

Perspectives and Strategies for the Asian Livestock Sector
in the next three decades:
Sub-regional Report, China

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1. Introduction

1.1 *Background*

This study is prepared for the Food and Agriculture Organization as a sub-regional report of the project “Perspectives and strategies for the Asian livestock sector in the next three decades” in early 2001. The purpose of the study is to equip decision-makers at the national and international level with baseline information and strategic assessment on the Asian livestock sector. The livestock sector encompasses livestock production, processing and distribution. It includes production on the traditional farms as well as production in industrial livestock facilities that are characterized by high capital labor ratios. The time frame of the study is to 2030. Hence, the discussion and material presented should be presented in terms of short to medium term developments (five to ten years) and the long term (up to 30 years).

As the largest livestock products producer and consumer, the situation of the sector in China has great significance on the world livestock sector at large, and on Asian market in particular. Much of the information contained in this study has been collected through field visits to farms, officials from ministries, especially the Ministry of Agriculture, and from the State Statistic Bureau, the government body officially responsible for statistics in China. A large volume of internal reports and documents of various governmental agencies are used, which are not listed in the references.

1.2 *Significance of Livestock Sector in China.*

Livestock plays a very important role in China due to its multi-functions. For many part of China (other than the pastoral regions and suburbs of big cities), large animals are important primarily not for their meat and milk products, but for the draught force they provide for crop production and local transportation.

Swine raising has been highly valued, especially in the 1960s and 1970s as a major source of fertilizer. In the period of grain surplus such as in mid-1980s, early and late 1990s, pig and poultry raising was encouraged and regarded as a mean to solve the grain surplus problems. However, the livestock sector as a major source for food has never been attached the same importance as the crop sector. The share of animal production value in the overall agriculture has increased over the past two decades, from 15% in 1978 up to nearly 29% in 1999(MoA, 2000).

Livestock production in China has been characterized by its small-scaled structure. China has not only the largest swine inventory and pork production, but also by far the largest number of swine holders in the world. According to the results of the first national agricultural census, 70% of the rural households, or 135 million farmers, have swine inventory. Pig

inventory averages only 2-3 heads per household (SSB, 1998). Changes have taken place in the past decade, but not very significantly.

The small-scaled production system is cost-efficient. A considerable part of nutrients need for the livestock of the small farmers are provided by residues and byproducts of crop production, which are otherwise of no value. For example, pig raising in the South is heavily dependent on green feeder and roughage including leaves and vines of sweet potato and rice bran (Xu et al, 1994). This has not lowered the production cost, but also significantly reduced the feed grain/meat ratio, or the amount of feed grain for each kg of meat gain, to a level much lower compared with the industrialized production system. According to a survey on 6000 pig farms, the average feed grain/meat ratio is estimated at 1.8: 1 for pork in Sichuan province, the most important pig producer in China (Lu, 1997).

For many small farmers, livestock raising is an important source for cash income. Surveys organized by the Ministry of Agriculture indicated that, on the average of all kinds of farmers, pig's sales alone accounted 6-12% of farmers' cash income (MoA, 1992). The central part of the country and the group with medium-level income has the highest shares. The pig's share in cash income for almost all groups has risen by 1-2 % over the observed period of 1986-1990. In the major producing areas of pigs such as in Sichuan Province, pig sales consist up to 20% of farmers cash income, as estimated by local agricultural administrators and farmers interviewed by the author and CAU students.

For the major pig producing regions, often the poor and less developed inland areas, tax from pig marketing and slaughtering accounts for the major share of the township or even the county revenues.

In the process of transformation, the co-existence of traditional and modern production system is a new feature. In contrast to the vastly scattered traditional small holders, there is a growing number of large scale pig and milk farms in the suburbs of large cities, mostly state farms in the past, but also increasingly by individual farmers or private investors. The production method and productivity of these large operations are comparable with that in the developed countries. The large-scale pig and milk farms in the proximity of large cities are assumed an important role to secure the provision of livestock products to the urban population and hence the social stability.

1.3 Discussion Over Production and Consumption Statistics

In most developed countries, livestock statistics are based on the veterinary quarantine before slaughtering and are very reliable. In China, the veterinary quarantine control system is rather weak. Over 80% of the pigs in China are slaughtered and marketed by a great number of small traders, usually villagers. There are hardly any communal slaughtering facilities available and these small traders slaughter one or two pigs in their backyard each time (usually each day). They do not have much incentive to go through the quarantine process, which involves fees and transportation costs. In almost every province, pig slaughtering is subject to a slaughtering tax and various fees, which often accounts for up to 5% of the pig value. As a result, a large portion of the slaughtering evades the quarantine process and thus makes the quarantine statistics incomplete.

As an alternative, China has long adopted a reporting-based system to get livestock production statistics. It is a pyramid reporting system: village leaders make an accounting of livestock numbers and production in the village and report them to the township administration. Township administrators in turn compile the data from the villages and report them to the county authority. The county heads compile the data from the townships and

report them to the province government. During the collective time before 1980s, this system was technically rather reliable, for the collectives had booking records. However, with the dismantling of collectives and the introduction of individual household-based production system, the reporting system lost its basic ground. Although village leaders still make reports, these reports do not result from book keeping records or surveys, and are rather estimated. In addition, there is a tendency to exaggerate the production figures for officers at various levels as production growth is often regarded as an important indicator for the performance of local government officers. In recognition of this bias, the central government and sometimes also provincial governments make downward adjustments to the compiled reporting-based figures according to experts' views, market balance (price change) situation, etc.

It is generally assumed that the real situation falls somewhere between the above-mentioned reporting-based statistical data and the figures derived from slaughter tax, with the former as the upper limit and the latter as the lower limit. Example figures from survey by CAU students in a county in Guizhou province indicated that taxed slaughtered hogs was only 35-40% of that of official statistics for the recent years. The gap can not be completely attributed to tax evasion. At least part of the disparity is due to over-reporting. The problem of the over-report of meat production becomes more serious in the 1990s.

This over-reporting was confirmed by the results of the National Agricultural Census in January 1997. The census results are more than 20% lower than the previously reported figures (more details in the following sections). Downward adjustments have been made for the years since then.

As for consumption, the State Statistical Bureau implements annual sample rural and urban household surveys on income, expenditure and consumption. These surveys cover about 35 000 urban households and 67 000 rural households. Survey data are aggregated by these two consumer groups, for there are substantial differences in income and consumption patterns between the urban households and rural ones.

Officials from SSB believe with high confidence that the results of the surveys, both for the rural and urban households, are reliable, for the surveys have conducted through a very representative sampling and in a consistent way.

Based on the per capita consumption data from the household surveys and population statistics, total meat consumption for the whole country can be derived. Two approaches can be used to get the total consumption data: One based on the survey and the other one by the balance sheet, which is highly determined by production data.

A striking divergence exists between the figures from those two approaches, as show bellow in the table.

Table 1-1 Divergence in Livestock Consumption Data, in million tons

	1980	1985	1990	1995	1999
	Meat Total				
Data from Balance Sheet	12.58	18.75	27.95	51.87	58.90
Data from Household Surveys	10.53	15.35	18.20	19.59	23.95
Difference	2.05	3.40	9.75	32.28	34.95
in % of survey data	19	22	54	165	146
	Eggs				
Data from Balance Sheet	2.51	5.28	7.91	16.75	21.32
Data from Household Surveys	1.93	3.37	4.22	6.19	7.98
Difference	0.58	1.91	3.69	10.56	13.34
in % of survey data	30	57	94	171	167

Sources: SYC, and Custom Statistics of China.

There are several explaining reasons for the divergence. First, eating-out is an important factor. Eating-out for urban residents is about one third of meat consumption in term of expenditure in the 1995 surveys. Take the national as a whole, the meat consumption in restaurants and canteens should not exceed 10% of the total meat consumption in quantitative term.

Secondly, the actual urban share of the population should be larger than the statistical figures. The so-called “floating population”, rural migrants working in the cities and town, is estimated as over 90 million in 1999. Their meat consumption level should be somehow close to that of representative urban households.

Thirdly, the difference in meat weight definition may be an important source for the imbalance. Meat production is in principle measured by carcass weight, while the consumption figures are the actually purchased weight, mostly without bones.

Fourthly, consumed by foreign tourists. Consumption of foreign visitors registered at 40-50 million a year, or less than 4% of the domestic population, should not be significant. Given an average stay period of four weeks a visit and a doubled daily meat consumption level compared with ordinary Chinese, the total meat consumption by foreigners is less than 1% of the total meat consumption in the country.

Finally, there might be bias in the sampling of the households. The sampled households may have a lower meat consumption level than the actual national average, if assumed that the numbers of households with high meat consumption levels have not been adequately included in the surveys. Such households include herdsman population, urban and rural consumers in less-fish consuming regions, and in the major meat production areas.

Put all the above-mentioned factors together, it can be estimated that the actual meat consumption may be 40-50% higher than that derived from the household surveys. This estimation is largely consistent with the estimation made by SSB officials, in that they indicated that the actual consumption in 1995 was about 30 million tons.

This is also agreeable with the general opinion that until the second half of 1980s, the over-reporting of livestock production was not very significant. Since late 1980s, especially since the early 1990s, the over-reporting has become increasingly serious.

In the official statistics, the production data since 1996/1997 have been adjusted. However, the figures for the years prior to 1996 remained unchanged. The author of this report is not in

the position to make adjustments. Therefore, the attention should be given to this fact that the time series figures in this report is not completely comparable across years.

2. Production Systems

2.1 Meat, Milk and Eggs Production Development

Table 2-1 Livestock Production development in China, in million tons

Year	Meat Total	Pork	Beef	Mutton	Poultry	Other meat	Eggs	Milk
1980	13.08	11.34	0.27	0.44	1.0	0.03	2.57	1.37
1985	19.27	16.55	0.47	0.59	1.6	0.06	5.35	2.89
1990	28.57	22.81	1.26	1.07	3.23	0.10	7.95	4.75
1995	52.60	36.48	4.15	2.02	9.35	0.27	16.77	6.73
1999	59.49	40.06	5.05	2.51	11.15	0.72	21.34	7.18
1990/80	2.18	2.01	4.68	2.41	3.23	3.33	3.09	3.47
1999/90	2.08	1.76	4.01	2.35	3.45	7.20	2.68	1.51

Sources: MoA

As indicated in Table 2-1, livestock production in China has developed very rapidly in the last two decades. Though the exact figures might be to some extent over-reported, it is beyond any doubt on the strong growth trend.

There are a number of reasons for this rapid growth in livestock production, including institutional renovation, introduction and development of feed industry, technical progress in animal breeding, nutrition, disease control. The institutional renovations changed the collective operations into private operations and such improved greatly the incentives of individual farmers to produce more and in a more efficient way. The technical progress in breeding, nutrition and feed industry have not only enabled the establishments of large scale intensive livestock farms, increased their technical and economical efficiency, but also changed the feeding structure and raising methods in the small traditional farms. The improvements in parameters of technical efficiency will be discussed in further details in the following sections.

Due to the uneven development paces among meat categories, the composition of meat production has changed. Share of pork continuously fell, from 87% in 1980 to 67% in 1999, while that of all other meat categories has risen. Poultry's share registered the largest increase from 8% to 19%, followed by beef from 2% to 8%, and mutton from 3% to 4%.

The changes in the meat production structure reflect changes on the technical side and on the economic environment. Given its efficient feed-meat conversion ratio, commercialized chicken industry has developed fastest. Cattle raising, under the prevailing raising systems in China, needs less grain than pigs. Furthermore, mechanization process in crop production has reduced the number of draught animals and increased beef and milk cattle. Sheep and goat meat production has increased, but due to the constraint in grazing areas, the growth rate is slower than that of cattle.

Development and changes in product prices, feed prices, feed industry, technical innovation and extension, as well as policy reforms, have all contributed to the development features of the livestock sector in China. Those factors are discussed in more details in the following.

2.2 Size Structure (by Species)

Livestock sector in China has been dominated by the traditional system. In fact, until very recently, the livestock sector in China remained as a sideline farm activity for long. The industrialized intensive operations occurred only about fifteen years ago in China. Though the intensive system has developed rather rapidly, especially in economically more developed regions, but its share in the overall production is still low. The development has also rather uneven among different livestock species, with poultry the fastest and dairy sector the slowest.

Pig Sector

According to 1997 Agricultural Census, there are 135 million pig holders in China, over 92% of which are of very small operations, with an annual production of only 1-5 heads. They account nearly 60% of the total production. Large operations with an annual production volume of 200 heads or more contribute only about 10% to the total pig production, as indicated in Table 2-2. Most of those relatively large operations are located in suburbs of big cities and the coast provinces, i.e. close to the consumer centers.

Table 2-2 Pig raising structure in China, year-end of 1996

	Million		in %	
	Holders	Slaughtering	Holders	Slaughtering
1-5 heads	110.127	205.195	92.61	59.41
6-10 heads	5.509	40.659	4.63	11.77
11-30 heads	2.932	44.8	2.47	12.97
31-50 heads	0.177	7.016	0.15	2.03
51-200 heads	0.143	13.091	0.12	3.79
201-1000 heads	0.024	9.406	0.02	2.72
Above 1000 heads	0.006	25.247	0.01	7.31
Total	118.918	345.414	100.0	100.0
Sows	18.269	21.665*		

* Inventory

Source: 1997 Agricultural Census in China.

Poultry Sector

Poultry sector is much more concentrated compared with other sectors. Over 56% of the poultry production are from farms with an annual output of over 1000 birds. The high feed and economic efficiency, high consumer preference and high price are among the major factors leading to the rapid intensification process of poultry production in China in the past decade.

Table 2-3 Poultry raising structure in China, 1996

	million		In %	
	Holders	Slaughtering	Holders	Slaughtering
1-50 birds	101	835	96.82	26.98
51-200 birds	2.399	220	2.30	7.11
201-1000 birds	0.59	283	0.57	9.14
1001-10000 birds	0.291	968	0.28	31.28
above 10000 birds	0.032	789	0.03	25.49
Total	104.312	3095	100.00	100.00

Source: 1997 Agricultural Census in China.

Cattle Sector

The cattle sector is the fastest growing livestock sector in China, though there seems to have some over-reporting problems with the official statistics as mentioned earlier. Several factors explain the reasons for this fast growing pace in beef production. First, the reform policy has greatly increased the incentives of farmers to expand livestock production, as mentioned earlier. Second, the production level at the beginning of the observation period, i.e. at the beginning of the 1980s, was very low. The Chinese beef production in 1980 was only slightly over a quarter of a million tons, or a quarter of one kilogram per capita. The inventory was large, at over 70 million heads in the early 1980s. However, the off-take rate was very low, only 4-5%. The most important reason for that was that the draught cattle had a large share in the total cattle inventory. Beef from extensive pastoral system, mostly located in Tibet, Inner Mongolia, Qinghai, Sichuan and Xinjiang, accounted the dominant part of the total beef production. In the eastern farming provinces, beef production was only a by-product from the fallen and eliminated draught animals. Third, considerable technical progress has been made. New breeds and artificial insemination, new production methods, especially the progress in exploring new feed resources such as ammoniation of crop straws, have significantly expand the scope of the efficiency of the production. The mechanization might also have played some role, in replacing the draught animals.

