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A COMPARISON OF DAIRY AND HOG PRODUCTION, MARKETING AND MANAGEMENT BETWEEN THE PEOPLE'S REPUBLIC OF CHINA AND THE UNITED STATES OF AMERICA

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**A COMPARISON OF DAIRY AND HOG PRODUCTION,
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Hu Xi-Ji

The purposes of the paper are to (1) compare dairy and hog production, marketing and management between the People's Republic of China (PRC) and United States of America (U.S.), (2) attempt to find out both the advantages and problems that exist in the two countries and the social, economic and technical reasons which generate the advantages and problems, (3) promote a better understanding by agricultural economists of the historical and present situations in both countries with respect to dairy and hog production, and (4) anticipate trends which may develop by the end of the century.

General Comparison of China and the U.S.

The PRC and the U.S. are the largest agricultural producers in the world. The former is by means of her intensive agriculture to support her people which account for 22 percent of the world's population with less than 8 percent of the world's arable land. The U.S. not only supplies an abundance of agricultural products for her people but also for other areas of the world. Her exports account for 40 percent of total agricultural products trade of the world.¹ The agricultural production of both countries make a great contribution to the welfare and stability of the world.

The PRC and the U.S. are located in the eastern and western hemispheres. The total areas are nearly equal. The area of the former is 2,400 million acres compared with 2,264 for the latter. Both countries are

situated in the northern hemisphere and the latitudes are almost the same. However, there are great differences in geographic conditions between the two countries. China is largely a mountainous country with cultivated land accounting for only 11 percent of the total area, leaving 89 percent as mountainous, hilly or desert land. She has only 0.27 acres² of cultivated land per capita. It is, indeed, very hard to support more than one billion people in the PRC. In contrast, except for the Appalachian Mountains in the east, the Ozarks, and Rocky Mountains and desert areas in the west, much of the area in the U.S. is plain and/or only moderately hilly land. The cultivated land in the U.S. is approximately 410 million acres of which about 370 million acres are in growing crops.³ The per capita area is 1.9 acres, seven times that of China (see Table 1).

Table 1. Comparisons of Land Area, The PRC and the USA,
Total and Per Capita

Item	China	U.S.	China* as % of U.S.
Total Area (million acres)	2,400	2,264	106.4
Arable Land (million acres)	264	413	63.92
Arable Land Per Capita (acre)	0.27	1.9	14.2

*Excluding Taiwan Province

Although the latitudes of both countries are similar, the weather is not the same. The west and northwest parts of China, accounting for more than half of the total area, is far from the sea and ocean and has much desert and semi-desert with a continental climate and rainfall per year less than 12-15 inches, distributed in a manner unfavorable for farming.

There are similar desert areas in the U.S. but they are less extensive than in China. Except for the conditions mentioned above, rainfall in the U.S., generally speaking, satisfies the water requirements for crops with from 20 to 50 inches⁴ especially in the Corn Belt where the soil is fertile and rainfall is adequate and well distributed during the growing season.

From the above brief discussion, it is clear that the natural environments of the two countries have advantages and disadvantages respectively. However, from the overall point of view, climatic conditions in the U.S. are better than those in China. Institutionally, technically and from the standpoint of human development, there are also substantial differences between the two countries. Since 1862, the government of the U.S. has followed a series of policies and measures to promote the development of agriculture such as in education, technology and public credit, leading U.S. agriculture to become the first in the world. In addition, there has been no war or great social turmoil in the continental U.S. during the one hundred and eighteen years since the Civil War.

The General Nature of Agriculture in China and the U.S.

China is a country with a very long history. For more than four thousand years, the people of China have engaged in agricultural activities. In this time they have accumulated much knowledge and skill in agricultural production. In much of Chinese history, the subsistence agriculture sector has dominated her economy which limited commercial agriculture advance. From 1950 to 1956, Chinese agricultural production developed rapidly after relative peace was established and land reform and improved policies were implemented. With the establishment of more peaceful conditions in the early 1950s, the rate of growth per year in grain production was up to 7 percent while that of population was 2.2 percent.

After 1957, however, when the advantages of peace were exploited, the former slowed down to 1.87 percent while population was 1.91 percent and exceeded the farm because policies encouraged population growth (see Figure I).

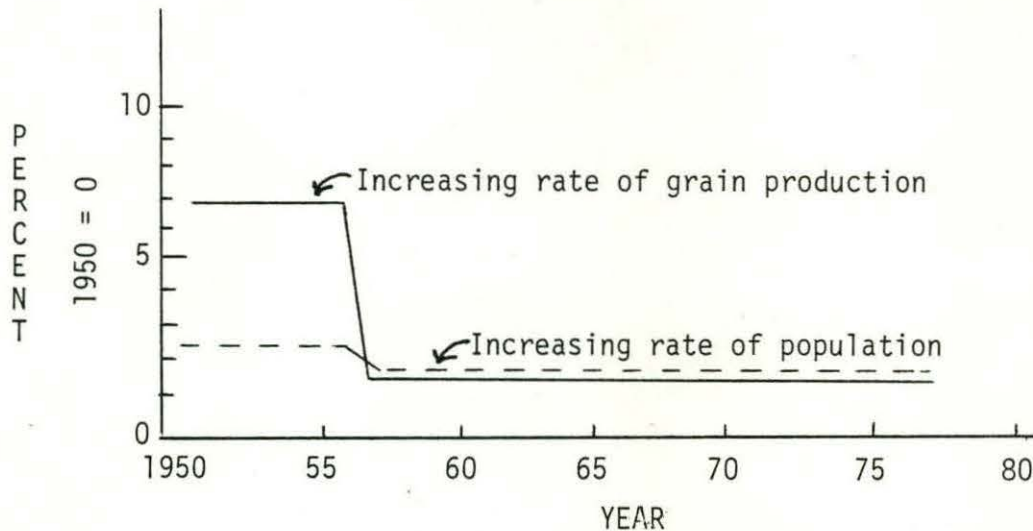


Figure I. The Increasing Rates of Grain Production and Population of PRC, 1950-1977

