structure of enterprises, **(b)** increase the quality and variety of products, and **(c)** decrease the proportion of milk powder production in the mass, while increasing the yield of liquid milk, cheese, butter products etc. appropriately. By 2005, it was expected that the yield of the dairy products would reach 13 million tons and the annual increase would be 10%. On the other hand, the fluid milk yield would reach 4.5 million tons and the annual increase would be 20%.

2. The status of the consumption of milk products: The Food and Agriculture Organization (FAO) estimated that the average annual consumption of milk per person all over the world was 97.6 kg in 2004. Meanwhile, the average consumption in the developed countries was 268 kg and in the developing countries was 50.9kg. Surprisingly, the average consumption in China in the same year was merely 10.9 kg which was equal to 1/9 of that in the developed countries and 1/5 of that in the developing countries. However, in recent years, the consumption of milk products in Beijing, Tianjin, Shanghai, Chongqing and many provincial capital cities has increased quickly with the consumption of liquid milk increasing by 20-30%. There are a few reasons for that growth. To begin with, promotion of milk products has been strengthened since 1998 in order to stimulate the development of milk industry. Secondly, a largest variety of milk products are now available for consumers to choose from. Finally, the level of income of people in cities and towns is continuously rising. The city retail distribution system is gradually improving and is convenient for consumers. However, the consumption level of the milk products is still low (only 1.2 kg per person in 2001~2003). The main reasons are summarized as follows:

Table 2. The trend of milk product and consumption in recent 7 years

Item	1996			2002			Increase ratio (%)		
	Consumption (kg/person)	Production (ton)	Import (ton)	Consumption (kg/person)	Production (ton)	Import (ton)	Consumption	Production	Import
Milk powder	0.41	490,000*	19,307	0.55	680,000	110,799	34%	38%	473%
Liquid milk	4.83	120,000**	7,696	15.68	3,010,000	6,499	224%	2,408%	-15%
Acidophilus milk	0.32	3,500	422	1.82	530,000	1,663	468%	15,042%	294%

* data of 1997, **data of 1998

Table 3. Distribution of natural grasslands and their degradation in Western China (1,000 km²)

Province* / Autonomous Region**	Area	Degraded area	Degradation ratio (%)	Degradation degree (%)		
				Light	Medium	Heavy
Inner Mongolia**	788.0	467.3	59	52	37	11
Xinjiangwuerzu**	572.6	346.7	61	47	39	14
Qinghai*	363.7	203.7	56	42	36	22
Tibet**	678.3	292.9	48	65	24	11
Gansu*	179.0	85.6	43	37	39	24
Ningxiahuizu**	30.1	29.2	97	29	40	31

- (a) The country side economy is not flourishing and per capita income stays at a low level.
- (b) The people in the country side are accustomed to the traditional foods and do not recognize the nutritional value of milk products.
- (c) It is difficult to distribute the milk products in the country side because the milk processing enterprises are centralized in big cities or their suburbs.

II. The Latest Tendencies in Modernization of Forage Production

1. The serious situation in traditional forage resources in north and west of China: As shown above, Heilongjiang, Inner Mongolia in Northeast, Hebei in North China, and Xinjiang in Northwest are all expected to have the most active growth from now on. However, the rangeland ecosystem in the North and the West of China where grassland vegetation has been originally dominant is getting worse and worse in recent years as a result of the increasing human activity.

The Statistics report that 90% of grasslands in China are degenerating or have already degenerated. As shown in Table 3, degradation is particularly serious in West China where there is a great deal of dependence on pastorals. The seriously damaged grasslands have low grass output, and the natural pastures which had originally functioned as the main forage source cannot meet the need of increasing demand of cows any longer. If China is to have a sustainable environment, the Norths of China should not undertake more productive responsibility, but more ecological responsibility for their grassland areas (Figure 1). Thus, various organizations in Northern China have been eagerly concentrating on the projects to expand the cultivation of silage maize, improved forages (both grasses and legumes), and fodder root crops, in combination with active utilization of maize and other crop residues, which formerly were not consumed efficiently but were often abandoned as waste.

2. The construction of cultivated grasslands: In order to mitigate the imbalance between the livestock number and grass supply, many Provinces are constructing great area of cultivated grasslands. In 2004, the total area reserved for cultivated grasslands was ca. one million ha (Figure 2). The



Figure 1. The renovation project of degraded natural grasslands. Fragmentation of grass rhizomes by destructing soil surface is often effective for renovation of vegetation.



Figure 2. The industrialized production of alfalfa in a cultivated grassland (Heilongjiang Province). In 2004, the total area of cultivated grasslands amounted to ca. 100,000 km² in China (mostly localized in Northern China).