Small holders still play the prevailing role in beef cattle sector, as indicated in Table 2-4. Farms with 100 heads or more cattle account for less 10% of the total production currently, in spite of its rapid development in the recent years.

Table 2-4 Beef cattle raising structure in China, 1996

	Million		in %	
	Holders	Slaughtering	Holders	Slaughtering
1-5 heads	10.434	14.043	96.86	72.20
6-10 heads	0.195	1.493	1.81	7.68
11-100 heads	0.113	2.314	1.05	11.90
101-1000 heads	0.03	0.964	0.28	4.96
above 1000 heads	0.00025	0.636	0.002	3.27
Total	10.77	19.45	100.00	100.00

Source: 1997 Agricultural Census in China.

Dairy Cattle

Dairy cattle sector has a relative large scale in structure. Holders with 100 or more cows account for 20% of the total cow inventory. There were very few dairy cattle in China prior to the 1980s. In Chinese statistics, dairy cattle implies improved milk cow. As of 1980, there were just 641 thousand heads such cow, an inventory that included crosses with beef type as well as purebreds or high-grade animals. However, it has since grown very fast.

Table 2-5 Dairy cattle raising in China, 1996

	number		in %	
	Holders	Inventory	Holders	Inventory
1-5 heads	714553	1409356	86.66	41.63
6-10 heads	70057	525460	8.50	15.52
11-100 heads	38358	776803	4.65	22.95
Above 100 heads	1623	673478	0.20	19.90
Total	824591	3385097	100.00	100.00

Source: 1997 Agricultural Census in China.

There is no data on the relative shares of different systems. It lacks a clear definition and distinction between intensive and extensive raising systems applicable for China's situation. The intensive dairy cattle system as understood in developed countries are almost only found in state farms, mostly located in the suburbs of large cities and in the northeast province of Heilongjiang, according interviews with officials from MoA.

Geographically, milk production is concentrated in the North. With a share of nearly 30% in the national total, the Heilongjiang Province is by far the largest milk producer in China, followed by Inner Mongolia and Xinjiang, each with around 8%. The three municipalities, Beijing, Shanghai and Tianjin, are also important in milk production, taking account that they are very small in areas. The milk production system in the suburbs of those three large cities is highly intensive and productive.

Similar to that of beef cattle, the rapid growth in milk production has been a result of technical progress and, especially, the fast growing demand. The development of milk processing industry has provided more and diversified milk products and greatly stimulated milk demand. Prior to the reform in the late 1970s, there were hardly any other milk products except milk powder. The development of milk processing industry and related food industry, including ice cream, yogurt, butter, cheese, cakes and so on, have pose great demand for milk. On the other hand, market development, especially the expansion of retailer shops with refrigerator facilities, have significantly extended the market reach of milk products. Food shops with refrigerators now can be found everywhere in the cities and towns. Fifteen years ago, there were hardly any such shops, even in large city like Beijing.

2.3 Technical Parameters (by Species and Systems)

Pig Sector

Pig inventory remained somehow constant in the first half of the 1980s at around 300 million heads, and then increased steadily to over 400 million heads in the 1990s, as shown in Table 2-6. The slaughtered number showed the same trend, but at a larger pace. During the last two decade, the slaughtered number has more than doubled, from around 200 million heads in 1980 to close to 520 million heads in 1999.

The changes in technical variables and other factors effecting efficiencies find expression in changes of a number of production parameters. The off-take rate (annual slaughtered animal as a percentage of inventory at the year-beginning) has increased steadily and considerably, from 62% in 1980 to 123% in 1999. At the same time, slaughtered animals have become heavier. Slaughtering weight of hogs on the average has increased from 57 kg to 77 kg. The productivity measured with meat production per head of inventory, the combined result of off-take rate and slaughtering rate, has increased by almost twice in the past two decades.

Table 2-6 Pig and Pork Production in China

Year	Inventory at year- beginning million heads 1 年初存栏	Slaughtered Million heads 2 全年出栏	Meat Output million t. 3 产量	Offtake Rate □ 4=2/1 出栏率	Carcass Weight kg/head 5=3/2 平均出肉量	Productivity per year kg/head 6=3/1=4*5
1980	319.7	198.6	11.34	62	57	35.5
1985	306.8	238.8	16.55	78	69	53.9
1990	352.8	309.9	22.81	88	74	64.7
1995	414.6	480.5	36.48	116	76	88.0
1999	422.56	519.77	40.06	123	77	94.7

Source: SSB; SYC; SYA

The introduction of private incentives and market mechanism has triggered changes in producers' traditional production attitude, objectives or utilities. Many producers now pay high attention and place high priority on the economic returns. Now it is the amount of the income, not the size of the herd, that earns respect to a producer from his or her fellow society. In addition, the technical progress in the field of feed and improvement in other areas, including in breeding, feeding method and disease control have greatly contributed to the expansion of the livestock production.

The Research Center for Rural Economy (RCRE) of Chinese Ministry of Agriculture organized a survey on livestock performance in China in 1996 and in 1999 respectively. The RCRE 1996 survey on pig sector was conducted in seven provinces, covering 2453 farmers' households with pig production. The surveyed livestock farms were divided into traditional farms and specialized farms.

Several observations can be derived from Table 2-7. Generally, there are variations among provinces and between operation types. Particular features can be summarized as following: First, traditional farms show a wider variation in slaughtering weight, from about 90 kg in the two provinces in Yangtze river reach to almost 140 kg in the north province of Jilin. The

specialized sector shows a relative small weight span among regions. Secondly, there is a similar variation pattern in fattening period, with a range from 170 days to over 300 days by traditional farms, and 130 – 190 days for specialized farms. Third, in feed structure, specialized farms depend completely on purchased feed, while traditional farms, in particular in the three northern provinces, mainly use grain produced by themselves. Fourth, both types of farm purchase processed feed, with specialized farms having a much high percentage. Further, there is also regional difference, indicating the uneven development in different regions. Fifth, the feeding efficiency varies significantly, both between types and across the provinces, showing a wide range of feed-meat conversion ratio from under 3 to over 4.5. The cold weather in the northern province such Jilin and warm and favorable climate in the southern provinces such as Sichuan, Guangdong and Hunan, may somehow explain the differences. In the warm regions, the non-grain feed usage should also high, given the abundant supply of green feed. Finally, there is an explicit gap in daily gains between the traditional farms and specialized farms, with the latter showing a significant higher value for all provinces. This is in nature a difference between the traditional system and the intensive system.

Table 2-7 Technical indicators for pig sector by type and province, 1996

	Type	Jilin	Shaanxi	Shandong	Jiangsu	Hunan	Sichuan	Guangdong
Number of surveyed farms	Traditional	376	219	191	437	419	447	244
	Specialized	14	18	18	12	19	20	19
Inventory Heads/farm	Traditional	1.7	1.5	1.1	1.7	3.0	2.6	1.4
	Specialized	262.3	87.3	304	211	44.7	48.3	476.3
Slaughtering weight, Live weight in kg	Traditional	138	109	103	103	88	90	105
	Specialized	117	109	97	93	91	104	104
Fattening days* Days	Traditional	313	295	207	171	188	229	193
	Specialized	165	191	130	145	130	191	132
Purchased feed %	Traditional	15	14	11	45	50	39	41
	Specialized	100	100	100	100	100	100	100
Purchased processed feed %	Traditional	3.4	5.3	2.1	12.3	15.9	9.1	36.8
	Specialized	20.6	56.2	3.9	17.3	34.1	31.5	87.4
Feed ratio	Traditional	4.35	3.66	4.17	4.6	3.77	3.05	2.9
	Specialized	4.57	4.04	3.38	2.87	3.51	2.74	3.1
Daily gains kg	Traditional	0.4	0.33	0.54	0.46	0.39	0.31	0.41
	Specialized	0.58	0.51	0.63	0.5	0.58	0.44	0.5

* Days from abolactation to slaughtering.

Source: RCRE 1996 survey.

As indicated very clearly in the following table, the value of major technical indicators varies progressively as farm size changes. There exists a close co-relationship between the values of slaughtering weight, fattening days and feed sources.

Table 2-7b Technical indicators for pig sector by size, 1996

		1-5 heads	6-15 heads	16-30 heads	31-50 heads	over 50 heads
Slaughtering weight	kg	109	86	89	86	84
Fattening days	days	234	158	132	130	122
Share of purchased feed	%	17	39	60	73	92

Source: RCRE 1996 survey.

Poultry Sector

It should point out that apart from broilers and layers, a relatively significant part of poultry in China is duck, especially in South China. However, a detailed breakdown of data for the various poultry species is not available.

Poultry meat production has seen the fastest growth in the past 20 years among all meat categories, from 1 million tons in 1980 to 11.15 million tons in 1999, as indicated in Table 2-8. Egg production has shown almost the same growth rate, from 2.57 million tons to 19.65 million tons in 1999.

Table 2-8 Poultry-meat and Egg Production in China

Year	Poultry meat	Eggs	Slaughter million bird
	Million t	Million t	
1980	1.00	2.57	
1985	1.60	5.35	
1990	3.23	7.95	
1995	9.35	16.77	6302
1999	11.15	19.65	7461

Source: China Agricultural Statistics.

Though it is nearly impossible to have a precise measurement of the technical efficiency in the traditional sector, it is commonly perceived and believed that the feed conversion ratio should be rather low in the backyard-form of poultry raising.

RCRE 1996 survey covers only the specialized sector. Main results are included in Table 2-9.

Table 2-9 Technical indicators for poultry production, 1996

	Jilin	Shaanxi	Shandong	Jiangsu	Hunan	Sichuan	Guangdong
Number of surveyed farms	10	10	12	9	6	10	13
Inventory, heads/farm	9288	1843	1737	2886	1900	1982	5345
Slaughtering weight	2.82	1.92	2.57	2.15	2.17	2.01	2.22
Feeding days	55	62	55	68	52	88	76
Feed ratio	1.94	2.96	2.30	2.49	3.25	3.20	2.89

Source: RCRE 1996 survey.

Table 2-9a Feed Conversion Ratio for Chicken and Duck in China, by farm size

	Average	≤ 100	101~500	501~1000	1001~5000	≥ 5000
Chicken	2.25	2.76	2.51	2.40	1.77	2.76
Duck	3.27	2.07	2.70	3.13	6.49	2.44

Source: RCRE sample survey 1999.

Table 2-9b Technical indicators for egg production, 1996

	Jilin	Shaanxi	Shandong	Jiangsu	Hunan	Sichuan	Guangdong
Number of surveyed farms	12	16	19	8	6	10	12
Layer inventory, birds/farm	6467	1826	4458	2476	530	891	2065
Slaughtered birds	4415	934	2590	1986	382	295	1466
Eggs, kg/layer/year	12.5	12.2	18.0	15.9	15.3	20.6	15.8
Feed-egg ratio	3.92	2.85	2.65	2.22	2.74	1.72	1.76

Source: RCRE 1996 survey.

Beef Cattle

Beef production has increased very rapidly during the past two decades, from merely a quarter of a million tons in 1980 to over 5 million tons in 1999. Several factors explain the reasons for this fast growing pace in beef production. First, the reform policy has greatly increased the incentives of farmers to expand livestock production, as mentioned earlier. Second, the production level at the beginning of the observation period, i.e. at the beginning of the 1980s, was very low. The Chinese beef production in 1980 was only slightly over a quarter of a million tons, or a quarter of one kilogram per capita. The inventory was large, at over 70 million heads in the early 1980s. However, the off-take rate was very low, only 4-5%, as indicated in Table 2-10. The most important reason for that was that the draught cattle had a large share in the total cattle inventory. Beef from extensive pastoral system, mostly located in Tibet, Inner Mongolia, Qinghai, Sichuan and Xinjiang, accounted the dominant part of the total beef production. In the eastern farming provinces, beef production was only a by-product from the fallen and eliminated draught animals. Third, considerable technical progress has been made. New breeds and artificial insemination, new production methods, especially the progress in exploring new feed resources such as ammoniation of crop straws, have significantly expand the scope of the efficiency of the production. The off-take rate has risen markedly and the slaughtered cattle have become much heavier. Beef cattle raising has gained special promotion since mid-1990s, especially in some eastern provinces such as Shandong, Henna and Anhui. Massive efforts have been made in those provinces to provide feed grain, silage feed and straw feed treated with ammonia.

Table 2-10 Beef Production in China

Year	Inventory at year-beginning million heads	Slaughtered Million heads	Meat Output million t.	Off-take Rate %	Carcass Weight kg/head	Productivity Per year Kg/head
	1	2	3	4=2/1	5=3/2	6=4*5
1980	71.35	3.32	0.269	4.7	81	3.8
1985	82.13	4.57	0.467	5.6	102	5.7
1990	100.75	10.88	1.256	10.8	115	12.5
1995	123.32	30.50	4.150	24.7	136	33.7
1999	126.98	37.66	5.054	29.7	134	39.9

Sources: SSB; SYC; SYA

As a result of the unbalanced development, the regional patterns of the beef production have changed remarkably. The five pastoral provinces mentioned above have lost its share in beef production considerably from 55% in 1980 to only 15% in 1999. The major beef providers are no longer the pastoral provinces in the West, but the farming regions in the central and eastern part of the country. Five major cropping provinces, Shandong, Henan, Hebei, Liaoning and Anhui, have become the most important beef producers in China, with its combined share rising from 10% in 1980 to 52% in 1999.

This shift in regional patterns of beef production reflects a structural change process, which has been both resource-driven and demand-driven. Cattle inventory in the western pastoral regions, such as Tibet, Xinjiang, Qinghai and Sichuan (the west half) have shown only slight growth in cattle numbers. The widely recognized problem of over-grazing and desertification in those areas indicates the feed resource constraint. The extensive nomadic production system has also been weak in adopting new technology. The remote distance and transportation bottleneck has posed further constraint to the market access. In contrast, the farming areas have been favored with close access to fast growing demand market, much better natural, technical and economical conditions for development of intensive producing system. Intensive beef cattle raising in farming areas has been encouraged by the government. According to the Ministry of Agriculture, 122 counties have been selected as "beef production bases" by 1996. Special support in loan and technical assistance has been provided through a support program.

Dairy Cattle

There were very few dairy cattle in China prior to the 1980s. In Chinese statistics, dairy cattle imply improved milk cow. As of 1980, there were just 641 thousand heads such cow, an inventory that included crosses with beef type as well as purebreds or high-grade animals. However, it has since grown very fast, and just 15 years later there were six time as many and, by 1995, 4.17 million heads. The dramatic rise in dairy cattle numbers has been mainly via dual-purpose animals (Simpson, et al, 1992). As a result, the milk yields on the average have not increased in the past 15 years. There might be other reasons for the calculated declining yields. The over-report of inventory numbers as discussed earlier should also have contributed to this.

There is no data on the relative shares of different systems. It lacks a clear definition and distinction between intensive and extensive raising systems applicable for China's situation. The intensive dairy cattle system as understood in developed countries are almost only found in state farms, mostly located in the suburbs of large cities and in the northeast province of Heilongjiang, according interviews with officials from MoA.