During this period, animal husbandry was neglected. Before 1966, livestock production accounted for only 16 percent of the gross value of agricultural output even in good years. After 10 years, in 1976, the proportion declined to 13.2 percent.⁵ There were deep-rooted historical and social reasons for stressing crop production and neglecting livestock. In the long period of subsistence agriculture in which people supplied themselves in order to survive, it was natural to put emphasis on irrigated grain production to feed more people from the limited arable land -- the organic relationship between crop and livestock production was not understood because of the lack of modern science and knowledge. Livestock production in China has always been regarded as a sideline to crop

production. In contrast, in the U.S. and other developed countries, the proportion of livestock in the value of total agricultural production always accounts for 50 percent more or less of the total. Traditionally, the western countries are meat eaters.

Hog raising, however, is very popular in the countryside of China with most of the farmers raising only a few hogs. China has more hogs than any other country in the world. In 1980, China produced more than 300 million head and 7.5 million tons of pork.⁶ By contrast, dairy cows are rare in China with only 640,000 head in total and those mostly in the suburbs of big cities. In 1980, the U.S. produced 64.52 million hogs and pigs,⁷ only 19.4 percent of that in China, but produced 6 million tons of pork or 80 percent of that in China. The U.S. also kept 10.8 million dairy cows.

Table 2. Comparison of the Pork and Dairy Subsectors,
The PRC and the USA, 1980

Item	China*	U.S.	China* as % of U.S.
Number of dairy cows million head	0.64	10.8	0.59
Total milk production million kg	2240	5.78	0.038
Milk production per cow kg	3500	5344	65
Number of hogs and pigs million head	300	64.52	473
Pork produced million tons	7.5	6	125

*Excluding Taiwan Province.

This situation explains that dairy and hog production in China is presently backward, not only in the number of cows, but also in productivity per cow and in dressing percentages and size of hogs marketed. On the other hand, China's development potential is huge if (1) more attention can be given to pork production; (2) hog production is encouraged by the government, (3) natural resources are more rationally used in pork production, and (4) if fuller use is made of improved agricultural sciences and techniques.

Livestock Production in the Two Countries

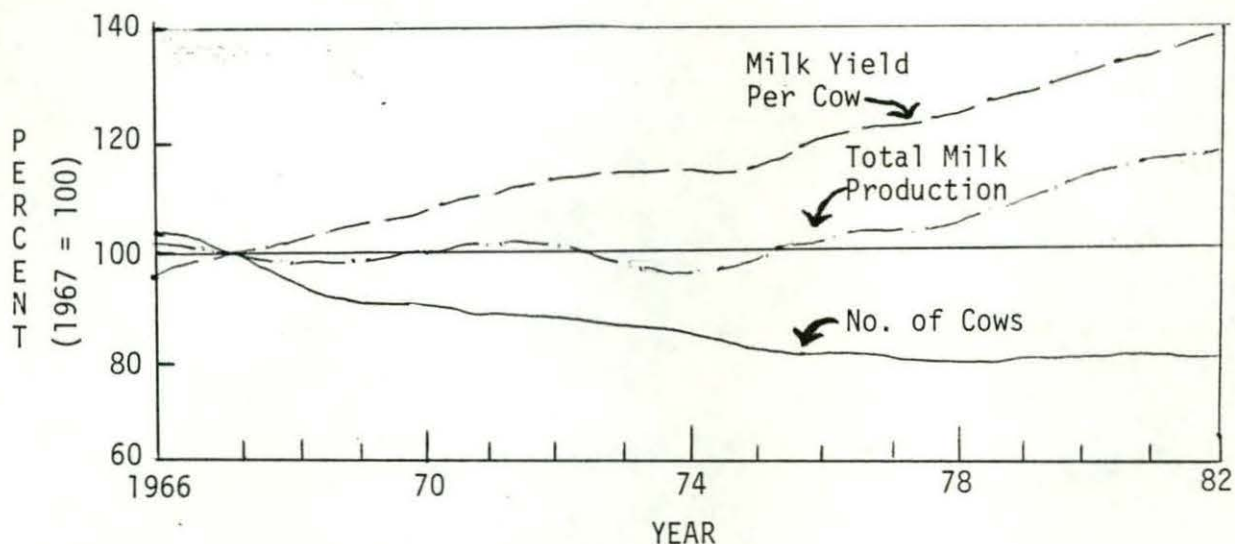
As mentioned above, the livestock industry of China has not been emphasized recently in China, and even after 1949, the situation was basically the same. It is only since 1979 that livestock have been given greater emphasis by the government. As it is difficult to develop and shape an independent industry in such a short period, the dairy and hog production industries of China are still sidelines. Dairy production is largely limited to the suburbs of Beijing, Shanghai, etc. Herdsmen in the grazing zone produce some dairy products but production is limited because of transporting, marketing, processing and storage constraints.