Table 4. The list of cultivated grasses and legumes popular in China

Family	English name	Latin name
Grass	smooth bromegrass	<i>Bromus inermis</i> Leyss.
	perennial ryegrass	<i>Lolium perenne</i> L.
	Chinese leymus	<i>Leymus chinensis</i> (Trin.) Tzvel.
	oat	<i>Avena sativa</i> L.
	crested wheatgrass	<i>Agropyron cristatum</i> (L.) Gaertn.
	Dahurain wildrye	<i>Elymus dahuricus</i> Turcz
	sudangrass	<i>Sorghum sudanense</i> (Piper) Stapf.
Legume	alfalfa	<i>Medicago sativa</i> L.
	red clover	<i>Trifolium pretense</i> L.
	white clover	<i>Trifolium repens</i> L.
	erect milk vetch	<i>Astragalus adsurgens</i> Pall.
	sainfoin	<i>Onobrychis viciaefolia</i> Scop.

main areas for cultivated grasslands are indeed located in Northwest, North China and Northeast (we call them Three Norths). Forage plants mainly cultivated in these areas are introduced legumes and grasses such as alfalfa, red clover, smooth bromegrass, perennial ryegrass, Sudangrass, etc., most of which have been well improved for high productivity in both the US and China (see Table 4). Cultivated grasslands with high production and quality greatly alleviate the imbalance between the livestock number and the grass supply, and help to increase the production of milk.

However, most of China's forage industry is still far behind the standard of developed countries. Farmers are not skilled in cultivating forages on low-production farmlands or saline farmlands which are not suitable for grain crops but are only suited for forage cultivation, and just a few farmers are beginning to try grass cultivation on fertile farmlands. Also most people are unaware of the concept of maintaining sustainable utilization of farmlands by rotating forage and grain crops which actually brings economical profits from the combination of grass and livestock. Most people have little knowledge about the productive forage cultivars and storing technology. Poor management in cultivation and harvesting, together with low use of mechanization, cause the low forage quality. For the present, the large dairy farms are usually the only ones that feed high quality planted forage crops to their cows.

3. The cultivation of silage crop (maize): Although the Chinese have a long history of planting forage crops, processing and utilizing silage, the main users had been the large-scaled state-owned farms (Figure 3). Since 2000, the big-area planting and utilization of silage crops have been increasingly universalized and expanded by dairy farmers. Nowadays, most farmers who use supplemental feed have built their own silos. The most popular silage crop varieties are maize and grain crops such as sweet sorghum. The government supports the farmers' efforts to cultivate silage crops; for example, the government provides 1~2 *mu* (Chinese scale for area, 1 *mu*=667m²) farmland for farmers to plant silage crop for each cow. Along with the continuous



Figure 3. Silage maize harvesting on a large area (Heilongjiang Province), the cultivation of maize crop is very popular everywhere in China. The government supports farmers, who provide ca. 10a of maize crop for each cow.

extension of the husbandry scale, some farmers began to plant silage maize on their own farmlands. In the areas where dairy cow farms are centralized, some non-dairy farmers even utilize their own farmlands for planting silage maize in order to sell harvested maize to dairy farmers.

In spite of recent progress in silage crop cultivation mentioned above, silage crops are still in serious shortage in most areas as many farmers in medium or small husbandry scale do not hold enough farmland to expand silage maize cultivation. The time for feeding silage crop is restricted (October to the next May); dairy farmers have to feed crop straws (a low quality) or graze in order to meet the needs of the cows during the rest of the year. Thus, the crop straw is high priced during this period in agricultural areas. Every May, the price of crop straw rises to about 0.05 Yuan/bundle in some areas near Harbin in Heilongjiang Province.

The silage on medium and small scale husbandry farms

is generally of bad quality and a large portion is wasted, because most farmers cannot build large silos suitable for keeping maize silage properly, and the conditions of the silos cannot meet the requirements for processing quality silage. Recently, the wilted, wrapped big-baled silage has been introduced, and has quickly popularized in several Provinces where cows are centralized. Because it is small, lightweight and convenient to transport, the wrapping machine for bundling small ensilage is acceptable for smaller scale farmers in China.

4. The cultivation of root crops: Recently, some large-scale husbandry farms and some skilled breeding farmers have begun to plant succulent fodder crops such as feed beet and feed carrot, in order to improve the milk quantity and quality. Most of fodder beet cultivars are introduced from abroad and produce large crops. For example, a beet can weigh as much as to 18 kg and the production of the beet root may be 7~8 tons per *mu* with the maximum of 10 tons. At the same time the beet plants produce 3~5 tons of leaves per *mu*. The beet leaf is used in summer and autumn and the beet root is used in spring and winter. The yellow colored feed carrot is the only variety that the Chinese cultivate. Although the taste of feed carrot is worse than normal edible varieties, its productivity is very high. The production of feed carrot, which looks like a small beet, can amount to over 7 tons per *mu*. The feed carrot is not only palatable to cows but also can improve the milk production and quality and increase the amount of fat in the milk. As the winter is longer in north China, the fresh and green high-quality forage is limited. However, by feeding these high-quality juicy forages that have more nutrients, the cow will produce a larger amount of more nutrient milk. The improved diet also helps to produce healthier calves. Thus the cow provides more profit for the farmer.