Geographically, milk production is concentrated in the North. With a share of nearly 30% in the national total, the Heilongjiang Province is by far the largest milk producer in China, followed by Inner Mongolia and Xinjiang, each with around 8%. The three municipalities, Beijing, Shanghai and Tianjin, are also important in milk production, taking account that they are very small in areas. The milk production system in the suburbs of those three large cities is highly intensive and productive. The milk yields there are over 3500 kg, more than doubled that of the national average. The pastoral areas in Xinjiang, Gansu, Tibet and Inner Mongolia, in contrast, have much lower yields, just 500-800 kg.

Similar to that of beef cattle, the rapid growth in milk production has been a result of technical progress and, especially, the fast growing demand. The development of milk processing industry has provided more and diversified milk products and greatly stimulated milk demand. Prior to the reform in the late 1970s, there were hardly any other milk products except milk powder. The development of milk processing industry and related food industry, including ice cream, yogurt, butter, cheese, cakes and so on, have pose great demand for milk. On the other hand, market development, especially the expansion of retailer shops with refrigerator facilities, have significantly extended the market reach of milk products. Food shops with refrigerators now can be found everywhere in the cities and towns. Fifteen years ago, there were hardly any such shops, even in large city like Beijing.

2.4 Production Economics (by Species and Systems)

Pig Sector

The following table shows some economic indicators of pig production in China. The data are derived from the RCRE 1999 survey. The traditional backyard farms obtained a higher sale value, to be attributed to the heavier animal produced in backyard system. The lower cost for piglet purchase in the specialized sector mainly reflects on the large volume of purchase and relatively smaller piglets they bought compared with the traditional farms. The specialized sectors bear costs for land and hired labor which the small traditional farms do not need to budget. Tax for traditional farms is

significant higher, most possibly due to the fact that local fees and levies were imposed to the farm, which is not necessarily in proportion with the number of animals. The net earning from pig raising ranged from 150 to 200 Yuan/head in different locations. This is significant, taking into account that the national average income of farm population was 1926 Yuan in 1996. If considering the cash income, the importance of pig raising is still striking.

Table 2-12 Production Economics of Pig Production in China, by Type

		Yuan/head		In %	
		Specialized	Traditional	Specialized	Traditional
Sales		829.33	850.9		
Cost	Total	643.42	682.5	100	100
	Piglet	109.91	130.1	17.1	19.1
	Feed	430.61	438.00	66.9	64.2
	Land	4.52	0	0.7	0.0
	Hired labor	12.11	0	1.9	0.0
	Animal health	10.82	12.42	1.7	1.8
	Tax	3.84	10.44	0.6	1.5
	Depreciation	13.76	8.7	2.1	1.3
	Others	57.85	82.84	9.0	12.1
Profit		185.91	168.4	28.9	24.7

Source: RCRE 1999 survey

Poultry Sector

In poultry sector, several features have been observed. First, poultry waste as manure for horticultural crops and as feed for fish production generates a good portion in returns. The manure value in percentage of total return is not very high, just 1-3%. However, if measured in term of the net profit, its significance then become much more obvious, in some cases even decisive. Second, cost for chicks and feed combined accounts over 90% of the total production cost in all provinces. Third, the net benefit varies greatly across the provinces.

Table 2-13 Production Economics of Poultry Production in China, by Province

		Jilin	Shaanxi	Shandong	Jiangsu	Hunan	Sichuan	Guangdong
Total Return	Yuan/kg	7.62	8.58	7.28	7.58	9.19	8.93	9.27
Sales of bird	Yuan/kg	7.54	8.50	7.23	7.55	9.17	8.75	8.94
Manure value	Yuan/kg	0.08	0.08	0.05	0.03	0.02	0.18	0.33
Total Cost	Yuan/kg	5.79	8.57	6.26	7.53	6.64	7.57	8.60
Chicks	%	22.3	15.8	17.9	17.7	22.8	19.0	23.2
Feed	%	65.9	76.5	72.3	76.9	69.2	62.0	61.6
Disease control	%	4.0	1.7	4.2	2.0	5.8	2.7	3.5
Land rent	%	0.2	0.4	0.2	0.2	0.0	2.5	3.1
Depreciation	%	0.2	2.7	2.3	1.0	1.0	6.4	3.3
hired labor	%	1.3	0.4	0.7	1.6	0.0	4.9	2.4
other costs	%	6.0	2.4	2.5	0.6	1.2	2.4	2.8
Net Profit	Yuan/kg	1.82	0.01	1.01	0.06	2.55	1.35	0.67

Source: RCRE 1999 survey

2.5 Feed Industry and Feed Issues

Feed Processing Industry

With its virtual inception in late 1970s, feed industry has developed from the very ground during the past 20 years. Industrial feed production soared from merely 2 million t in 1980 to over 67 million t in 1995, including complete feed, concentrated and premixed feed (Table 2-14). In its development process, the quality and the credit of the industrial feed has also been improved gradually. Many livestock producers, including in the traditional sector, have changed their reticence toward using industrial feed and have become accustomed to it. The robust development of the industrial feed sector has been the decisive factor for the rising share of the intensive livestock systems, especially for poultry and pig sectors.

Table 2-14 Industrial Feed Production in China, million tons

	Complete	Concentrate	Premix	Capacity *
1980	2.00			
1985	15.00			
1990	31.22		0.51	0.21
1995	48.58		3.46	0.64
1999	56.00		10.00	1.60

* Production capacity in two shifts.

Source: Unpublished report of the Ministry of Agriculture.

As indicated in Table 2-15, pig feed has the lion share in the total industrial feed production, and was 40% in 1999. Layer feed and broiler feed has the similar shares, together accounting for 48% of the total production. Fish feed has a share of 10%, and the remaining 2% are divided for cattle and other animals. Hints can be drawn from this composition of feed that the layer and broiler sector should have been to a much greater extent commercialized than cattle and other livestock sectors.

Table 2-15 Composition of Compound Feed Output in China
Million tons

	Pig Feed	Layer Feed	Broiler Feed	Fish Feed	Other Feed
1990	14.30	4.66	5.68	0.96	0.80
1995	17.91	10.82	9.94	2.10	1.20
1999	27	16.2	16.2	6.7	1.4

Source: National Feed Industry Office, Feed Industry Statistics (1990-2000).

Geographically, feed industry is located in a pattern that reflects the pig and poultry production. The major pig and poultry producers (or feed consumers) are also the most important industrial feed producers. Leading pig-producing provinces, including Sichuan, Shandong, Jiangsu, Hunan and Hubei, are also important pig feed producers. Guangdong, Shandong, Hebei and Jiangsu, the major poultry production regions, are also the major broiler and layer feed producers. This location of feed industry is different from that of feed grain resources, which are more based in the northeast provinces.

Foreign investment and foreign ventures have played an important role in the development of Chinese feed industry. By the end of 1998, there were 368 foreign funded feed companies in China, mostly located in the eastern coast provinces of the country. Of those, 78 are under the CP group of Thailand, accounting for one-third of all foreign investment in feed industry in China. The CP group was also the first one of foreign enterprises to set up a feed company in China. In 1979, the CP group set up its first joint-venture chicken farm in China, and in 1982, its first feed mill with a production volume of 0.24 million tons, the largest one then in China, was put into operation. By now, the CP group has 96 feed companies in China, with about 60 employees. Among the top-500 foreign ventures in China listed by the Ministry of Foreign Trade and Economics Cooperation and State Statistical Bureau, 22 are under the CP group, with a total asset of 4.2 billion US\$, and sale of 3.6 billion US\$ in 1998. The CP group has the largest share in Chinese processed feed market, as high as 30% in the 1980s and still around 8% currently, twice as much as its closest competitor, the Hope group.

The foreign investment in Chinese feed industry has made great contribution to the development of the industry. The foreign companies have brought into China the concept of animal nutrition, what was complete new in China until early 1980s. These foreign companies have played a kind role of pioneering and catalysts. Following their successful example, domestic feed companies have been set up, including many private ones. One leading private feed company in China is the Hope group, which is located in the Sichuan province, and whose inception can be directly attributed to the inspiration of CP group's activities in the biggest pig producing province in China. The Hope group as a feed company was created in 1988 by private entrepreneur, who used to be a big partridge raiser. He accidentally saw farmers staying in line buying feed produced by the CP group and puzzled by the high price of feed. That gave him the initial pulse to start the feed business. The indigenous feed company soon successfully gained its ground in competition with the CP group by providing feed of equal quality but lower price.

Feed mills of all kinds of ownership have mushroomed since mid-1980s in China. Currently, there are about 11 000 feed mills with an annual production of 3000 tons and over, and 1937 of which produce 10 000 tons a year. It is apparent that China's feed industry is still dominated by a great number of relatively small companies. A consolidation process of the sector has been underway for years, as the competition has become increasingly fierce in recent years. According to statistics of the National Office of Feed Industry, the number of feed companies with an output of 10 000 tons and over have increased from 555 in 1990 to 1937 in 1999. It is estimated that the average profit rate of the feed industry in China has been very low, from about 1% in 1998 to about 0.5% in 1999. Many money losing feed mills will be squeezed out of the sector, and the market will be shared by fewer but large companies, including state-owned, joint ventures and private ones.

Scale of economy and the different quality are the main reasons for the structure transformation. According to the regular feed quality inspection of the governmental agency, there is a close co-relationship between business scale and product quality. The larger companies generally produce higher quality feed. The percentage of feed up to grade was 86% in big feed company, 77% in middle-sized ones and only 54% in small ones in 1990. The corresponding figures for 1999 were 95%, 91% and 80% respectively. There has been a general improvement, but the large companies still lead far in the product quality.

At the same time, the ownership structure has also undergone drastic changes. Among the registered large scale feed mills, state-owned ones reduced from 5996 in 1990 to 3656, while private mills increased from nil to 3671, and foreign funded including joint ventures increased from 62 to 383. This means that the dominant force in Chinese feed market has changed from the state sector to non-state sectors. There is also noticeable difference in product quality among different type of enterprises. According to a survey by the state feed authority, products from foreign and joint ventures show the highest rate of quality: 98.5% of their products reach the state-set standard. The corresponding figures are 88.7% for feed produced by private companies and 75% for the feed by state-owned enterprises. This partially explains the shrinkage of the state sector in feed industry

Non-conventional Feed Resource

Non-conventional feed has been emphasized in China since long due to at least three major reasons. First, non-conventional feed is cost-efficient, especially for the small traditional farmers; Second, it substitutes for food-grain feed, which was of special importance in the past when food shortage was a prevailing problem. Third, it has also some positive environmental effects. The treatment of straws as non-conventional feed for cattle reduced the environmental problem in major grain producing provinces where farmers used to burn straw in the field. The smoke from burning straws was some times so heavy that cause the nearby airport to be closed.

In recent years, the research in non-conventional feed has gained increased attention. Even a special Research Center for Non-conventional Feed was established at China Agricultural University, a leading agricultural education and research institution in China. Chinese scholars classify non-conventional feed resources into seven types. (1) crop straws; (2) by-products of forestry, including leaves, fruit peels and other fruit by-products; (3) distiller's grains, dregs; (4) oil cakes (other than soybean cake, mainly including cotton cakes, rape-seed cakes, etc.); (5) by-products from livestock slaughtering; (6) Renewable feed, such as chicken dung; (7) Some minerals.

Table 2-16 Estimated available amount of non-conventional feed resources in China

Type	1	2	3	4	5	6
Million t	350	7.5	48	10.5	1.35	2.3

Source: Liang Yesheng, Non-conventional feed and utilization perspectives, in: China Agricultural Resources and Regional Planning, No. 4 1998

Table 2-17 Nutrition value of some non-conventional feed (%)

Name	Source	Try mass	Raw Protein	Raw Fiber	Calcium	Phosphor
Paddy straw	Jiangsu	89.4	2.5	38.8	0.07	0.05
Wheat straw	Hebei	85	4.5	36.7	0.27	0.08
Corn stems	Shaanxi	88.8	3.5	28.1	0.49	0.44
Soybean straw	Hubei	88.1	4.7	39.8	0.87	0.05
Peanut vine	Jiangxi	92.3	10	14.5	3.58	0.1
Sweet potato vine	Shandong	86.3	10.3	25.7	2.44	0.16
Pine needle	Heilongjiang	33.5	4	8.8	0.21	0.01
Locust tree leaves	Hunan	23.3	5.3	4.1	0.23	0.04
Cotton seed cake	Jiangsu	86.5	37	13.3	0.32	0.6
Chicken dung	Hebei	90	26	15	8.5	2.5

Source: Liang Yesheng, Non-conventional feed and utilization perspectives, in: China Agricultural Resources and Regional Planning, No. 4 1998

Feed Resource and Use Structure

As indicated in previous sections that a verities of feed are used in livestock production in China, and there are some differences in feed structure among different raising systems. Table 2-18 shows the results of a survey by Chinese feed authority.

Table 2-18 Feed use structure in China (1997)

Feed Type	Pig			Cattle		Broiler	Layer
	Trad. small farm	Middle-sized farm	Large Indus. farm	Trad. small farm	Middle-sized farm	Middle-sized farm	Middle-sized farm
Cereals	41.2	38.5	0	35.9	39.6	20.9	33.9
Complete	8.6	34.6	100	0	0.2	69.7	52.3
Cakes	1.4	6.9	0	2.1	8.5	7.2	6.2
Bran	26.9	14	0	6.3	5.7	0.2	4.2
Concentrate	0.6	3.5	0	0	0.4	1.9	1.9
Fish meal	0	0	0	0	0	0.2	1.5
Other farm by-products	1.9	2.6	0	7	13.8	0	0
Green/ raw feed	18.5	0	0	48.6	31.4	0	0

Source: MoA internal report.

3. Demand for Livestock Products

3.1 General Trend

Changes in meat consumption should have followed very closely to development on production side as trade accounts for a very small part share of total supply. Hence, in line with the above-mentioned production development, meat consumption has also increased. However, due to the over-reporting of production mentioned above, there are large differences between the consumption data from the household surveys and that derived from the food balance sheet (Table 3-1 and Table 3-2).

According to the household surveys (Table 3-1), pork consumption has the lowest growth rate for both the urban and rural residents, while poultry meat and eggs have the fastest growth rates, more than doubled since 1980. For urban consumers, pork consumption has first increased in the 1980s, but then fell again in the 1990s close to its original level in the early 1980s. This seems to be a puzzle, taking the rapid income growth and the positive income elasticity into account. One possible reason may be the rapid increase in eating-out for urban residents, which already accounted for 13% of urban food budget. Other possible reasons have already discussed in earlier sections. Many people have doubts on the reliability of the survey data. For rural population, there has been a continued improvement in consumption level of all livestock products. Beef and mutton consumption for both the urban and rural consumers have doubled, though the absolute amount increased only by around 1.5 kg and 0.5 kg respectively.

On the other hand, according to the data based on food balance sheet, the growth rate is much higher for all products (Table 3-2). However, the relative growth relationship between different products is roughly the same. Pork consumption has registered lowest growth. Poultry meat consumption has shown a much higher increase rate. Beef consumption has shown an extraordinary high growth, especially since 1990.