By 1982, the number of dairy cows in China had increased to 0.8 million head, more than 12.7 percent above that in 1980,⁸ but milk production is still very short relative to potential demand in big cities. For instance, the fresh milk shortage in Beijing is thought to be 150,000 kg per day at present prices and income levels. There are more than 200,000 babies and children who need milk in Beijing. Even in Harbin, a big city where dairy production has developed rather rapidly in recent years, the milk supplied was 17.52 million kg in the first half of 1981, or a per citizen supply of only 0.9 kg per month or 10.8 kg per year, calculated on

the basis of a population of 2.4 million in the city. Even though the Harbin figure is much higher than the average for the whole country, it is still a very low figure.⁹ Milk products, such as milk powder, butter and cheese are rare items in markets, except for a few cities and towns. China can improve the nutrition standard of her people by energetically developing her dairy industry. There is a huge potential market for milk production in China. Recently, the United Nations Development Program and the world food planning program of the United Nations signed a contract with the Chinese government to help the dairy industry develop in the suburbs of six big cities in China.¹⁰

In contrast to China's dairy production industry, the U.S. has one of the world's most developed dairy industries. In 1980, total milk production in the U.S. was 5.78 billion kg. The average cow was producing 5,344 kg,¹¹ which is 144 percent above China's. It is worth noting that from 1966 on, the number of cows was 10.81 million head, or a decrease of 23 percent from 14.0 million in 1966. Between the same dates, however, total milk production increased 9.3 percent, from 54 to 58 billion kg (see Figure II). By 1980, the milk yield per cow had increased 30 percent over that of 1966, while in the same period, the number of cows decreased about 23.2 percent.

China's pork industry is quite different from her dairy industry. Most farmers have a tradition of hog production. Of all provinces, Zuechuan is in first place. It provides one-sixth of the pork China produces.¹² From 1949 to 1979, China's hog production increased 5.87 percent per year.¹³ Pork is the main meat of one billion Chinese people. In 1980, total pork production in the whole nation was 7.5 million tons and accounted for 91 percent of red meat consumption. In 1982, the figure was



Source: U.S. Department of Agriculture.

Figure II. Relative Changes in Milk Yield Per Cow, Total Milk Production and Number of Cows, USA, 1966-82

up to 12,738 billion kg. The average annual pork consumption per person was up to 12.7 kg. Definitely this resulted mainly from the new policy that was implemented beginning in 1979. The shortage of pork in the market before 1976 has been reduced.

It should be pointed out, however, that the proportion of all hogs slaughtered in China is still low. Even in 1982 it has been up to 100 which is low compared with 164 percent for the U.S. Although the number of Chinese hogs and pigs account for one-third of hogs in the world, China produces only 7 percent of the total. If pork consumption is counted on a per capita basis, each person consumes 29 kg in the U.S. or more than twice that in China and, it should be noted, that pork is only the second meat on the table of the U.S. people whereas in China it is the predominant meat eaten.

In general, China's dairy and hog production are still comparatively underdeveloped, mainly because of (1) incorrect policies, (2) poor technology and (3) especially poor feed. In China, dairy cows are mainly in suburbs and there are few dairy cattle. The quantity of feed concentrates required is still small at present. Roughages such as hay, stalks of crops, chaff and distiller by-products are obtained from local plants and farms. In Inner Mongolia and in Northeast China, sugar beet pulp is often fed to cows. Concentrates are generally supplied by the national feed company but the amount varies in different areas. In recent years, as grain production has increased rapidly, the concentrate needed by dairy farmers of the suburbs of big cities has been easier to supply. The problem of how to produce good quality concentrate is a very important subject in the development of the industry at present. Of course, at the same time, attention should be paid to the quantity of roughage as the number of cows is increased.

In comparison to the case for dairy cows, the problem of feed for Chinese hogs is more complicated and harder to solve. China differs from the U.S. In China, corn and sorghum are foods for people. Consequently, a great part of the feed for hogs is from local wild grasses and crop by-products rather than corn grain, sorghum and barley. For instance, sugar beet pulp in the north and the tops of sweet potato in the south are fed as roughages. Only when a hog is close to slaughter is a limited amount of concentrate added to the ration. The rate of concentrate feed conversion in China is a little bit lower rather than higher than that for the U.S., namely 5.1:1 and 4.86:1 assuming that the concentrates are at all comparable.¹⁴ The time needed to produce a marketable hog in the U.S. is much shorter than in China due to use of better feeds and sanitation. In

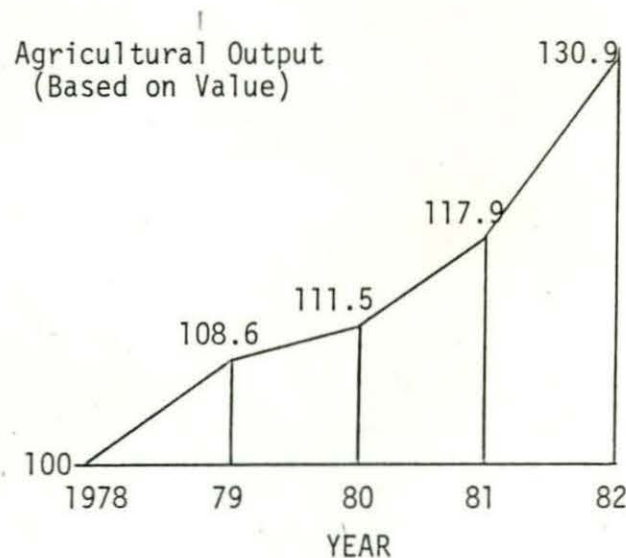
general, U.S. hogs reach a slaughter weight of 90 to 100 kg in six months while it takes 7 to 8 months in China. Shortening the feeding period with more and better concentrate may be important for the further development of Chinese pork production especially if Chinese labor becomes more valuable. The problem is probably one of developing better hog feeds and of adjusting the number of hogs to the supply of such feeds.

