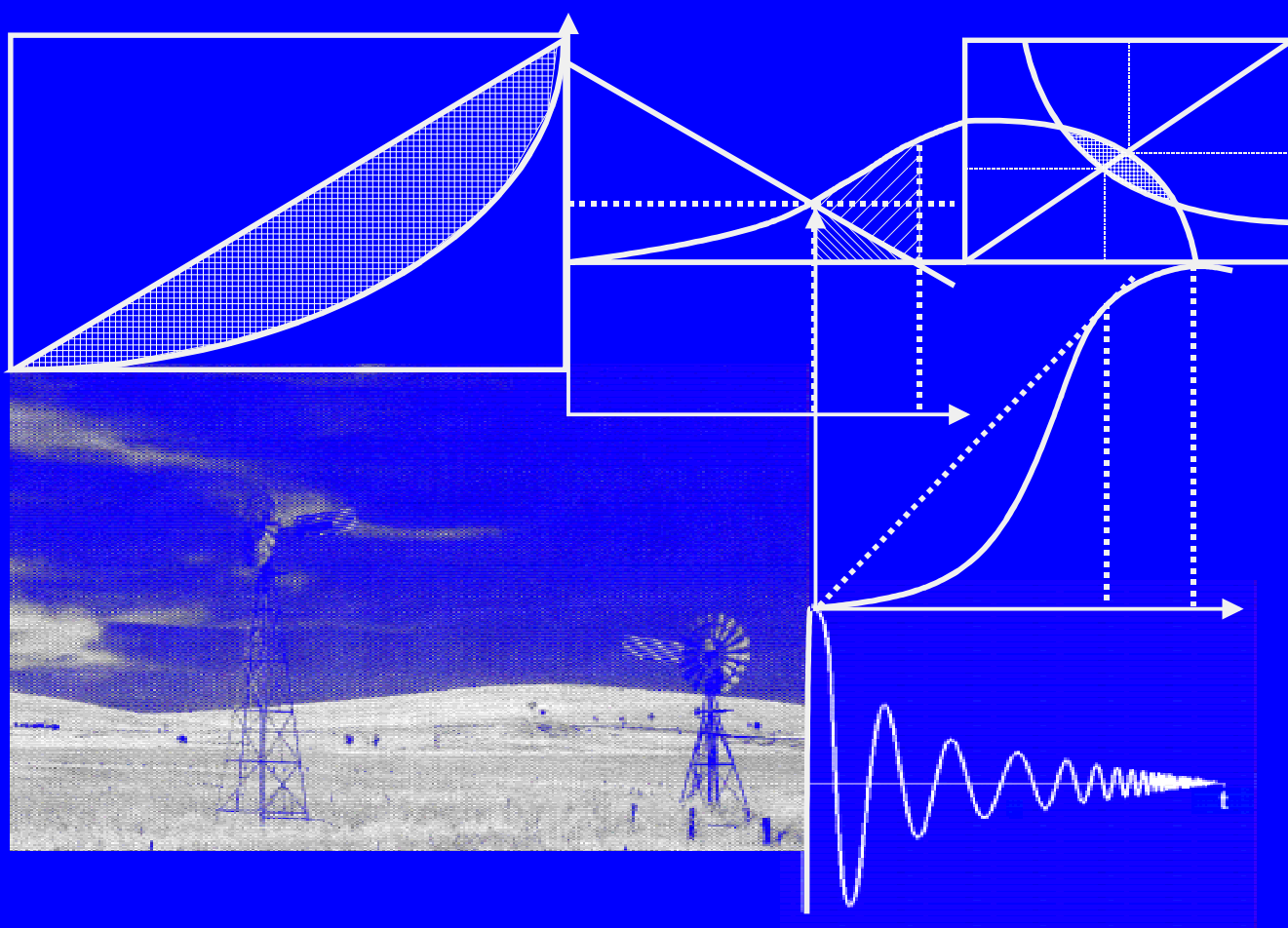


# Agricultural and Natural Resource Economics Discussion Paper Series



School of Natural and Rural Systems Management  
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**Spatial Integration, Regional Specialisation and  
Transport Linkages in the  
Chinese Cattle and Beef Industry**

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# **Spatial Integration, Regional Specialisation and Transport Linkages in the Chinese Cattle and Beef Industry<sup>1</sup>**

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## **Abstract**

Demand for feeder cattle, slaughter cattle and beef is growing rapidly in China. In response to this increased demand, many regions of China have attempted to develop fully or partially integrated beef production systems. This paper will focus on initial findings on some of these systems, and assess levels of regional self-sufficiency in beef and cattle production. The extent and efficiency of cattle and beef transportation infrastructure will also be examined, and comments will be made on any regional production specialisation that has been occurring. The aim of the paper is describe ongoing research into likely future developments of spatially integrated cattle and beef production and marketing systems in China.