**Table 3-1 Livestock Consumption Based on Household Surveys
kg / per capita**

Year	Urban Household					Rural Household				
	Meat Total	Pork	Beef & Mutton.	Poultry	Eggs	Meat Total	Pork	Beef & Mutton.	Poultry	Eggs
1980	19.8	16.5	1.5	1.8	5.0	8.4	7.3	0.5	0.7	1.2
1985	22.6	16.7	2.6	3.2	6.8	12.0	10.3	0.7	1.0	2.1
1990	25.2	18.5	3.3	3.4	7.3	12.6	10.5	0.8	1.3	2.4
1995	23.7	17.2	2.4	4.0	9.7	13.1	10.6	0.7	1.8	3.2
1999	24.9	16.9	3.1	4.9	10.9	16.4	13.0	0.9	2.5	4.3

Sources: SSB, Statistical Yearbook of China, various years.

**Table 3-2 Livestock Consumption Based on Food Balance Sheet*
kg / per capita**

Year	Meat Total	Pork	Beef	Mutton	Poultry	Eggs	Milk
1980	13.3	11.5	0.3	0.4	1.0	2.6	1.4
1985	18.2	15.6	0.4	0.6	1.5	5.1	2.7
1990	24.9	20.0	1.1	0.9	2.8	7.0	4.2
1995	43.2	30.1	3.4	1.7	7.7	13.8	5.6
1999	46.7	31.8	4.0	2.0	8.9	17.0	5.7

* Calculated from SSB data on production, trade and human population.

3.2 Urban and Rural Disparities and Income Effects

As hinted in the previous sections, there are remarkable differences in the consumption patterns between urban and rural households. On the average, urban residents have higher income and consume much more livestock products than their low-income rural fellows (Table 3-1). Largely, the urban residents consume double as much eggs and 50% more meat compared with rural residents.

As a result of this urban-rural disparity, the total demand and consumption of livestock has also been influenced by the change in population composition. Given increased expansion of cities and rural-urban migration, China has undergone a dramatic urbanization process. Urban population has grown by over 4% per year, from 191 million in 1980 to 389 million in 1999. The urban proportion in the whole population increased from 19% to 31% during the same period. This figure will be still larger if it included the so-called “floating population”, the rural migrant who are working in cities but without permanent urban residency status, and which is currently estimated at around 50-90 million depending on definition. This process of urbanization is likely to continue at an even greater pace in the future.

The primary driving force for the increase in livestock consumption is income improvement. The average income for urban and rural population has risen significantly in the past two decades shown in Table 3-3. The nominal income per capita rose by over ten folds for both urban and rural households. In real term, namely deflated by inflation rate, the per capita income has increased by three folds for urban population and two and a half fold for rural residents.

Table 3-3 Per Capita Income Development in China

	Yuan/per capita		Income Index		Price Index	Deflated Income Index	
	Urban	Rural	Urban	Rural		Urban	Rural
1980	439	191	100	100	100	100	100
1985	685	398	156	208	119	132	175
1990	1387	686	316	359	192	164	187
1995	3893	1578	886	825	329	269	250
1999	5854	2210	1333	1157	333	400	347

Sources: Statistical Yearbook of China.

Cross sectional statistics of income also show a close co-relationship between income and livestock consumption. For every year in observation, the income group with a higher income

level has a markedly higher consumption level of livestock products. The top income group consumes about 70% more pork than the lowest income group. For chicken, beef and mutton, the consumption disparity is about 100%.

There are few studies on the income elasticity of livestock consumption due the data constraints. Research staff of SSB has conducted a study on the income elasticity for food in rural households (Table 3-4). According to this study, the average income elasticity for poultry meat and fish were the highest in 1988, 1.46 and 1.34 respectively. The corresponding figures for pork, beef and mutton were at the same level of 0.57. The figure for egg was somehow higher, 0.66. In comparison with crop products, whose income elasticity was bellow 0.30, all livestock products had apparently higher income elasticity.

Table 3-4 SSB's Estimation of Income Elasticity, Rural Households, 1988

Products	Income Group					
	Average	Low	Lower Medium	Medium	Higher Medium	High
Pork	0.57	0.68	0.66	0.71	0.62	0.40
Beef and Mutton	0.57	0.50	0.33	0.17	0.12	0.34
Poultry	1.46	1.15	1.40	0.90	0.83	1.02
Egg	0.66	0.77	0.55	0.30	0.32	0.38
Fish	1.34	1.64	1.31	1.02	0.82	0.79
Food Grain Total	0.16	0.26	0.19	0.15	0.01	0.07
Rice and Wheat	0.26	0.35	0.31	0.26	0.24	0.13
Coarse Grain	-0.23	0.04	-0.20	-0.32	-0.29	-0.40
Vegetables	0.30	0.52	0.34	0.30	0.22	0.09

Source: SSB, 1996, Rural, Agricultural and Farmers' Issues in China.

Another study has been undertaken by the International Food Policy Research Institute (Huang, et al, 1997), which shows a slight different picture of the income elasticity for livestock products in China (Table 3-5). One of the same results is that all livestock products have much higher income elasticity than crop products. The figure for fish is higher than that for all meat categories. Beef and mutton has the weakest income responses compared with other meat, especially in the rural households, a result different from that of the SSB study. One of the important features of results in Table 6-5 is that the income elasticity for all livestock products are higher in the urban households than that in the rural households, which is against the popular views in China that the rural consumers have a higher income response on livestock consumption due to the very low consumption level currently.

Table 3-5 IFPRI's Estimation of Income Elasticity, 1990-2020

	Early 1990s		1990-2000		2000-2010		2010-2020	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Livestock products	0.757	0.835	0.757	0.835	0.835	0.870	0.835	0.870
Pork	0.765	0.782	0.765	0.782	0.782	0.797	0.782	0.797
Beef and mutton	0.343	0.689	0.343	0.689	0.789	0.686	0.689	0.686
Poultry	0.854	0.985	0.854	0.985	0.985	1.064	0.985	1.064
Egg	0.512	0.455	0.512	0.455	0.455	0.491	0.455	0.491
Milk	1.557	1.637	1.557	1.637	1.637	1.912	1.637	1.912
Fish	1.053	1.244	1.053	1.244	1.244	1.290	1.244	1.290
Food Grain Total	0.246	0.092	0.150	0.000	0.000	-0.050	-0.050	-0.100
Rice	0.326	0.140	0.200	0.100	0.100	0.000	0.000	-0.050
Other Grain	0.175	0.052	0.105	-0.083	-0.089	-0.091	-0.095	-0.141

Source: Huang, Jikun, et al, 1997, China's Food economy to the 21st Century: Supply, Demand, and Trade, IFPRI Discussion Paper.

The above-mentioned studies were conducted several years ago. The practical development since then has suggested that the income elasticity values from those studies seem to be overestimated. Recently, renewed efforts have been made which showed downward adjusted income effects on major livestock products. One study shows the following results:

Table 3-6 MoA's estimation of Income Elasticity

	Pigmeat	Beef and mutton	Poultry	Eggs	Milk
Rural	0.25	0.57	0.22	0.36	0.32
Urban	0.32	0.49	0.48	0.26	0.49

Source: Liu Jiang, Agricultural Development Strategy in China in early 21st Century, Chinese Agriculture Press, 2000

3.3 Price and Consumers Preference

Consumer prices for different livestock products have developed unevenly in the past two decades. Mutton price has risen by eight folds, the largest margin among all animal products. The growth figure is six folds for beef and four folds for pork (Table 3-7).

This uneven price development has resulted in complete changes of price ratios. Chicken traditionally used to be the most expensive meat in China, followed by pork, beef and mutton. Eggs were as expensive as pork. However, in the past twenty years, the price relation has been inverted. Mutton has become the most expensive meat, followed by beef and pork. In contrast, chicken has turned to be the cheapest meat. Relative price of eggs has also fallen from higher than beef and mutton in 1980 to less than half that of beef and mutton in 1999.

Together with shifts in production, the change in livestock price ratios also reflected changes in the quality of the meat and in consumers' preference. Beef used to be a low quality meat product in China, produced as a by-product of draught animals, as beef from fallen cattle

constituted the major part of supply in the pre-reform era. This situation has changed substantially with the development of the beef cattle sector. On the other hand, pork and especially chicken production has become increasingly industrialized, resulting lower production cost, but also to some extent lower quality of the meat. At the same time, consumer's preference has also changed as income rose. For instance, prior to 1980s, pork was used as a major source of cooking oil, and therefore rated and priced according to the thickness of the fat. The fatter, the more expensive. Given an improved supply of vegetal oil and improved living standards, people have become to prefer lean to fat meat. Diversification of demand toward beef and mutton have driven up their prices, supported, in the case of beef, by the development of fast food restaurants which have become extremely popular in the larger cities.

Table 3-7 Consumer Price Development for Livestock in China

	Yuan/kg				
	Pork*	Beef**	Mutton**	Eggs	Chicken***
1980	2.02	1.76	1.65	2.08	
1985	2.75	3.20	2.86	2.50	
1990	5.30	6.38	6.15	4.80	6.95
1995	13.70	16.95	19.45	7.00	11.95
1999	10.54	12.69	15.16	5.13	9.45

Sources: SSB: Statistical Yearbook of China, and MA: Unpublished reports of the Information Center.

* Boneless leg; ** Boneless average; ***Slaughter weight.

3.4 Geographical Pattern of Consumption

One further striking feature in livestock consumption in China is the noticeable differences in regional patterns, especially for the rural households. The general picture is that rural households in the southern provinces have higher consumption level of animal products than those in the north. The meat consumption in Guangdong, Yunnan and Sichuan is 4 to 5 times that in Henan, Shanxi and Shaanxi provinces.

The regional patterns in meat consumption reflect differences in income, consumption preferences, abundance of own supply and of substitutes, as well as transportation and other marketing costs which determine the local prices.

The high consumption level of meat and eggs observed in Guangdong, Fujian, Shanghai, Zhejiang and Beijing can be explained with their high income, while the same high figures for Yunnan, Sichuan and Guizhou, three low income province, are attributed to the abundant local supply, and very unfavorable marketing conditions (the transportation is very poor due to the extremely mountainous topography), resulting in low consumer prices.

The three northeast provinces, the most important feed grain (corn and soybean) producers in China, have a rather low consumption level of meat. This is compensated by higher egg consumption, and larger intake of protein from vegetal origin associated with very abundant local soybean production.

Fish has played to some extent a role as a meat substitute in the eastern coast regions, such as in Tianjin and Jiangsu and Hainan.

In the pastoral provinces including Xinjiang, Inner Mongolia, Tibet and Qinghai, very little poultry is consumed, nor much pork. Beef and mutton account for the major part of meat consumption there. This reflects production-based diet habits, poor transportation and poor access to market. In Ningxia where the Islam religion plays a dominant role, pork consumption is low.

For urban households there are no direct regional consumption statistics available. However, conclusions can be drawn from household expenditure data that there do exist regional disparities in the consumption patterns of animal products, though maybe not as large as for rural households. The regional pattern in meat consumption for urban resident seems to be very similar to that for rural households. The meat expenditure in the South is two to three times that in the North. This regional disparity can be jointly explained by difference in income as well as in prices. Urban dwellers in the rich provinces earn as much as twice that in the less developed provinces. The price difference causes different expenditure for the same physical amount of meat product, or different physical consumption level of meat among people with the same income. This income disparity has impacts not only for the expenditure on meat, but also for the actual quantity of meat consumed.

3.5 Future Demand Projections

Population expansion will be the primary driving force for China's future food demand. The average annual population growth for the past decade was 1.4%. If this trend will continue into the next 40 years, China's population will then reach 2.0 billion by the year 2030. The Chinese government has set a high population control goal, according which the total population should be within 1.4 billion in 2010, 1.5 billion in 2020, and 1.6 billion in 2030. Whether this goal can be realized will have substantial impacts on food demand growth and hence the Chinese food balance in the future. The high population growth scenario implies 25% more food need compared with the low population growth scenario, with other things equal. Given a grain consumption level of 400 kg per capita, this means 160 million tons additional grain need. How China will be successful in implementing its population control policy will play a crucial role in her future food balance.

Due to the rural-urban migration, the urban population growth is higher than the national average, and registered an annual rate of 3.8% over the past two decades. This resulted in a rising share of urban population, from 24% in 1985 to 31% in 1999. If this trend will continue into the next 30 years, the urban share would be nearly 75% by 2030. This seems unlikely. Many believe that it will be around 50%. Even the share of urban population will reach 50%, it will have significant impacts on food demand. This process of urbanization will further increase the food demand and change the food demand structure, i.e. less food grain and more feed grain. As shown in Table 3-1, the urban residents and rural residents have significant differences in food consumption patterns. Generally speaking, urban population has a high food and grain (including direct consumption of food grain and indirect consumption of feed grain through livestock products) consumption level due to higher income and other factors.

One further factor is the overall income development trend and its impact on demand of livestock products. As discussed in previous sections, the income elasticity of all livestock products is largely in the range of 0.2-0.8. Given an annual income growth of 3-4 percent, the per capita demand increase will be 0.6-3.0%. According to MoA, the per capita demand of

meat nation-wide will be 1.8%. The corresponding figure is 1.7% for eggs and 2.5% for milk, as shown in Table 3-8.

Table 3.8 MoA’s projection on per capita demand in China

	Year	Meat total	Pork	Beef and Mutton	Poultry	Eggs	Milk
		kg	kg	Kg	Kg	kg	kg
Rural	2005	29.46	20.76	3.49	5.22	7.97	3.39
	2015	33.79	23.56	4.39	5.84	9.51	3.97
	2030	40.37	27.81	5.77	6.8	11.86	4.86
Urban	2005	57.93	34.89	10.69	12.35	17.58	16.92
	2015	68.99	40.54	13.2	15.24	19.93	21.01
	2030	84.19	48.29	16.67	19.23	23.14	26.63
Average	2005	39.14	25.56	5.94	7.64	11.24	7.99
	2015	47.87	30.35	7.91	9.60	13.68	10.79
	2030	60.97	37.44	10.89	12.64	17.16	15.09
Growth Rate in %		1.8	1.5	2.5	2.0	1.7	2.5

Taking all of those three factors, i.e., population growth, population structure changes (urbanization) and per capita demand growth resulted from income improvement, together into consideration, it seems safe to project that China’s total demand for meat and other livestock products in the next three decades will strongly increase, most likely with an annual growth rate of three to four percent. This strong demand development trend will place daunting pressure on the production side, leading to an inevitable increased intensification process of livestock production.

4. Marketing and Trade

4.1 Marketing Systems and Channels

At the beginning of the 1950s, private marketing activities in livestock sector were still allowed. However, since 1955, a compulsory delivery system was introduced, under which farmers had to sell a certain part of their livestock production to the state marketing agencies. The share of the private trading in livestock fell sharply, from 80% in the early 1950s to only around 1% by the end of 1950s. From 1958, private trading was completely forbidden throughout the 20-year period of 1958-1977. The marketing of livestock products were monopolized by the state marketing agencies and private butcher as an occupation actually disappeared during that time. Only direct sale from producers to consumers was occasionally allowed after the state purchasing quota had been fulfilled. This kind of direct sale accounted merely for a very small percentage of the total livestock marketing because the state quotas were usually set at a very high level. Farmers even did not have enough for their own consumption, let alone had many surpluses for sale.