In addition to the technical problems mentioned above, the poor agricultural policy established in China in the late 1950s and early 1960s has been changed to the "production responsibility system." This system is based on public ownership of land while the commune distributes the land to farmers on the basis of the number of laborers in the family. Farmers cannot sell and buy land and have to adhere to the national plan through contracts. Once distributed, the land is managed by individual families.

Chinese agricultural production has increased year by year since the responsibility system was implemented. Last year, total agricultural production was valued at \$139,250 million, increasing 11 percent over that of 1981. Of this total value, livestock products accounted for \$27,800 million, having increased 13.2 percent over 1981 and accounted for 15.5 percent of the total value of agricultural production.¹⁵ This is one of the best records since 1949. The income per rural person in 1982 rose to \$135. This improved the feeding, clothing and shelter of the rural population and increased the demand for the products of the livestock industry. Figure III shows how the situation for agriculture has developed since 1979.

Specialized households have emerged in Chinese agriculture. Also, as the responsibility system has been implemented, a more diversified agriculture has developed. The so-called specialized household is a household which emphasizes one particular item of agricultural production. Most of

them specialize in dairy cattle, hog feeding, forestry or grain farming, of which the number specialized in dairy cattle and hog feeding account for 32.4 percent. Up to now, the number of specialized households account for 10.0 percent of the total number of farmers. The specialized grain producing households sell around 50 percent of their production with the maximum being around 70 percent as compared to 35 percent for the ordinary farmer.¹⁶ The specialized dairy and hog producing households sell even higher proportions of their output.



Source: China Reconstructs, 1983, p. 36.

Figure III. Agricultural Production of China, 1978 to 1982

The specialized household helps attain a more efficient division and use of labor and helps develop the economies of rural areas. In the present countryside of China, this kind of farm/household is larger and more skillfully managed than general farms. For instance, the specialized hog producing farm/household in the Zeeping area, Jelin Province, account

for 1.7 percent of the total number of households but produce 14.5 percent of the total marketings of the area.¹⁷ The minimum hog number for a specialized farm/household is more than 10 ranging up to a maximum of more than 100. Therefore, this kind of production unit has broken through the category of traditional family sideline production and developed into an agricultural firm with intensive management and better use of labor and skills. Specialized households are leading to better resource utilization and modernization. It is separating livestock production from crop farming, and in the near future, will tend to further subdivide the livestock industry and increase the productivity of Chinese agriculture.

In reality, the specialized farm/household is not the "patent" of China. There has been specialized production in the U.S., Europe and elsewhere for a long time. Since World War II, its development has been rapid in these countries. At present, farmers in the U.S. who keep dairy cows and raise hogs are 333,620 and 512,292 or 13.7 percent and 21.1 percent respectively of the total number of farms.¹⁸ In 1979, dairy farms with sales of over \$2,500 per year numbered about 205,000, while the farms which sold hogs and pigs in the 15 leading hog producing states totaled around 325,000.¹⁹ Because of specialized production, most of these farms are equipped with more advanced facilities and follow up-to-date techniques. The ratio of capital to labor is very high. Most dairy farms are equipped with bulk milk storage tanks, pipeline milkers, barn cleaners, silo unloaders and other labor-saving equipment. The hog farms have facilities for confined feeding with different groups being fed according to their ages. Labor productivity is very high. For example, the Perkinson's hog farm, located in the state of Illinois, which has only five

laborers, has a hog inventory of up to 9,000 and sells up to 25,000 hogs per year.

Because hog production is often reported with other livestock operations in the U.S. Census, it is difficult to know exactly how many specialized hog farms there are in the U.S. As specialization progresses, the U.S. hog and pig farms have been subdivided into three categories, namely, feeder pig farms, feeder pig finishing farms, and farrow-to-finish farms. This has resulted in greater efficiency in the use of labor. It was reported in a USDA bulletin that in 1975 the average labor input to produce one hundred pounds of pork was 1.77 hours and the total hours labor used for hog and pig farms was about 343 million. Pig and hog farms where marketings per year were more than 2500 head only used 0.72 hours per hundred weight. According to that rate, in 1975 the hog production would have required 139 million hours. The farms for which productivity was the highest used only 0.5 hours or 97 million hours in total.²⁰ Production per hour further increases as the hog enterprise expands with increased investment in labor saving equipment when labor is valuable and with further specialization. Furthermore, feed costs also decrease. For example, in Illinois, on the farrow-to-finish farms which produce under 250 litters per year, the cost of feed to produce 100 pounds was \$27.20 as an average, but on the farms which produced 250 litters or more, feed cost was \$25.89 for a difference of \$1.81.²¹ According to the above, one can conclude production specialization increases productivity regardless of the social system. The development of Chinese specialized hog production households and the agricultural production specialization in the U.S. support this judgment.