5. The utilization of the crop residues (straws and decayed leaves): Because China is densely populated, the food crop production is very important. Food production generates a great deal of the crop residue after grain harvesting. The statistics indicate that the yield of various crop straw is 550~600 million tons each year in China. Among them, the rice straw production is 180 million tons, the maize straw is 140 million tons, the wheat straw is 130 million tons, and the others (including the bean, miscellaneous food, peanut and cassava etc.) are 100~150 million tons; 70% of these straw are utilized for the fuel to heat houses, or directly burn in the field; nearly 20% of the straw is used as forage, the remaining 10% of the straw is used for the craft industry and paper-making. Thus, it is clear that there is a huge opportunity to use the straw better. Particularly in North China, the crop straw has become the main source for crude fodders (Figure 4). Although the palatability and the rate of digestion can rises by processing the straw properly (such as smashing and rubbing, the alkalization, the salinization, and microbe processing), the nutrient content of the unprocessed crop straws is basically low and only satisfies the stomach of the livestock (fill the stomach), so that



Figure 4. Active use of maize residue, which was not so useful before and often abandoned as waste, is now one of valuable forage resources.

the nutrient content that the livestock need mainly depends on the concentrates (maize, soy-bean, etc.) in such feeding systems. It means the improvement of quality forages such as cultivated grasses and legumes, and silage crops is the most critical goal for the development of dairy husbandry.

III . Problems Resulting from the Rapid Expansion of the Dairy Industry

As a result of the 15~20% annual increase in the dairy cow population, various inconsistencies have been resulted in. For instance, haphazard increase in milk production sometimes ends in abandonment of extra milk because of the shortage of processing capacity. Insufficient supply of forage crops often forces farmers to purchase grasses, raises their feeding costs, and suppresses their income. The facts show that the need to balance the number of cows, milk processing capacity, and forage productivity is one of the most important subjects for the development of each dairy husbandry program of every region in China.

In addition, environment protection problems have become central concern of the dairy husbandry industry. As dairy farming increased, the air pollution and the contamination in groundwater resources are getting more and more serious. For the present, some medium and small-scaled breeding farms have almost no way to deal with the offal produced by the cows. The waste matter produced by dairy farmers is directly deposited near their houses; the stack of animal wastes is like a hill in winter and generates serious odors in summer. In the areas where the cows are centralized, the liquid excrement of cows pollutes the groundwater seriously.

Although some local governments have taken various measures such as fermentation of animal wastes to control the pollution, the situation is still unsolved. Now, the government authorities are actively involved in program

to build large factories to process the waste in regions of cow concentration and to produce organic fertilizer. Such measures may greatly improve not only the ecosystem in areas where there are a lot of cows, but also raise the profit of the dairy farmers (as a results of greater milk production) by producing organic fertilizers useful for grass and silage crop cultivation.

IV. The Topic and Prospect for the Future

In order to satisfy the increasing demand for milk products, the expected fresh milk yield will increase to 53.5 million tons by 2010, and milk processing technology will improve correspondingly, and the number of cows will increase from 10.7 million in 2005 to 21.4 million heads in 2010. Accordingly, the planting areas of roughages, especially high-quality pastures and silage maize fields, will increase from 4 billion ha to 6.7 billion ha. At the same time, it will be necessary to improve the management of high-quality pastures and forage processing technologies, especially the research of silage technologies and extension of the research results. Increasing the quality and quantity of good pasture is necessary to satisfy the need to develop the dairy cow industry. In Heilongjiang Province where the number of cows is the greatest in China, the average annual yield of milk per cow is only 4,500 kg owing to the shortage of high-quality forage and silage, by comparison, the value is 8,000 in Japan, 10,000 in Israel, and 9,000 in U.S.A, respectively. Furthermore, the rapid increase of the amount of cow holding accompanying the scarcity of processing technologies and equipments, frequently results in the pollution of the environment, which lowers the living standard of dairy farmers. The dairy cow industry should not just blindly concentrate on increasing the number of cows, but should attempt to raise the yield per cow, so that the demand for increased milk production will be satisfied. Thus, effective measures should be taken in order to attain the above goal. First of all, it is necessary to improve the quality of degenerated natural grasslands. Secondly, scientifically improved and managed pasture-land should be established, especially increasing the planting areas of high-quality pasture grasses. Thirdly, silage technologies should be expanded. By these measures, the need for high-quality pastures for cows can be satisfied. Finally, developing more processing equipments for cow excrement is one effective

way to decrease the environmental pollution and to construct the circulatory system of sustainable utilization, i.e., the system of "pasture-animal-soil-pasture".

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