At the end of the 1970s, private trading activities in livestock was again allowed as China introduced the economic reform policy. In order to promote a better supply and marketing efficiency, private marketing was first permitted and then encouraged by the government. “Free markets” were established in cities and towns throughout the country and private

marketing of livestock products developed very rapidly. By mid-1980s, when the compulsory purchasing system was abolished, the private sector already gained an equal marketing share as the state sector.

In the 1990s, as the many beneficial measures, i.e., subsidy in various forms, to the state sector was gradually abolished, the private sector has finally become the dominant player in the livestock marketing, especially in the purchase of live animals, slaughtering and retailing. Facing the increased competition from the private sector, many state-owned slaughterhouses could not survive without governmental subsidy and got closed. However, the state sector still plays the key role in following areas: processing, storage, inter-regional transportation and foreign trade. Those activities need large investment and have high technical requirements, and the private sector has not yet developed to a level sufficient to meet those requirements.

Generally speaking, the purchase of live animals are usually conducted by private traders, most of them are part-time farmers, or former farmers. They then bring the animals to the government “designated slaughtering point”, a kind of public slaughterhouses, and slaughter the animals there, pay due fees and tax. Retailers of various kinds in the towns and cities buy meat in the form of slaughter-halves from those slaughter-places and bring to the consumer, in fresh meat or processed form. Most of the products were sold to consumers as fresh meat, and only a small part as processed products. According to MoA official’s estimation, for example, only about 15% of the pig-meat in China is consumed in processed form. The common retailing outlets are wet markets. Supermarkets have mushroomed in recent years, especially in large and middle-sized cities, and have become increasingly important outlets of livestock products.

4.2 International Trade

China has kept its position as a net exporter of livestock products in the world market. Table 4-1 displays the composition of China’s foreign trade of edible livestock commodities in the recent years. It shows clearly that both export and import have increased by large margin over the past decade. The share of livestock products in the total trade has also changed. On the export side, the livestock share has fallen from 1.6% to under 1% in the total export, and increased from 15% to 18% in total food export. On the import side, the livestock share has increased markedly, from 0.3% to 0.5% in the total import, and from 5% to 20% in total food import.

**Table 4-1 Import and Export of Livestock Products in China
In million US\$**

Commodities	1990	1995	1999
		Export	
Live Animals	429.73	503.17	385.15
Cattle	62.86	56.71	38.78
Pigs	270.91	278.71	235.92
Poultry	84.53	125.34	95.47
Meat and entrails	522.66	1021.47	1386.88
Beef	158.74	33.59	33.79
Pork	215.48	245.35	129.82
Mutton	4.46	3.09	4.29
Poultry	84.09	620.82	479.99
Entrails	46.21	79.64	334.22
Milk and products	13.18	27.28	40.76
Eggs	41.67	33.57	23.24
Total	1007.24	1585.49	1836.03
		Import	
Live Animals	13.62	36.61	65.60
Cattle	1.63	0.50	
Pigs	0.00	1.93	
Sheep & goat	1.19	0.45	
Poultry	10.72	15.18	
Meat and entrails	53.25	94.84	574.93
Beef	2.91	4.23	6.31
Pork	0.01	0.96	24.35
Mutton	0.25	0.72	7.74
Poultry	47.81	79.91	404.65
Entrails	0.20	1.32	71.83
Milk and products	78.74	58.04	90.71
Eggs	2.04	1.68	1.00
Total	147.65	191.17	732.24

Sources: China Custom Statistics, various years.

Major export commodities are live pigs and pork, live poultry and poultry meat. These four commodities account about 70% of the edible livestock products export of China in early 1990s and about 50% currently. The processed products like sausages have gained a large share in recently years. Major import products are practically only milk products and poultry, accounting for 70- 90% of the total food livestock import. Poultry import increased very rapidly in recent years. It is not the whole bird, but certain parts of the chicken, mainly wings, claws and giblets. These parts of chicken are priced very low in western countries, but enjoy very high prices in China due to special preference of Chinese consumers. They are usually more expensive than breast.

In physical term, meat export of all kinds, including live animal and birds as well as processed goods, was about half a million tons in 1999. On the import side, the import of poultry alone was almost 0.8 million tons, clearly exceeded the export volume (Table 4-2). This means that in physical term, China is in fact a net importer of meat, though it is a net

exporter in term of dollar value. This is because the large size import of chicken parts was at a much low cost compared with the export of hog and pork.

Table 4-2 Trade of major livestock products in China in 1999

	Live Pig	Pork	Beef	Live Poultry	Poultry	Eggs
	1000 heads	1000 t	1000 t	million birds	1000 t	million
Export	1960	92	25	45.00	306	466
Import	0	58	5	0	788	0

Source: Statistical Yearbook of Foreign Trade in China 2000.

Main destinations of China's livestock export are Hong Kong, Japan and Russia, accounting for some 80% of the total livestock export. The United State, with a share of over 60%, topped the supply country list, followed by West European and Australia, with around 10% and 5% respectively.

The total export and import volume is not significant to the domestic market. Live animals and various kinds and form of meat export, converted in meat equivalent, accounted only for 2-3% of the total domestic production in mid-1980s and for about 1% in 1999. Meat imports have been only about 10% of the export, or about 0.1 -0.2% of the domestic consumption before mid-1990s and about 1% in 1999. As a result, trade in livestock products does not have a significant impact on overall domestic supplies.

4.3 Impacts of WTO Entry

The possible impacts of WTO entry on agricultural sector including livestock sector in China has been a heated topic since the signing of China-US accord in November 1999. It is general opinion that Chinese livestock sector will benefit from China's WTO accession. The main argument for this it that China's labor-intensive sectors will enjoy comparative advantages and the livestock sector in China is one of those labor-intensive sectors.

Tariff Reduction

In the WTO accession negotiations, China has made tariff reduction concessions. Import tariff for most livestock products will be reduced from the current level of 40-50% to 12%(Table 4-3). This seemly substantial tariff reduction will certainly have some potential impacts on import. However, these impacts from tariff reduction should not be over-evaluated. This is because even after the tariff reduction, most of the imported livestock products will still be more expensive compared with domestic production. Those imported products mainly serve the need of the population segments with high income for high quality products.

Table 4-3 Import Tariff Reduction Concession of China's WTO Entry

	Current	2004
Beef	45%	12%
Pork, Poultry	20%	12%
Cheese	50%	12%
Ice-cream	45%	19%

Tariff Rate Quota for Feed-grain

Another important factor is the impacts of China's WTO accession on feed-grain import. According to the negotiations, China will use the TRQ mechanism to its grain import (Table 4-4). Because the quota amount is bigger than the actual import in the past and the tariff for in-quota import is only 1%, the possibility of greater and cheaper import of feed-grain will have some positive impact to domestic livestock production. Soybean is not included in the TRQ system, and will continue to be only subject to a 3% import tariff. This will also be beneficial for the livestock sector.

**Table 4-4 Tariff Rate Quota in Context of China's WTO Entry
In million tons**

	Wheat	Corn	Rice
Actual Import, average of 1990-97	8.88	0.75	0.43
Production 1997	123.29	104.30	140.50
TRQ upon accession	7.30	4.50	2.66
2004	9.64	7.20	5.32
Tariff In-quota	1%	1%	1%
Over-quota	77-65%	77-65%	77-65%

Sanitary and Quarantine Issues

One major barrier to China's export of livestock products is the sanitary and quarantine issue. China's WTO entry will have some positive impacts in two ways: First, it will increase the domestic awareness and efforts to raise the standard of the products. Secondly, it will also provide China with a more fair treatment and reasonable requirements from the importing countries, and widen the door of many members. The dispute settlement mechanism of WTO will provide a more equal competition environment for Chinese farmers in the world market.

Taking all above-mentioned factors into consideration, China's foreign trade in livestock products will undergo some changes upon WTO accession. Both export and import will rise, with poultry, beef and pork as the main gainers on the export side and chicken wings and giblets and milk products as the major gainers on the import side.

5. Policy Development

Under the previous planning system, before the economic reform initiated at the end of 1970s, the livestock sector in China was under strict direct government control. This control encompassed all the phases of the economic process, from the very beginning of production, through distribution to consumption. This system has been greatly, if not completely, changed through the various reform stages initiated since 1978. Now, on the whole, a market system has been established, though there are still some government interventions. This holds true for all livestock categories and products. These policy changes, coupled with enormous changes in macro economic sectors, have had significant impacts on and have resulted in substantial changes in production, marketing and consumption of livestock products in China.

5.1 Policy Goals

The policy goals for livestock sector are an integrated part of the overall agricultural policy objectives. The agricultural and food policies in China today are completely different from those in place before the initiation of the rural reform program begun in the late 1970's. Many of the current policies are a result not only of continued reform of the rural economy, but also a response to the success of the country's overall economic development. From the broadest perspective, the policy shifts over the last two decades have moved China's rural economy closer and closer to a market-oriented system.

The general goal of agricultural and food policy in China, like other countries, was to develop the country's economy. Before the rural reform began in 1979, the specific goals of agricultural and food policy can be summarize to mainly produce ample and cheap food for urban residents and to export farm products, as planned, to earn hard currency for importing advanced technology and equipment to develop industries in urban areas. Those specific goals have evolved over the last two decades and can be generally characterized into the following seven areas: reduced support of industrialization in urban areas, reduced emphasis on obtaining foreign currency earnings via agricultural trade, more concern with farmers' incomes, a greater emphasis on long-term food security and self-sufficiency, increased attention paid to minimizing government budget deficits and state-owned enterprise debts, more concern with environmental protection, and increased concern with food quality and safety. The last one is of special relevance to livestock products.

Reduced Support of Urban Industrialization

A central policy goal under the old planned economy was to provide cheap food for industrial development in urban areas. Production targets and mandatory state procurement quotas were determined according to the needs of urban industrialization plans and targets. Procurement prices for agricultural products were set very low in order to reduce the labor and raw material costs for industrial production.

This goal was gradually given up in the process of rapid economic development after rural reform began in the late 1970's. Beginning in the early 1980's, China's government first began to decentralize the system of agricultural production, and from the mid-1980s began to gradually liberalize the markets for fruits and vegetables, then fishery products and livestock

products. Currently, procurement policy only applies to two major products, grain and cotton. Even for these two products, the policy goals have been changed, though the policy means remain largely unchanged. China's policy makers are now much more concerned with the issue of stability in domestic agricultural markets rather than the old goal of drawing resources from agriculture to support urban industrialization.

Reduced Emphasis on Agricultural Sector to Earn Foreign Exchanges

Exports of agricultural products played a crucial role in earning foreign exchanges in China in the past, particularly before rural reform introduced 20 years ago. The foreign exchange earnings were used to import modern technology and equipment necessary for building up the country's industrial sector.

China's foreign trade grew sharply over the past 20 years, in total export volume as well as value. As a result, agricultural export share of total exports declined drastically, from over 20 percent down to around 6% now. China's foreign trade managed to record consecutive years of trade surplus and large foreign exchange reserves. Foreign exchanges earned from agricultural exports are no longer a major concern for China in terms of its agricultural and food policy.

More concern with farm income growth

Since the early 1990's, government policy makers and researchers studying agricultural and food policies have paid more attention to the issue of farm income. In the mid-1980's the income gap between rural and urban citizens narrowed. But the gap is now again becoming widening, to an extent that average farmers' income is below 40 percent of that of urban population.

More recently, the central government also began to establish an annual growth rate target for farm income at the beginning of each year. The actual farmer income growth has been below the target for the past three years. The need for putting more effort to improve farm income is not just an economic issue, but broadened into a social and a political issue. Currently, in China, the situation of farm income has significant and direct influences on rural-urban migration, on farmers' purchasing power, particularly in buying consumer products manufactured in urban areas, and on social stability in rural places.

More emphasis on market stability and on long-term food security

Under the rigid planned economy before rural reforms began, prices of farm products were tightly controlled by the government. Therefore, price variations or fluctuations were basically nonexistent, unless the government decided to change price levels for some product. As market mechanisms were introduced, price variations and market fluctuations occurred more and more frequently. There were significant increases in farm product prices both in late 1993 and in 1994 and many economists blamed the rise in agricultural prices as a major reason for high inflation at that time. Similarly, the sharp price fall of food products and the overall sluggish market situation for almost all farm products since 1997 has also caused great concerns for policy makers.

Over the last 4 or 5 decades, food security and self-sufficiency have been a dominant theme of China's agricultural and food policy. In the past couple of decades, the top priority in agricultural policy was to increase domestic food supply through various means. Although the emphasis on production of food has been shifting from greater quantity to better quality and variety, food security and self-sufficiency remain important policy goals for agricultural and rural development in China.

More concern with environmental protection

In recent years, policy makers and scholars in China have become more aware of the importance of sustainable agricultural production and development, especially after the severe flooding in 1998. The government is paying more attention to areas such as soil erosion control, flood control, desertification control, and promotion of research and extension of water-saving technology. In the last several years, the Ministry of Agriculture has also promoted the concept of "Green Food" (similar to organic products in western countries) with food products produced without or with reduced chemicals and with uncontaminated irrigation water. The environmental problems caused by over-grazing in pasture areas and intensive pig farms in suburb areas have already generated increased concerns among both policy makers and the general public.

More focus on the state budget and state-owned enterprises

China's government began to pay attention to its state budget partly because of burgeoning subsidies to the agriculture marketing sector since the early 1990's, mostly to the money-losing state-owned grain marketing enterprises. Subsidies to livestock production and marketing used to be one important part of the whole agricultural and food subsidies. However, since mid-1990s, direct subsidies to livestock sector only exist in large cities and granted by the local governments to the state-owned livestock marketing companies. To some extent, this kind of subsidies is similar to subsidies provided to state-owned enterprises of other sectors rather than commodity-specific subsidy.

More Concerns Towards Food Quality and Safety

As livestock production has greatly increased over the past two decades, the market balance situation has drastically shifted from shortage to abundance and surplus. In the past, people worried about the availability of animal protein, without much consideration of the quality. Now consumers pay increased attention to the quality and safety of food, demanding livestock products to be risk-free and healthy. The concerns of the policy makers and the general public have been particularly aroused by the outbreak of some major livestock diseases in other countries, such as mad cow disease, chicken flu, foot and mouth disease. Disease prevention and control in the production and marketing process has become a dominant area of the livestock policy. In addition, the use of biotechnology, in the areas of breeding, feed additives and injection of growth stimulant, also present uncertainties in food safety. To reduce the possible risk, regulations and restrictions have been formulated.

5.2 Institutional and Production Policy

Institution Reform

Institutional reform is seen as the most important factor for China's agricultural achievement in the past two decades. This is also true for the livestock sector.

Livestock especially large animals such as horse, donkey, cattle and buffalo were considered to be production means during the pre-reform period, and were owned either by state farm or collectives. Individual farmers were not allowed to raise large animals. Exception existed only in the northwest and southwest nomadic regions, where each herdsman household was permitted to hold one or two milk cattle, or a couple of sheep or goat, to meet the consumption needs of the family. The same applied for pig and poultry raising in farming areas, mostly located in the eastern half of China.