More than 90 percent of U.S. farms are under family management and Chinese agricultural production units, after implementation of the responsibility system, are also family managed. Although land ownership is private in the former and land cannot be sold and bought in the latter, there is one point in common and that is that better management directly benefits the producer and, indirectly, consumers. This form of family management has stimulated producers and created more wealth for society. There are many reasons why there is a huge production capacity of U.S. agriculture, family management being one of the important factors. In view of present productivity levels in China, the further potential of family management is still great. The Chinese government has determined that the form of responsibility system will not be changed for a long period. The future of Chinese agriculture will be bright if Chinese society and politics can remain stable.

Transportation and Trade of Agricultural Products in Both Countries

Trade in agricultural products should be developed as agricultural production develops. Trade is a necessary component of production and whether or not trade is obstructed has an important effect on production. Two aspects of trade are (1) transportation and (2) marketing, slaughtering, processing and storage services.

The U.S. is a country where agricultural trade is well developed. All areas in the country participate in production and trade consciously or unconsciously with the role played by transportation being prominent. The transportation of U.S. agricultural products depended mainly on railroads and ships before the 1930s. Afterward, highway transportation accounted for a growing role as the automobile and trucking industry developed. Today, the highway system has spread over all states and constitutes a

framework which leads to every corner within the country. In addition, the development of frozen food techniques in the last 30 years makes it possible for agricultural products to be easily transported from farms to the processing plants in the case of milk and from processing to retailing and consumption facilities in the case of pork. Because farm products can be sent to their destination directly from the farm by highway, transportation efficiency is, in a sense, higher than it was by railroad.

The development of the transportation industry further promoted regional specialization of U.S. agriculture. For example, hog production in the U.S. is mainly concentrated in the north-central states where 77.9 percent of all hogs were produced in 1980²² in close association with corn production.

The situation is quite different in China. At present, China depends mainly on rail transport. Since 1949 the trackage has been increased to 49 thousand kilometers from 40 thousand kilometers but is still far behind the needs of a country whose area is so vast and whose highway system is undeveloped. There is still considerable subsistence production in Chinese rural areas, trade in grain accounting for only 25 percent of production in 1980.²³ Though subsistence production results from limits on irrigated land and the low productivity of other land, the undeveloped transportation industry makes self-sufficiency important as has China's history of internal wars and social unrest. Though trade in livestock products is higher than for crops, it, too, has been seriously limited by poor transport. For instance, the potential to develop livestock production would be huge in Inner Mongolia if the transport of livestock products out of the grazing zone were more rapid and better. Thus, transportation

is one key to developing a nation-wide Chinese economy before the end of the century.

The slaughtering, processing and storage industry for livestock along with transportation will play a crucial role in the future development of Chinese livestock production. In general, it is not reasonable for slaughtering to be concentrated too much and it should be close to the areas of livestock production. Before World War II, Chicago was the major slaughtering city in the U.S.; however, slaughtering has spread gradually since 1960 to the places where hogs are produced. This can (1) save transportation costs for living animals or feed (six pounds of feed are used to produce a pound of wholesale meat) and (2) minimize pollution in or near the cities.

In 1980 there were about 115 big slaughter houses in the U.S. in addition to many smaller ones for a total of about 500. Over three-quarters of the hogs are purchased directly from farmers in a buying radius of around 100 miles. Increasingly, slaughterhouses also process, cut and pack the pork before shipping it directly to retail outlets to make the whole procedure very specialized and efficient.

Hog production, slaughtering, processing and transportation are dependent on each other. When the hogs are ready for marketing, hog producers (1) do not have to worry about the problem of slaughtering and selling their hogs directly after finishing, while (2) transportation costs are kept low.

The hog slaughter houses in China, except those in Beijing and Shanghai, etc. are mostly medium and small because (1) the area of hog production is less concentrated than in the U.S., (2) transportation is poor, (3) the freezing facilities in slaughter houses are limited, and (4) in cities,

cold storage capacities are small and refrigerated trucks are still uncommon. Farm slaughter is still common in the vast farming and grazing zone. Since 1979, hog production has increased rapidly to stress the capacity of existing slaughtering and processing facilities. As a consequence, a situation has emerged in some areas where farmers have difficulty selling hogs while consumers have difficulty in buying pork. As the problem cannot be solved quickly, farmers are bound to be upset. The Chinese government has recently decided to build some large cold storage facilities in several cities to help solve the problem.

There is no serious problem in marketing milk produced in the suburbs so far, as the distances are short and the amount to be moved is small. In the grazing zone, however, the situation is quite different and many herdsmen do not wish to keep more milk cows because of the marketing problem.

In addition to the problems mentioned above, there is another problem worthy of note which impedes agricultural trade and that is the system of government conducting trade in farm products.

Since 1958, supply and marketing cooperatives (which belonged to farmer collectives) have been made a part of a national governmental marketing organization which handles the pork trade. Since 1979 the interior faults of that organization have been exposed. When only one trading organization exists and that is obstructed, farmers cannot sell their products. It has been the practice of this organization not to buy more or less depending on how much the farmers have produced and consumers want. Instead, purchases depend on the attitude of those running the organization. For example, when production is high, the officials are unwilling to buy more, instead, they stop or limit selling by farmers²⁴ because their wages are not determined by how many hogs they buy. In pork production,

there is a close relationship between results and benefits received by farmers, but in slaughtering, processing and trade, there is no link between the results and earnings. A "responsibility system" is needed in Chinese agricultural trade as well as in farming.

**The Determination of the Price of
Agricultural Products in China and the U.S.**

The price of a commodity always affects its production. Price is determined by the supply and demand, or by its cost of production and its value or usefulness to consumers. This is true in both capitalist and socialist societies.

In the U.S., with other conditions constant, pork production is determined in an important part by market price. Hog producers get their price information through various channels and adjust their production levels according to the price. Generally speaking, hog prices are determined by supply and demand with feed an important item in the production costs which affects supply. In the 1950s, feed accounted for 65-70 percent of hog production costs, but at the end of the '70s, had decreased to 50 percent in the farrow-to-finish operations because nonfeed costs increased more rapidly than costs of feed inputs.²⁵

An important factor affecting demand is the preference of consumers. After World War II, the trend in preference was toward beef in the U.S. so the production of beef, from 1950 to 1970 doubled while the production of pork was basically stable and its proportion of total red meat decreased from 50 percent in the 1950s to 33 percent at the end of the '70s.

There is no overall meat pricing plan for the entire U.S. as it has a market controlled economy. Therefore, producers have to pay close attention to price so as to adjust their production, and improve their production and management techniques to maximize their profit. This situation

inevitably requires society as a whole to improve the means and ways of transmitting information on price. Daily newspapers report the price of agricultural products. Also there are generally radio and television reports three times or more per day. Farmers also contact buyers directly by telephone. Some producers can get detailed price information through their computer terminals.

China is a socialist country and the role of prices differs from that in the U.S. Prices are regulated to affect production and consumption rather than production and consumption regulating prices. Much depends on the skill of those who set prices as low prices discourage production and encourage consumption. China has had successes and failures in administering prices during the past 30 years.

One purpose of the new agricultural policy of China is to increase the production of marketable surpluses of agricultural products, particularly livestock products. As more than 90 percent of the pork is produced by individual farm families, the government improved the price to stimulate farmers to produce more pork and gave farmers more decision making responsibility. For example, the purchasing price for pork per 100 kg in 1979 was increased 26.43 percent over than in 1978.²⁶ In order to stabilize living costs for people who live in cities and towns, the government, starting in 1979, provided a food subsidy to each person of \$2.50 per month to offset price increases.

Presently, there are two price systems for Chinese agricultural products. One, controlled by the government, includes all the agricultural products that have to be sold to the government, such as grain, pork, oilseed, etc. No one has a right to change this price. The other price system is a "free market" system price. The commodities sold on free

market are (1) that part which exceeds the government production quota, and (2) is produced under the responsibility system for farmers. The prices of these commodities are determined by supply and demand within the constraints of production quotas, government distributions and the buying and release prices of the government. Generally speaking, free market prices are slightly higher than the government price. For instance, the governmental price of pork per kg in Huhout, Inner Mongolia is about four-fifths of the free market.

The present role of prices in Chinese society is important, particularly for agricultural production, but less important than in the U.S. as it is limited by the many factors mentioned above. However, the greater role recently given to prices has increased production.

Questions Relative to Future Livestock Production in the Two Countries

As aforementioned, the following questions relating to milk and pork production in China and the U.S. should be discussed. These questions have to do with: (1) the difference in the level of per capita consumption, (2) trends in dairying, (3) improved hog breeding and feeding efficiency, and (4) the question of future production prospects.

1. Several economic indices such as GNP, total value of agricultural products, etc. measure the production of a country. For some purposes, per capita measures of production and consumption are very helpful. If one considers grain production in 1980, China produced 328.22 and the U.S. 322.5 billion kg., roughly the same.²⁷ If one considers pork production, China produced 9 million tons and the U.S. 7.5 million tons in the same year. That means China produced 16.3 percent more than the U.S. However, total absolute figures are not the best measure. It is better to use per capita production or

consumption. Grain production per capita in China in 1980 was 327 and the U.S. was 1,452 kg., 4.5 times China's but much of U.S. production is exported. In the same year, pork consumption per capita was 10 kg. in China and 33.5 kg. in the U.S. despite the much greater consumption of other meats in the U.S. Total meat consumption per capita (not including poultry) was 81.4 kg in the U.S. These figures indicate that food production per capita in the U.S. is much higher than in China. Why is the gap between these two countries so big? Except for the natural conditions mentioned in the first part of this paper, two considerations have been important. First are better agricultural policies and a long history of U.S. support for agriculture. As early as in 1862, the Department of Agriculture was set up as a part of the U.S. government. It promotes agricultural production through the collection and distribution of agricultural statistics and information, the introduction of new varieties of plants and animals, the development of better farm implements, the conduct of soil tests and improvements in vegetables and fruits.²⁸ In this century, particularly, the U.S. government has supported the prices of some agricultural products, enhanced credit for agriculture and supported the prices of several kinds of agricultural products. In addition, the government has endeavored to expand exports of agricultural products. These measures have played an important role in the development of U.S. agriculture. Second is education and science. In the year the USDA was founded, the Congress passed the famous Morrill Act that established a land-grant university (or college) in each state with responsibility for agricultural education and, later, scientific research and extension. In the 1850s, good results from several

agricultural technical schools and Michigan State College contributed to the passing of the Morrill Act. This public system of teaching, research and extension has played an important role in developing U.S. agriculture. Agricultural experiment stations were established in each state, and the federal-state governments strongly support them²⁹ (see Table 3). From 1915 to 1970, after discounting for inflation, the funds allocated to agricultural scientific research increased five times at least while agricultural output increased four-fold. With the popularization and improvement of education, the educational level of U.S. farmers was raised step by step. In 1970, U.S. farmers under 25 years of age who did not complete elementary school accounted for only 7.4 percent and decreased further to 6.1 percent in 1975.³⁰ These higher levels of education mean that scientific research achievements can be used faster and more effectively.