Since the end of 1970s, the old system has been progressively reformed. Though farming as well as grazing land remains public goods, its use right has been contracted to the individual farmers and herdsmen. Livestock herds in both pastoral areas and crop farming areas have been divided to individual herdsmen and farmers. The prevailing production system has turned from collective to rural household-based ones. Presently, except for a limited number of large-scale state pig and milk cattle farming enterprises in suburbs of large cities like Beijing and Shanghai, almost all livestock are owned by individual farmers.

In summary, the reform process of the livestock sector basically can be regarded as one of privatization. The individual farmers and herdsmen have become the decision-makers for their livestock production and marketing. This has greatly improved production incentives, resulting in a rapid expansion of livestock inventory and output. However, at the same time, over-grazing and other environmental problems have also been aggravated.

Due to low economic efficiency resulting from high production costs and management problems, large-scale state pig raising and milk cattle farms operate mostly at a loss. The major purpose of establishing state livestock farms closely located to large cities has been to secure animal products for the urban population to ensure social and political stability.

Subsidy via Low Priced Feed

There were times when also individual farmers got direct support for pig raising and milk production, through the provision of subsidized feed. This practice has been terminated in the recent decade.

Subsidy to Large Producers

This used to be a very popular policy practice in China until mid-1990s, when large livestock farms were normally state-owned or collective-owned and located in suburbs of large cities. The main goal was to keep the inefficient system survive and provide urban population with sufficient meat, milk and eggs. This was seen as crucial for social and political stability in a time of food shortage. For example, in Beijing in mid-1990s, state pig farms obtain 50 Yuan for every head of pigs they sell to the state slaughtering houses. It looks like a subsidy to state pig raising farms, but in reality it is a subsidy to the state pig marketing agencies. This is because the state pig marketing agencies pay a lower price compared with the market price, thus offsetting the potential benefit from the premium for the state pig farms. The 50 Yuan subsidy has enhanced the market position of the state marketing agencies in competing with private pig traders.

In the process of deepening economic reform in the state sector and given improved market supply brought about by booming private economy, the previously common practice of regular subsidy to large livestock farms has been substantially reduced or largely abolished. Only in suburbs of some big cities are there occasionally still targeted subsidy, mainly to sow producers, in an effort to level the recycle fluctuations of pig production. Now when the subsidy is provided, it makes generally no difference between different ownership, either state-owned or private ones.

Investment Subsidy

In the past, local government often provided investment subsidy for establishing large livestock farms in order to secure market supply to nearby urban consumers. Though this practice has been largely terminated since some time, there are still occasional investment subsidy to livestock sector in some localities, usually for promoting some special forms of operation. For example, in one county of Beijing Municipality, the local government

designated certain sites for livestock operations, and grant investment subsidy, either direct or through subsidized credit programs, to farmers who move their livestock operation to those sites. This measure aims to attract the farmers away from their backyard manner of raising livestock, such reduce the environmental problems in the villages. In other places, local government provided investment subsidy to promote an experiment to integrate livestock production with greenhouse vegetable production.

Technical Extension Programs

Technical extension to promote production has long been a major policy area in livestock sector. There are both nation-wide programs managed by the central government and local programs initiated by local governments at provincial, prefecture or/and county level.

One of the priority areas for technical extension is the establishment and maintaining of a nation-wide net of breeding system. It consists of the introduction of high quality species, breeding farms providing farmers with breeding animals, and artificial insemination service. Currently, there are over 1700 state-owned livestock breeding farms across the country, of which 104 are cattle breeding farms, 555 are pig breeding farms, 438 are poultry breeding farms, and the rest are mixed breeding farms with more than one animal or poultry categories. Among those 1700 breeding farms, 83 are designated as the national key breeding farms. In addition, there are over 3100 artificial insemination stations across the country, which play a key role in improving the local breeds.

Another important area of technical extension is demonstration farm programs. There are several kinds of such programs. One type of such program is the so-called “model county for feeding cattle with ammonia-treated straw”. Under this program, counties in major grain producing areas have been selected and encouraged to use the ammonia-treated straw to raise beef cattle. The central government grants subsidy to improve the related facilities and investment conditions for cattle raising. This program was first launched in 1985 and now there are about 200 such model countries. A similar program was implemented for promoting hog with higher meat rate. By now, over 400 counties have been designated as “lean meat pig raising base counties”. The aim is to improve the local pig to produce more lean meat instead of fat. In the pre-reform era, people preferred fat meat as the supply was in shortage. This consumer preference has completely changed since 1980s, and lean meat is now preferred and high priced.

Training is also a key area for governmental actions, especially for prefecture and county governments. This can take many forms, including distribution of information sheets, printed technical materials, books and manuals, and training courses. Training activities are often an integrated part of the demonstration program.

Other Supports and General Service

Among the guidelines for priority areas of high technology to be supported by the government, agriculture is listed on the top. There are 16 project areas under agriculture, and 7 of which are related to livestock sector, including animal genetics, environment-sound facilities for intensive livestock farming, high quality animal breeding, facilities for organic manure, pasture seed development, straw treatment for feed and feed additives. These guidelines help various governmental agencies in determined the priority areas for various kind of support, including in providing research fund, investment loan program, etc.. This indicates the high attention attached to the development of livestock sector in China.

Animal health, epidemic prevention and quarantine have always been key areas of governmental actions. The public awareness and concerns about the quality and safety of

livestock products has become more than ever apparent in line with rising in personal income and living standards. On the other side, due to the fact that Chinese livestock sector is still characterized by a great number of producers with a very small production scale each on average, the task of animal disease control is really not easy work. The governments at all levels have made great efforts to provide public service in these areas.

5.3 Feed Policy

Feed policy can be grouped into two categories: Those promoting feed production and reducing feed costs and those regulating feed safety.

Promoting Feed Production

This kind of policy measures mainly refers to the tariff and tax exemptions. Technical equipment for producing feed additives and for developing animal protein resources is exempted from both import tariff and value-added tax. The value-added tax is 13% of the product's market value. Both imported and domestic produced feed including feed additives is also exempted from value-added tax. This policy has been crucial for the development of feed industry in China.

Feed Safety

Feed safety has become an increased concern in China in recent years. The incident of dioxin poultry in Belgium has fueled this concern. In addition, the heated disputes on use of growth stimulants including hormone in North America and Europe have also aroused responses in China. In order to have a sounder control on feed safety issues, the State Council issued a special decree on production, import and use of feed in 1999. Among other regulations, the decree prescribes that all new feed products and additives have to pass feed safety and environmental impact examinations before permitted into production. It also banned the use of hormone in feed. According to MoA officials, one argument among other considerations is, that entrails of livestock are very popular in Chinese dieting habits, and the entrails are of much higher contents of additive residues and therefor higher risk. This ban on hormone use in feed may cause some trade disputes with the United State.

5.4 Consumption Rationing Policy

Rationing

In the pre-reform period, before the end of 1970s, livestock products were provided at subsidized prices and rationed to urban consumers. The rural population was not covered by the ration scheme, i.e. rural population had to meet the consumption need by themselves. The availability of the livestock products in each city determined the level of the rationing. Both the quantity and quality of the rationed products were far from satisfactory. Meat purchasing was often a source for quarrel between customers and meat shop clerk, for the customers usually could only get the pieces of meat the clerk assigned to them, but not the ones they mostly wanted and preferred. Following the abolition of the rationing system by the mid-1980s, all the population has been given access to meat at the market retail prices.

School Milk Program

This is a new initiative introduced in 2000 and is still in experiment phase. The plan is to provide school children with milk through specially organized marketing channels. It is largely a promotion campaign to call for children to drink more milk. The financial

commitments of the government still remain unclear. Major reason for the initiative is that many nutrition scientists believe that Chinese children drink too little milk and this situation should be changed by organized campaign. Experiments have been conducted in selected schools in five largest cities in China, including Beijing, Shanghai, Tianjin, Guangzhou and Shengyang. It is planned to gradually extend first to provincial capitals and then to other cities small towns.

5.5 Domestic Marketing and Price Policy

In parallel with the reform of production policy, marketing and price policies for livestock products have also undergone dramatic changes since 1980. The market liberalization process for livestock products was initiated much earlier than that for grain. By mid-1980s, the obligatory delivery scheme had been completely abolished. Not only have livestock raisers obtained the freedom in their marketing decision making, but also private intermediate traders have been allowed to enter the livestock market. The state monopoly marketing in livestock products has been abolished and a very competitive market has been formed.

Price control in various forms has been gradually lifted. Government subsidy to state-owned marketing agencies and shops have been substantially reduced. In small cities and towns and vast rural areas, the state marketing agencies get no more subsidies. Only in large cities do they still get direct subsidy, but at much reduced level. Reasons for the maintenance of the subsidies include cost compensation for stock holding, price stabilization and support to retired state enterprise employees. The level of the subsidy is usually the result of the negotiation between the state marketing agency and the municipal government.

The current market structure of livestock products in China is characterized by a dual marketing system. On the one side there is a very large number of small private traders with very simple or even primitive slaughtering and marketing methods, while on the other, some large scale state marketing enterprise are equipped with much better or modern marketing facilities. The market share of state marketing agencies is directly related with the size of the city. The larger the city, the higher the share, but it does not exceed 50% even in metropolises like Beijing. It is estimated that, taking the nation as a whole, the private traders have a dominant market share of over 80%. The hygienic control of the meat handled by the small private traders is becoming an increasing headache for local governments.

Based on the available prices, gross market margin for pigs is calculated, which has been rather stable, within the ranges of 50-60% of the producer price under the normal conditions. Exemptions only occurred for 1994 and 1995, when it rose up to 100%, reflecting a much higher consumer price rise than producer during the overall price soar in that time.

Thought there have been no national subsidies for the marketing sectors of livestock, some local governments still pay subsidies to intermediates, such as slaughterhouse or meat processors. Those key downstream enterprises are called “dragon head company” if they have some contracts with small livestock farmers. It is hoped by policy makers that with a strong “dragon head company” and a better connection between this company and livestock farmers, the small farmers will be able to better meet the consumer need and in a better position to deal with market competition or unstable market situations.

Livestock quarantine constitutes another important policy area. In the past when state-owned agencies monopolized the meat marketing, quarantine was conducted by their own employees of the slaughterhouses of the meat company. The shortcoming of the system is obvious, especially as the market mechanism was introduced into the economy. In the recent years,

reforms have been implemented and the quarantine is now conducted by independent state agencies in large slaughtering facilities in ten provinces.

5.6 Taxation Policy

There are two types of taxes collected during the marketing process of the livestock, one is slaughtering tax and the other one is value-added tax. The slaughtering tax was as high as 10% in the past. Currently, the tax is calculated on a per head basis and the value is decided by each province. Table 5-1 presents the slaughtering tax value in selected provinces.

Table 5-1 Slaughtering tax in selected province, Yuan/per head

	Hog	Cattle	Sheep
Beijing	4	6	1
Guangdong	8	12	
Jiangsu	10	18	2
Hunan	12	20	10

The market value of a hog is about 500-600 Yuan. The slaughtering tax seems not to be a big sum. However, in some major hog producing counties of the central and western provinces of the country, slaughtering tax is an important source of the local governments (county and township governments) revenue. Because the tax is collected at slaughtering place, it happened that some local government prohibits export of live animals out their administration boundaries, causing complaints from farmers. The conflicts between local governments and farmers in some places are especial tense as the value-added tax is usually also collected at the same time by slaughtering. The value-added tax poses a much high burden, as much as 13-17% of the market value of the animals. Because farmers have to pay the two kinds of tax and slaughtering fees at the same time, they often do not tell the difference among them and simply take all as slaughtering tax. This sometimes also confuses investigators when interviewing farmer on slaughtering tax issues. The figures farmers provided seems often much higher than the investigators expected, for example, as high as 100 Yuan per head of hog. This is because farmers put all together. This gives farmers very strong incentives to slaughter their animals outside of the designated slaughterhouses to evade tax. This poses a great risk for animal quarantine inspection and food safety, because the quarantine inspection is also conducted at slaughterhouses. Successful tax evasion means also the sale of meat at the market without inspection. For this reason and to reduce farmers tax burden, many policy advisers and MoA officials strongly suggested to abolish slaughtering tax and the value-added tax for livestock.

5.7 Favorable Treatment for Foreign Investment in Livestock Sector

Foreign investment in livestock sector including the upstream and downstream sectors is welcomed and encouraged in China. Favorable treatments include tax reduction or exemption policy by the central government. For example, foreign investment in establishing livestock farms enjoys exemption of import tariff and value-added tax for importing related facilities and equipment. The same tax exemption policy also applies to foreign investment in feed industry. Local governments offer other preferential treatment for foreign investment, including providing land at favorable terms.

5.8 *Environmental Policy*

Environmental problems related to livestock sector can be divided into two types, traditional ones such as overgrazing in grassland, and new ones caused by “modern” intensive large livestock farms.

The overgrazing problem had been long recognized and gained increased attention from the central government as sandstorms from Inner Mongolia invaded Beijing and other coast areas more frequently in recent years. The root of the problem is the grassland utilization system. In grassland regions, the livestock have been privatized in the process of economic reforms, but the grassland ownership remains state-owned and publicly used. Unlike cropland, the use right of which is granted to individual farmers, the use right of grassland is not divided individually. As a result, exploitation of the land and overgrazing is inevitable. This problem-cause relationship has been recognized and Chinese government has been drafting a law to grant the use right of grassland to individual herdsmen. Problems in these areas will be nationally addressed.

On the other hand, the problems caused by industrialized intensive livestock farms (mainly pig farms) have become apparent only recently, as the intensive production has just developed practically since end of 1980s in China. The impacts of the problems are also more or less localized, and pose no marked risk in the national perspectives. This explains that until now there are only some local regulations but no national policy on environmental protection in association with intensive livestock activities. Examples on local policy practice in this regard will be illustrated in separate sections in the following.

5.9 *International Trade Policy: Tariff, Licenses*

International trade in livestock products is subject to a licensing system. Traditionally, export of livestock products has always been encouraged by government for the purpose of earning foreign hard currencies. Subsidy was also often needed and provided. Since the beginning of 1990s, export subsidy has been canceled.

Imports of breeding animals are exempted from tariffs. Imports of other livestock products are subject to high import tariffs, varying from 12% to 65% under preferential trade terms and 30% to 90% under normal trade terms. In addition to that, value-added taxes are collected, which range from 13-17%, as indicated in Table 3-1. The import tariff will soon be reduced after China’s WTO accession as discussed in previous sections.

Table 5-2 Import Tariff for Livestock in China, %, 1997

	Preferential	Normal	Value-added tax
Breed Animal	0	0	13
Other cattle	12	30	13
Other swine	12	50	13
Other goat and sheep	12	50	13
Other poultry	12	50	13
Beef	50	70	17
Pork	45	70	17
Mutton	45	70	17
Poultry meat	45	70	17
Eggs	55	80	13
Butter and cheese	65	90	17

Source: Beijing Custom, Custom Declaration Manual, 1997.