Table 4. U.S. Public Expenditures for Research and Extension in Agriculture, 1915-1970

Year	State Agricultural Experiment Stations	U.S. Department of Agriculture	Federal-State Extension
-----Million Dollars-----			
1915	4.6	6.0	3.5
1920	5.0	7.7	14.7
1925	7.3	9.3	19.3
1930	13.1	15.5	24.3
1935	11.1	11.4	20.4
1940	16.8	22.1	33.1
1945	19.8	22.9	38.2
1950	48.2	46.8	74.6
1955	73.8	53.4	100.7
1960	120.3	105.2	141.7
1965	181.8	192.5	188.9
1970	296.1	238.7	290.7

Source: Willard W. Cochrane, The Development of American Agriculture, p. 247.

2. There are important trends in dairy production. Most U.S. dairy cows are Holstein. In 1980, the average milk production per cow was 5,343 kg.³¹ Of the leading states in milk production per cow, California is first. Production per cow in that state almost doubled from 1950 to 1979 -- from 3,469.5 kg to 6,483.6 kg.³² It is possible to further increase yield per cow if breeding, feeds, and feeding, and management can be further improved. However, because the preference of U.S. people has changed, total milk consumption in the U.S. decreased 10 percent from 1966 to 1980, while average yield per cow went up and cow numbers went down. According to present living customs and consumption preferences of U.S. people, total milk consumption levels will further decrease unless (1) population grows faster than milk production (average yield per cow multiplied by number of cows) and (2) the rate of net foreign imports decreases. As the decrease in consumption has to influence production, it is possible for the rate of increase per year in U.S. milk production to be lower than in the past 15 years during the remainder of this century.

The dairy industry of China began in 1979. The main breed of Chinese cows at present is Holstein and variations thereof. Their average production per cow per year of 3,800 kg. is about equal to the U.S. level in 1966. According to the herd books in various places, there are from 50 to more than 100 cows producing at least 10,000 kg per year. The yield per cow per year on the Great Black River and Yellow River dairy farms in Inner Mongolia is 5 to 5.2 tons, close to the yield of the U.S. This was attained only after the responsibility system was implemented. It is possible to increase the yield further as the quality of feed and feeding management is improved. The

problem today is that the number of cows and the supply of high quality feed is small. There were only 0.8 million dairy cows in 1982. As the living standard of Chinese people is raised, milk consumption will increase and it is reasonable to expect an upward trend in milk production in China for a considerable period. In the U.S., milk production tends to exceed demand whereas in China supply lags far behind demand. This basic situation is likely to persist for the two countries.

3. Questions of hog breeds and breeding and feeding efficiency are important. From 1966 to 1980, hog production in the U.S. increased 22 percent.³³ The average yearly increase was 1.5 percent. Because of population increase, the annual per capita consumption per person increased only 0.8 percent. This is due in part to a shift in preferences. After World War II the meat preference of U.S. people tended to shift from pork to beef.

Most hogs produced in the U.S. are Bershires, Durocs, Chester Whites, Landrace large whites and Yorkshires. Their common characteristic is fast growth and high lean meat production rather than fat but the number of pigs per litter is low. It is reported that from 1960 to 1978, the average number of pigs per litter was 7.2.³⁴ As the number has not been increased for almost 20 years, the main problem in the U.S. is not feeding and management but breed and breeding.

Hogs in China differ from those in Europe and America in that they can be divided into local and improved breeds. They are South China breeds, Central China breeds and North China transition breeds. They are tolerant of roughage and moisture, are tame, and mature early

with the number of pigs per litter averaging around 12. The highest number per litter is by the Tai-Hu local breed with 24 to 30 small pigs as an average. It is reported in recent years that France has bought some of the Tai-Hu breed and crossed them with French breeds and gotten good results. The disadvantages are in their slow growth, low dressing percentage and, likely, lack of stamina when young.

Most of the improved breeds in China are the offspring of imported boars crossed with local breeds. They have high feed-to-meat conversion ratios, early maturity, a rather high percentage of leaner meat (about 48 percent) and tolerance for roughage in their diets. If one considers that hog feeds in the U.S. are almost entirely corn and soybean meal, and the nutrition values are much higher than that of wildgrass in China, it is not difficult to realize that capacity to utilize roughage is quite important for China. In addition, because of the policy change in 1979, hog production has become more specialized in China. Much of the labor force has shifted from crop farming to livestock operations. It is completely possible to develop hog production further if management and feed processing as well as the palatability and digestibility of feeds can be improved.

It should be noted that though there are advantages for Chinese hog breeds, pork production technology lags in China. This is shown by (1) the loss rate per litter of around 20 percent, which is comparatively high and reflects poor management as well, perhaps, as the smaller, weaker pigs of large litters, (2) the long growing period (around 210 to 240 days), (2) rations containing less concentrate and

more roughage, and (4) low meat production per head (about 60 kg. per hog).

In contrast, U.S. hog production is more advanced than in China in the following aspects -- the average loss rate in the U.S. is about 1.98 percent probably because of the larger stronger pigs of smaller litters and better sanitation,³⁵ labor is used very sparingly, concentrate feed are used effectively and disease control is good.

4. As to future production prospects, we know that the U.S. is an agriculturally advanced country and that China, generally speaking, is comparatively backward. From 1900 on, especially after the '30s, U.S. agriculture has made a lot of progress. In the 118 years since the Civil War in 1860, there has been several important factors keeping U.S. society stable, one of which was the development of agriculture because the basic problem of an adequate food supply for the people has been solved.

In the next 20 years, the development of dairy and hog production in the U.S. will depend, to a great extent, upon: (1) whether or not new technological breakthroughs are made in crop and livestock breeding (this will be difficult because it will require much capital and scientific skill), (2) the rate of population increase and (3) the preferences of consumers as they influence the demand for milk and pork. For the last ten years, the rate of population growth in the U.S. has been higher than that at present.

As to dairy and hog production in China, it will depend on: (1) the success of the responsibility system with family management as a key which has been implemented recently and hopefully will continue for a long period; (2) the perfecting and broadening of specialized

farm/household production, not only to encourage farmers to produce more per cow and per sow but also to produce better feeds to support the specialized livestock farm/households, (3) the strengthening of science and research work in livestock production, putting much emphasis on the development of new breeds and on improving feeding and management as it is impossible for China to feed animals with corn as in the U.S. which means China should develop new kinds of feeds and pay great attention to research on mixed feeds; (4) on the programs to popularize higher educational levels of farmers which will be the most important factor because without this, improved techniques are difficult to develop and apply in practice (Professor T. W. Schultz, Nobel prize winner, has emphasized the quality of laborers in his article, "Economics of Poor Countries"); and (5) the greater rationalization of the agricultural trading agencies of China.

Conclusions

Conclusions of the paper are as follows:

1. Dairy production in the U.S. is located mainly in the north-central states and the states of New York and California while hog production is largely in the Corn Belt, with both areas in close relation to their type of feed production. In addition, because the transportation industry is well developed, the specialization of production into zones or regions based on comparative advantage has developed. But in China, there is apparently little regional specialization in dairy and hog production except that dairy production is located in the suburbs of big cities. Hog production is rather evenly spread over the country. This is related to the preferences for pork by Chinese people, the adaptability of the small farm to one or two hogs,

limited transport facilities and the widespread distribution of the feeds (garbage, roughage and by-products) commonly fed to hogs. There is a solid base for hog production in China and the direction for development in the near future should be: (1) to develop new breeds. The new breeds should not only keep the advantages of present breeds, but should absorb the advantages of foreign breeds, (2) to keep the number at the present level, improve feeding management and shorten the growing cycle, and (3) further support the specialized hog production households and make them the major basis for developing Chinese hog production.

2. In nearly 20 years, the number of milk cows in the U.S. has decreased except in the past five years, but total milk production has continuously increased as the result of growing production per cow, with some shift of consumer preferences away from milk and the development of substitutes for dairy products. These trends will continue for a period of time, but the speed of change will be slower, unless much higher producing cows can be developed and the feed-milk ratio can be improved. U.S. hog production slowly increased during the past 20 years, but the proportion of pork in total meat consumption decreased because poultry production had almost caught up to hog production by 1982³⁶ while beef production had increased somewhat.

The number of milk cows in China today is much less than in the U.S. but the increase since 1979 has been rapid. The number in 1982 was 12.7 percent above that of 1980. So, we can be certain that the Chinese dairy industry will develop considerably in the next ten years unless the policy that has encouraged the present increases is changed.

3. The amount of capital used by U.S. dairy and hog farms is much greater than in China. This is the result of competition on the one hand and the high value of labor on the other. In present China, however, it is not necessary to emphasize mechanization but how to use fully the abundant labor force. In short, it is necessary to consider the employment of the rural population which accounts for 81 percent of total population in China, and to analyze the concrete situation of China herself in developing dairy and hog production.
4. The techniques of dairy and hog production in the U.S. are advanced. Whether they will be further developed will mainly depend on society's demand for dairy and hog products. Society's demand is one of the forces which is independent of producers and is not influenced much by them. Producers should strive for improved production techniques and lower costs of production to get more profit within the limits of demand.
5. The situation in China is quite different. In China, there is a great potential to develop improved production techniques and there is an unmet need for dairy and pork products which will be translated into demand as the incomes of the Chinese people improve and population increases. These demands will act as a strong propelling force to push the development of both dairy and hog production for a considerable period of time.
6. Despite the differences in the social systems between these two countries, several measures used in the U.S. can contribute to some extent to Chinese agricultural trading. At present, China sorely needs a better transport system and also needs to improve her trading

institutions. Both state-run commercial and cooperative trading institutions should exist side by side and be encouraged to compete with each other to promote marketing and trading.

7. Prices are one of the most important catalysts for production. They act as regulators of U.S. agricultural production. Like other commodity producers, dairy and hog producers have to pay careful attention to the market prices and their movement so as to adjust their production to the demands of U.S. society. In China, price is an important economic lever used by the government to regulate production. But it should be based on considerable investigation and the mastering of the necessary data before establishing the price. Otherwise, it may discourage or over encourage production rather than promote production of the correct amounts of pork and milk. The experiences of the past 30 years in China contain lessons to be remembered and used.

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