As practiced in many other countries, there are also non-tariff barriers such as sanitary requirements and quarantine inspection requirement. For example, the Chinese customs, as many other countries, banned beef import from United Kingdom when the mad cattle disease caused great health concerns in 1996.

6. Income and Social Effects (on Women and Children)

Though the weight of livestock in the overall agricultural sector in China on average is still far lower than that in developed countries, but there are big regional variations. As indicated in Table 6-1, the net value generated from livestock raising stands for about 50% of the total net value of agriculture in two pasture regions.

**Table 6-1 Share of livestock production in the net value of agriculture
(%, 1999)**

Region	%	Region	%	Region	%
China	23.5	Sichuan	27.5	Ningxia	21.2
Qinghai	52.7	Yunnan	25.9	Shandong	20.7
Tibet	46.8	Hubei	25.2	Liaoning	19.1
Beijing	35.8	Jiangxi	24.4	Shaanxi	18.9
Hebei	34.1	Guizhou	24.2	Fujian	17.7
Inner Mongolia	33.7	Guangxi	23.7	Jiangsu	16.1
Jilin	33.6	Chongqing	23.5	Guangdong	15.8
Henan	30.0	Gansu	23.1	Heilongjiang	15.2
Shanxi	29.7	Xinjiang	23.1	Hainan	14.3
Hunan	29.6	Anhui	21.3	Zhejiang	11.3
Shanghai	28.4	Tianjin	21.2		

Source: Agricultural Statistical Yearbook of China 2000.

The real income and social effects of livestock sector for small traditional farmers are far beyond that indicated by the figures in Table 6-1. This is especially true for the poor small traditional farmers. The role of livestock production in poverty-reduction is fully recognized in China. Many poverty alleviation programs in China place development of livestock production based on local human, economic and natural resources on the top of support actions. The role of livestock in this area has also been recognized by international organizations. For example, the World Bank recently approved a loan of 93.0 million US\$ to support small scale beef cattle raising in four central China provinces to help local farmers out of poverty. Those are the traditional major crop producing regions, and the development of beef cattle production in those regions will generate more value from the local grain production for the mixed farmers. The project will not only promote the value-adding function of the livestock sector local farmers, but also generate additional employment opportunities, as new feedlots and processing companies will be set up.

Livestock activities in the traditional backyard system are of special significance in offering work opportunities to rural women and children. It is women and to some extent children who undertake almost all of the raising work, including collecting green feed and raw feed, prepare the feed and take care of the animals. As sale from livestock is a significant source of cash income in poor rural regions, this livestock

raising responsibility of women in rural families has also important social implications. It strengthens the role and position of women in the family, both financially and socially.

7. Environmental Impact and Pressures on Natural Resources and Effects on Public Health and Animal Health

To evaluate the environmental effects in a more detailed way, research results in tow localities, Beijing suburbs and Jiangsu province, have been used in this Chapter.

7.1 Increased Problems and Awareness

The rapid development of livestock production, especially the intensification process leading to large-scale intensive operation and high density, has caused increasingly environmental problems. The environmental problems associated with the intensive livestock systems had been recognized not long after intensive operations were introduced in the late 1980s.

The unpleasant smell from large pig farms or poultry farms is the most direct environmental impacts being felt by people leaving close to those farms. It was reported that many of the large-scale pig farms and poultry farms have such kind of air pollution to the neighboring residents. There are often not sufficient distance between the livestock farms and the resident areas, either due to improper choice of the farm location or due to recent expansion of the residential areas.

The problem of air pollution is especially direct for the specialized farmers. Those farmers usually raise pig or chicken in hens besides their house in the small yards. In the winter there is not much problem, but during the summer season, the farmers' family have to bear the bad smell. The disposal of hen-washing water also causes direct pollution of their living surroundings in the village.

The disposal of the animal waste is the most serious problem. Though there is no direct technical data available on the deterioration of soil and water quality caused by livestock production, the problem is apparent. Field visits by the author reveal that most large pig farms simply dispose the animal waste in the open fields.

For example, in a large pig farm with 10 heads of pigs in Tongxian County visited, the waste is washed out of the pens and led to the nearby open area. Solid part of the waste deposited is transported away by trucks for composting, and the surface liquid is then simply led to the canals outside of the pig farm wall. The pollution to the canal water, groundwater and soil is directly observable.

The pressure to the groundwater becomes more obvious if the input of chemical fertilizer is also taken into consideration. As shown in Table 7-1, total fertilizer use in China has increased drastically at an average annual growth rate of over 6% in the past two decades.

Table 7-1 Chemical Fertilizer use in China, million tons

Year	Total	Nitrogenous	Phosphate	Potash	Compound
1980	12.7	9.3	2.7	0.3	0.3
1985	17.8	12.0	3.1	0.8	1.8
1990	25.9	16.4	4.6	1.5	3.4
1995	35.9	20.2	6.3	2.7	6.7
1999	41.2	21.8	7.0	3.7	8.8

Source: Agricultural Yearbook of China, 2000.

The national average chemical use per hectare stands currently by about 320 kg (effective components). However, there are large regional differences. In economically more developed coast provinces, it generally exceeds 500 kg/ha, while in the western inland regions is about 100 kg/ha.

In Beijing municipality, for example, the chemical fertilizer input has increased by almost 15 times since 1980. In the mean time, area of cropland has fallen by nearly 20%. The chemical fertilizer input level per ha of cropland was 552 kg (effective components), almost 20 times that level in 1980. Over 90 % of it are nitrogen. Combined with the very high animal density, this must have imposed extensive burden to the surface and ground water.

Table 7-2 Fertilizer Uses in Beijing Suburbs

	Cropland 1000 ha	Fertilizer Use 1000 tons	Fertilizer Use kg/ha
1980	426	12	28
1985	421	82	195
1990	410	144	351
1995	347	188	542
1999	343	190	552

Sources: Beijing Statistical Yearbook, various years; Economic Development in Beijing, various years.

Impressions from interviews with local officials in Beijing and farmers are:

- 1) Pollution to ground surface, ditches, canal and living environment are the mostly felt problems arisen from livestock production;
- 2) Not much bad impacts on crop production. On the opposite, improvements in the land quality have been observed as the organic content in the soil has increased from less than 1% to close to 2% during the past three decades (Interview in Shunyi County). The highly intensive vegetable production demands a lot of organic fertilizer, especially in protected vegetable production, including greenhouse and plastic sheet covered vegetable field. The vegetable production has expanded very fast during past two decades. Many pig farms have fixed relationship with vegetable growers for animal waste disposal. For example, a large private chicken farm in Songzhuang of Tongxian County has contracts with local vegetable and crop farmers. Farmers come to the chicken farm twice a year to get the chicken waste at 60 Yuan/m³. The improved fertility of land can be proven in that the yields of crops in Beijing area have increased continuously in the past two decades.

**Table 7-3 Grain Yield in Beijing
tons/ha harvested area**

	1980	1985	1990	1995
Wheat	2.17	4.15	5.38	5.83
Corn	4.50	5.20	5.85	6.40
Paddy	5.69	6.10	6.30	7.21
Source: Statistical Yearbook of China.				

- No direct impact on drinking water: Drinking water is usually pumped up from deep wells--as deep as over 100 meter.
- High incentives for control: polluters and suffers and the same group: the leaders and members in the village. The big livestock farms are mostly collectively owned in the village. Community incentives to reduce pollution are strong. Pollution caused by individual small pig farms has consequence both on the living environment of the farmer's own family and that of their neighbors.

Interviews with local leaders, professionals and farmers reveal that there is increased awareness on the problems associated with the development of the intensive livestock sector. Also high officials in the Ministry of Agriculture recognize the serious trend of the problems. The Ministry of Agriculture even helped the Beijing government to establish an institution, the Beijing Environmental Monitoring Institute for Livestock, to monitor the problems recently. The newly established has been engaged in setting up regulations and standards for measuring the degree of pollution caused by livestock sector. However, field investigation has not yet begun, so systematic data on pollution parameters are still not available by now. A study coordinated by FOA on the environmental perspectives of livestock production in Jiangsu Province in China investigated the environmental impacts of pig production. Main findings of the project is summarized as follow:

With today's practice of discharging the liquid manure to watercourses, pig production results in serious surface water pollution. In view of the eutrophication resulting from this pollution and the problems for using the water as drinking water, this practice can not be accepted. Run-off losses from manure stores or fields also contribute towards surface water pollution. Nevertheless, their contribution is quite negligible compared to that of the manure discharge. If liquid manure is discharged to the public sewerage system, this results in a high load for the sewage treatment plant and in surface water pollution by the effluent of the treatment plant. Such practice should therefore not be tolerated. As manure is usually stored in earth lagoons (liquid) and on bare ground (solid), ground water pollution through leaching losses is also significant. This can be a significant threat for the drinking water supply (nitrate, pathogens). If manure is applied in too high doses or at a time with no crop nutrient demand this can also result in high leaching losses. Ammonia volatilisation from livestock production must also be assumed to be considerable (approximately 40% of the N excretion of livestock). The emission density for different parts of the Province should be evaluated with GIS. Together with nitrous oxide (NO_x) emissions from industry and traffic these emissions cause eutrophication and acidification of sensible plant and water ecosystems. Heavy metal pollution of the soil can be assumed to be quite negligible if the manure is applied in recommended doses. Only for piglets the copper and zinc content of the feed should be reduced to prevent such pollution. While soil pollution is a problem of very local importance, ground water pollution can be considered of local to regional importance and surface water pollution and ammonia volatilization of regional to national importance. The order of

importance of these environmental impacts strongly depends on regional conditions. The view of Chinese authorities that surface water pollution is the biggest problem is probably correct at present. Nevertheless the problems of ground water pollution and ammonia volatilization should also be considered quite urgently.

7.2 Factors Influencing the Problem Dimension

Degree of pollution, difficulty in transportation and use, transportation cost, treatment cost, market and price for the products generated by treatment, are all influencing factors for the treatment practice.

1) Different livestock types

Cattle:

Different livestock types pose different degree of environmental problems and of difficulties in solution (Table 7-4). Waste from cattle production, both beef cattle and milk cattle, does not cause much problem. The cattle waste is mostly solid materials and of nature of easy transportation and almost free of bad smell. Local farmers like to buy and use it as organic manure for crop or vegetable production. No further treatment is felt needed according to local officials and farmers interviewed in several places of Suburbs Beijing.

Layers and Broilers:

Likewise, waste of layers is also easy to deal with. Its nature of solid material and high nutrient make it a favorable type of organic fertilizers for the crop growing farmers. Some big commercial layer farms have established affiliated plants to produce organic fertilizer using layer waste as the main component. It is such a successful practice that some layer farms have relied on this to compensate losses in egg production. Treatment of broiler waste is somehow less successful due to the fact that sometimes the wastes are usually more humid than layers and more inputs are needed for treatment.

In some cases of big chicken farms, adopted waste clearing method is washing. This causes big problems. The waste contains very high water content and is very difficult to treat and transport. The liquid waste is usually disposed to the nearby ditches and thus causes serious pollution to the soil, water resource and living environment. In other cases, the improper cleaning method is based on the bad drinking water supplying equipment for the chickens. There is bad water leakage from the bad quality equipment and force the use of washing. Sometimes, bad management also plays a role. But these problems are confined usually only in the very few super-large chicken farms.

General speaking, chicken waste does not pose big threats to the environment. The waste is easy to be cleaned from the pens regularly, and of high market value for crop producers. It can also be used to generate methane gas or added to feed for fish or swine after treatment (fermentation). This seems to be true for both backyard specialized and large scale operations.

Swine:

Swine waste is the most difficult one for treatment, transport and use. In fact, pollution caused by swine production is the most serious environmental problem observed by local people. This is because that the popular way to clear swine waste is washing in all big pig farms and most of the specialized operations. The liquid waste containing 92-94% of water is difficult to transport and to treat. Many ways have been tried to solve the problems, but none

seems to be both effective, efficient and ideal. Unreasonable high investment needed, high energy cost and low economic return is among the major constraints.

Table 7-4 Environmental Problems and Livestock Types

	Cattle	Chicken	Swine
Smell	*	***	**
Waste humidity and water need	**	*	***
Market value of waste	**	***	*
Difficulties for treatment	**	*	***
Difficulties for transport	**	*	***
Note: * = low level, ** = moderate level, *** =high level			

2) *Production Size and Production Types*

For the same livestock type, the environmental pressures are different between different operation types. Imaginably, the problems become more serious along the line from backyard operation, through specialized to big commercialized operations (Table 7-5).

Table 7-5 Environmental Problems and Operation Types

	Cattle	Chicken	Swine
Backyard	*	*	*
Specialized households	**	**	**
Big farm	***	***	***
Note: * = low level, ** =moderate level, *** =high level			

In backyard operations, where one or two cattle, a few swine, or a dozen of birds are raised in the small yard of the farmers, environmental problems are internalized. This means, when there are also some problems, they are confined mostly within the farmer's yard. The waste is usually dry cleaned and used for their own land as organic fertilizer after composting.

“Specialized household” indicates the farmer’s household which depends on livestock production as the main income sources. The size of the operation is usually not very clearly defined, but significantly large than the subsistence backyard operation. Farmer’s household with an inventory of 20 pigs or more can certainly be classified as specialized household for pig raising. There are two types of specialized livestock raisers in Beijing, namely those with cropland and those without crop land. Both types face more serious environmental problems than the backyard operation, simply because of the large number of animals. Specialized households in fact also raise livestock in the “yard”, so the bad smell is stronger to the family, and the waster amount is larger. However, there does exist one aspect that makes specialized operation deferent from large commercial operation: The specialized household usually adopts a semi-dry pen-clearing method. First, the solid waste will be cleared largely by manual work from the pens and sent out for composting, then the pen floor is washed with water. Washing water is drained out to nearby ditches. The amount of washing water and hence liquid waste is much less than that in large scale pig farms, in which the whole waste is washed away without prior separation. However, in one aspect the specialized operation causes worse problem than the large commercial ones: The wastewater is drained out in the

ditches directly in and surrounding the village, resulting direct air, water and scenery damage to the farmers and their neighbors.

Large commercial livestock farms are usually located in some distance to residential areas. Direct pollution to residents is not as obvious as in the cases of the backyard and specialized operations. However, the huge size of the operation means a large amount of waste, especially for pig raising. The pen design to use washing water to clear the pen is laborsaving, but results in large amount of water waste. Watery waste is very difficult to deal with. It can not be used for any purpose before the humidity being reduced to a certain degree. Moreover, the large water demand itself is a problem, for there is serious problem in water shortage in Beijing.

There have been reports on the conflicts between big pig/chicken farms and local residents/farmers for the pollution problems. For example, Yukou Chicken Farm, located in Pinggu County and with a regular inventory of 250 000 layers, has caused very serious environmental problems. Its disposal of wastewater was about 1000 m³ a day, with COD content as high as 22 000 mg/cm³. The discharge of the wastewater has in one year spilled over the waste pond and flooded the nearby cropland and orchard, resulting in withering of crops and fruit trees. Local farmers were very angry and blocked the gates of the chicken farm in protesting (Chinese Association for Poultry, 1992).

3) *Seasonality*

In wintertime, the problems are not felt as serious as in the summer. The low temperature keeps unpleasant smell to a much less degree. The idle and dry land can bear much more waste disposal than in the raining summer. This does not necessarily mean that the pollution problems are less in the winter, but rather that the problems are felt less by the local people in the cold and dry seasons.

To some extent, the lower degree of pollution in winter can also be explained by the fact that the animal inventory is usually lower in winter due to the mass slaughtering to meet the consumption peak during the New Years holidays in January and early February.

7.3 *Various Efforts Made to Address the Problems*

Various efforts have been made by local farmers and governments, each with some degree of success, but none of them seems to be completely satisfactory.

1) *Location and Relocation:*

In some places, location of livestock farms had been carefully chosen in a way to better discharge the waste. Those pig or chicken farms are located far away from the residential areas and close to fruit orchard, so to reduce the direct pollution to the living environment of the local people and to reduce the transportation problem of waste to the orchard for fertilizing. The direct fertilizing of the watery waste to orchards is practicable in winter, but not in summer as the capacity of the orchard fields to absorb liquid waster is rather limited. This practice of direct disposal of waste will also lead to second pollution if rains wash away the waste to the drainage ditches and crop fields. Some of livestock farms previously set up close to villages have been relocated. Some of those livestock farms have to been moved away after the expansion of the village in the development process.

2) *Liquid Fertilizing of Liquid Waste to Wheat Field:*

Again, this practice is only feasible in winter time. It is also a labor-intensive practice and labors are increasing expensive in the suburb areas.

3) *Sump Deposition:*

The most common practice of waste treatment is to use a sump for depositing the watery waste. The surface water is pumped for irrigation or simply drained out into the nearby ditches. The sediment is usually taken out for composting. This is a very primitive approach of treatment and in the nature not a solution at all. The sumps for deposition are usually small with a very limited capacity. As a result, it often happened that the waste spilled over the sump and overflowed to nearby fields or ditches. Though various kinds of efforts have been tried, but this kind of practice still remains as the prevailing one in Beijing. The problems remain largely unsolved.

4) *Composting:*

This is also a traditional method for waste treating. Solid swine waste and cattle waste is usually used for this purpose. Swine waste from backyard and specialized household operations are dry cleaned and are suitable for composting. However, the washing cleaning method used in large livestock farms produces large volume of liquid waste and prevents from using it for composting before water-separating. Also composting is a labor-intensive work and involves high labor costs.

5) *Heat-drying of Chicken Waste:*

Fresh chicken wastes after heat-drying are good materials for producing compound fertilizer and feed (for pig, cattle and fish). The heat-drying process does not only reduce the water content from 70-75% to 13-30%, but also is a sterilization process. Bad smell is also cleared. The Yukou Chicken Farm mentioned above has been often quoted as a successful example. Using a heat-drying equipment developed by Chinese Research Institute of Agricultural Engineering, the farm has used fresh chicken waste to produce organic compound fertilizer and feed for cattle and fish. The such produced fertilizer has a market value comparable or even higher than the best chemical fertilizer, welcomed by local vegetable farmers. According to tests in the farm, nutrient content of the heat-dried waste is as in Table 7-6.

Table 7-6 Nutrient Content of Dried Chicken Waste, %

Raw Protein	Raw Fat	Ammoniac Acid	N	P2O5	K2O	Ca
35.8	2.3	13.2	5.7	3.5	2.0	6.2
Source: Chinese Association for Poultry, Proceedings of the National Conveyance on Waste Treatment of Intensive Poultry Farms, 1992.						

Tests have also conducted to add 15-20% treated chicken waste to pig feed and fish feed, and to add up to 50% concentrate feed to cattle feed. Good results have been observed as the growth rate of those tested animals is comparable or higher than those in comparison groups.

The biggest constraint for the success of this treatment is the condition of fresh waste, which is determined by the quality of drink water system for the chickens. In many chicken farms, the equipment is in poor quality condition and has bad leakage problems. The leaking water

makes the waste-cleaning difficult, and often forces the workers to use water to wash the waste. The resulting watery waste is difficult to treat as in the case of washed pig waste.

6) Using Special Equipment for Separating Water and Waste:

How to separate the water from the watery waste remain as a crucial key point for pig and in some cases also for chicken waste treatment. In a large private own livestock farm in Tongxian County, an imported equipment has been installed for separating water from pig waste. The investment is jointly made by the owner, the local government and a research institute, each paying one third of the cost. The main reason for the public subsidy to the investment is that it is taken as an experiment. The equipment has not been put into practical use, because the pig farm operation of the farm is still in the construction phase as this investigation was conducted. But the major concerns for the extension of the technology are both the initial investment and the running (operating) cost. Energy cost in China is very high. This will also be true for other similar treatment approaches.

7) Using Animal Waste to Generate Methane:

Using animal waste through fermentation to generate methane is another traditional way promoted by local leaders to treat the waste toward multiple beneficial effects. These include the reduction of pollution, generated methane as energy for cooking and heating, the residue liquid and sediment can be used for fish feed or as fertilizer.

Different facilities have been used in generation methane for big livestock farms and household backyard operations. Facilities for big pig farms are somehow complicated and need large investment. For backyard operations, the facilities are very simple.

Box 7-1 Example of animal waste treatment and methane utilization

Place: Liu Ming Ying village in Daxing County.
Population: 970 in 235 farmer families.
Number of large pig farms: 5
Total animal inventory: 10 000 heads of swine, 50 cow cattle, 100 000 layers, 10 000 duck.
Arable land: 1900 mu(127 ha)
Crop production: wheat, corn and paddy rice(1650 mu), vegetable 250 mu, fruit yard 130 mu, fish pond 32 mu.

Methane generating sets: 178 small units in and for family uses, 1 with a capacity of 200 m³ in the big pig farm(operation under normal temperature), 1 with a capacity of 100 m³ in chicken farm(at 55°C).
Total production: 68 000 m³ annually, sufficient for cooking.

Eco-system: Crop production --> Feed input to animal production --> (water + animal waste) --> methane generating -->(solid and liquid residuals as fertilizer for crop production and as fish feed)

At the same time, positive results in other fields besides pollution reduction:
- increased soil fertility: organic matter content increased from under 1% to 1.8% during 1982 -1995.
- reduced chemical fertilizer input: from 150 kg/mu to 40 kg/mu.

Though there are reports on the success of both large-scale operation and household operations, this practice is not very widely adopted. The costs for initial investment, maintenance and operation, the performance failure under low temperature in the long cold seasons in North China, and the inconvenience and instability of methane supply, as energy might be the major reasons. The benefits are multiple, but none of them seems to be significant in market value.

8) *4 in 1 Combined Experiment:*

This is a very new practice, in which the household pig-raising and methane-generating system has been extended to include the vegetable production in greenhouse in it. The standard model is as follows: One pig pen with a raising capacity of 8-10 pigs is built in each vegetable greenhouse with a coverage of one mu (1/15 ha). The pig pen is equipped with a small methane-generating installation. Pig waste is directly let to the cement-built container under the pen for fermentation and methane-generating. The methane can be used for lighting or heating in the greenhouse. Residues can be used as fertilizer for vegetable production. According to the design, the system should have the effects of livestock production, pollution reduction, energy-generating and fertilizer supply for vegetable production, the so-called “4 in 1”: namely four functions combined in one system.

To promote this experiment into practice, local governments including the municipal government and the county governments pay subsidies to farmers adopting this practice. For building each such pig pen within a greenhouse, 1000 Yuan will be paid by the municipal government and 500 Yuan by the related county government. The subsidy should be sufficient to cover half of the building cost of the pig pen and the methane-generating installation.

The experiment is only at the beginning stage. The author was shown one such “4 in 1” greenhouse. However, though the installation looked being built some months ago, but still without pigs in it. The feasibility of the method still remains to be tested by mass practice.

9) *EM Technology:*

EM (effective micro-organisms) technology, developed in Japan, was introduced into China in the early 1990s. EM is a group of over 80 kinds of microorganisms, used as additives (zymogen for fermentation) for feed or fertilizer. Experiment reports indicate that EM fertilizer and EM feed can increase the productivity of crop and livestock production respectively. Experiments have also shown that the feeding of EM feed and EM drinking water can substantially reduce the ammonia content in the air of chicken farms by 70% (from 85-90 ppm to around 25 ppm). Bad smell in pig pens also significantly reduced one week after feeding pigs with EM feed (Li Weijiong et al. 1996). Major problem for the extension of this technology is the constraint in the availability of the original EM fluid, which is controlled by the Japanese developer. Besides, the effectiveness of the EM feed depends largely on the temperature, a precondition for the activity of the EM group.

To sum up, various efforts have been made by local governments and livestock farms to address the environmental problems associated with livestock production in the suburbs of Beijing. However, due to various constraints, including constraints in natural conditions, in technological feasibility, in economic feasibility and social feasibility, none of the existing technologies seems to have provided easy, satisfactory and sustainable solutions to the problems. The problems still remain as great challenges ahead.

8. Assessment of the Current Policy and Reform Considerations

For several reasons, high emphasis is placed on the importance of developing livestock sector in China. First, it is well recognized that the future demand for livestock produce will be strong, given expected population growth, accelerated urbanization and rising consumer income. This demand for meat, milk and eggs will translate into huge demand for feed grain. Given China's exhausted potentials of new reclaimable land resources and pressing shortage in water supply, it will present a great challenge for China to meet this challenge successfully.

Second, the income function of livestock is fully recognized. Very high expectations have been placed on livestock sector to improve farmer's income for the whole country in general and for the poverty stricken areas in particular. Expansion of livestock production is seen as one of the most important components in China's agricultural and rural restructuring strategy.

Third, the upcoming WTO entry also presents both opportunities and pressure for China to enhance the livestock sector. Livestock sector will be one of the most affected sectors in the nation's economy, where Chinese producers have to increase their economic performance, price and quality competitiveness at both domestic market and international market.

Fourth, the intensification process and structural change of the livestock sector will continue and bring about both positive and negative externalities (spill-over effect) on local economy, the upstream and downstream sectors, and in particular on environment.

And finally, the safety issues in livestock, i.e., the issues of animal and human health, have become an increased concern. The recent incident in both foreign countries and at home set alarm to policy makers as well as the general public.

It is beyond any doubts that China has made great efforts in liberalizing the livestock sector from a highly central-controlled system, from production through consumption, into a market-oriented system in the past two decades. However, this was largely done by mid-1980s. Since then, the above-mentioned recognition of the high importance of livestock in China is not sufficiently reflected in the practical policy actions and measures, including policies designing and policy implementation, in particular those ones demanding governmental funding. There are several constraints that lead to the weakness of the current policy.

- 1) The administration system at both national and local levels is not rational. As a heritage of the old system, the policy making structure is fragmented. Not the Ministry of Agriculture alone, but several ministries are involved in the policymaking and implementation, each responsible for just one section of the chain activities of the livestock sector. The Ministry of Agriculture is responsible for issues directly related to livestock production and feed production. The Bureau of Commerce is in charge of marketing. The Ministry of Foreign Trade and Economic Cooperation is responsible for trade policy. The quarantine inspection is divided into two separate parts: the import quarantine inspection under the supervision of State Custom Administration and the domestic quarantine by the Ministry of Agriculture. Frequently, the State Commission of Planning also interferes into the policy making process both in regards to foreign trade policy and domestic policy. With so many governmental ministries involved and each representing some interests of their own, the lack of good coordination is the unavoidable result.

- 2) Lack of coherence of the policy. This is partially to the above-mentioned fragmentation of policy making bodies. For example, on the one hand, subsidies in various forms have been paid to encourage livestock production, but on the other hand, slaughtering tax and value-added tax are collected from livestock farmers when they sell their animals. This counter-balancing measures have not only lead to low efficiency in using government (public) money, but also lead to corruption, as well as conflicts and increased risk of evasion of quarantine inspections. Another example is that the quarantine inspection process in large state-owned slaughterhouse in most provinces is conducted by the company employees, but not governmental staff or independent organization. This again makes the misbehavior in favor of the economic interest of the slaughtering company much easily, especially when the legal system is weak in a developing country like China. A further example is the set-up of the “designated slaughtering sites”. Because most of those sites are built on the bases of the former slaughterhouses of state meat marketing companies, they sometimes use this advantage trying to manipulate the market. The problem is, the marketing administration authorities (the state food bureau system) represent the interest of the state marketing companies, the malpractice in some localities are often protected by the local authorities for market administration.
- 3) Constraints in policy designing and implementation. Some policies are well intended, but did not achieve good result due to problems in policy designing or implementation. For example, the subsidy granted to the “dragon head company” is with a very good purpose, i.e., to help the farmers to have a better connection to market. However, the author doubts the true effectiveness of the policy. One fear of the author is that without proper regulation and care, such enhanced company can become a dominant and even monopolizing power in the local market. This market domination will most likely ends up with interest lost of the farmers, especially with livestock products and in places where the transportation facility and cost builds a bottleneck. Also the implementation of quarantine inspection and disease control is a big issue because of the lack of qualified staffing. Free marketing is the major achievement of the reform, and is protected by the law. However, this policy has not always well implemented in practice in places where the local governments imposed restrictions on over-regional trading.
- 4) Insufficient budgetary commitments. A lot of promoting policies have been formulated, but not really implemented. People in China often call this kind of policy as “slogan policy” or “document policy”, because their effects are no more beyond the speeches of some policy makers or the document papers of the government agencies. This is true for both the central government and local governments. Major reason is the lack of budget. It often happened that the central government makes a policy, but does not provide the fund accordingly. Instead, the central government asked local government to fund the policy. People say jokingly that the central government plays the host, but the local governments pay the bill.
- 5) Difficulties in changing government functions to suit development of the market economy system. The government functions under a planned economic system are totally different from that for a market economy. In the transition period from a highly centralized system to a system with market mechanism as the main force, there are often frictions and incapability. On one hand, the government continues to intervene things that should be leave to the market forces. On the other hand, the government has not timely and sufficiently played its due role for functions which can not depend on the market mechanism to automatically fulfil. For example, there lacks sound rules and regulations to address the environmental problems caused by intensive livestock operations or by overgrazing. Another area needing more policy action is the market transparency. There is work to be done in the areas of produce standard and classification as well as the marketing information system based thereupon.

Great efforts need to correct those policy constraints mentioned above. It is not an easy task and need continued long-term endeavor. Policy reforms should be considered stepwise in the following specific areas:

- To abolish the slaughtering tax and value-added tax for livestock.
- To reduce the subsidy to profit-seeking intermediates, both state-owned and private owned.
- To increase governmental investment and subsidy to the public slaughterhouses, to reduce marketing cost for farmers.
- To set up an independent and free quarantine inspection service, to invest more in building qualified inspection capacity across the country.
- To invest more public funding for research.
- To provide better marketing service, including improved public facilities, standard, classification and information system.
- To enhance market competition in the upstream and downstream sectors by restrict market monopoly and promote farmers' co-operatives activities in those sectors.
- To formulate and implement sound environmental regulations to better address the negative externalities of the sector.

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