**Key words:** China, cattle, beef, transport, infrastructure, spatial integration.

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## **Introduction**

Since the agricultural reforms of the late 1970's, and in particular since the early 1990's, the Chinese beef industry has developed rapidly. The number of beef cattle (defined as Chinese Yellow Cattle and their crosses) has doubled since 1980 to be around 106 million in 1996. The output of beef has increased at a much faster rate than cattle inventory. At the end of the 1980's, Chinese beef production was ranked 12th in the world. By 1996, the industry output made China the second largest beef production nation in the world. In response to increased demands for beef and higher levels of farm mechanisation, turn-off rates for cattle have increased. In the late 1970's the average yearly turn-off was less than 5 percent. By 1995 this had increased to around 23 percent, with some areas (such as the North-Eastern Provinces) recording rates as high as 35 percent.

The introduction of foreign genetics, improvements in feedstuffs and a change in focus of the industry toward confined feeding has meant that the average carcass weights of Chinese cattle have increased substantially over the past 20 years. The average carcass weight in 1980 was 77 kilograms, by 1995 this figure had increased to be around 140 kilograms.

An interesting feature of the beef industry's development has been that various production and consumption facets of the industry have developed in geographically separate areas. In other words, the raising of cattle, the production of beef and the consumption of beef occur in different parts of China.

This paper concentrates on the spatial nature of the development of the industry. It concentrates on three issues relating to this topic. These are the extent to which regional production specialisation has been occurring, transportation linkages for beef and cattle flows, and spatial integration of cattle and beef production and consumption across different regions of China.

### **1. Beef Production Patterns**

Prior to the 1980's, the pastoral region of China (Inner Mongolia, Xinjiang, Gansu, Ningxia, Qinghai and Tibet) dominated cattle raising and beef production. This beef production was aimed almost entirely at consumption within the region by minority groups, including the Muslim Hui people. A small portion of the beef output was procured by the State for sale to minority groups in the Eastern cities. Since that period the principal development of the cattle industry has taken place in the agricultural region of North and North-East China. This strategy has been adopted by the government to take advantage of the feed resources available in the agricultural

region, and its proximity to major beef consuming regions. For example the turnoff of cattle from Henan province alone in 1994 exceeded that of the five major pastoral provinces (Inner Mongolia, Xinjiang, Qinghai, Tibet and Gansu) combined. Table 1 shows the size of the provincial beef herds at the end of 1995.

Table 1: Chinese Provincial Beef Herds (December 1995)

Province	Number of Cattle ('000 head)	Proportion of National Herd (%)
Beijing	141	0.10
Tianjin	222	0.16
Hebei	5793	4.38
Shanxi	2517	1.91
Inner Mongolia	3893	2.95
Liaoning	3016	2.28
Jilin	3843	2.91
Heilongjiang	5115	3.87
Shanghai	69	0.05
Jiangsu	991	0.75
Zhejiang	503	0.38
Anhui	7013	5.31
Jiangxi	3844	2.91
Shandong	12393	9.38
Fujian	1276	0.97
Henan	12536	9.49
Hubei	4095	3.10
Hunan	4305	3.26
Guangdong	4715	3.57
Guangxi	7971	6.04
Hainan	1465	1.11
Sichuan	11159	8.45
Guizhou	6493	4.92
Yunnan	7861	5.95
Tibet	5385	4.08
Shaanxi	2781	2.11
Gansu	3703	2.80
Qinghai	5009	3.79
Ningxia	519	0.39
Xinjiang	3435	2.60
TOTAL	132061	100

Although beef processing does not necessarily take place in the same area as cattle raising, the traditional dominance of the pastoral region in Chinese beef production has also been eroded since the 1970's. As demand for fresh beef has increased in the major population centres along the Chinese coast and in the densely populated agricultural region, processing industries have developed in these areas.

Beef production in China occurs in a number of regions. These include;

Northern China - Hebei, Henan, Shandong, Beijing, Tianjin and Northern Anhui. In this area, average beef production per person in the agricultural labor force is 32 Kg per year. Northern China accounts for 50.2% of national beef production.

Northeast China - Heilongjiang, Jilin and Liaoning. Beef production averages 56 kg per agricultural labour *\*\*unit\*\** yearly. Northeast China produces 18.4% of total Chinese beef.

Eastern Inner Mongolia produces 31 Kg beef/agri. labor, which is 2.4% of the national total.

Far West - Xinjiang and Qinghai. This area produces 50 Kg beef/agri. labor, which accounts for 4.3% of national production.

Tibet, where the production level of 72 Kg beef/agri. labor is far above the national average, produces just 1.3% of the national total.

The production level of the Mid Western provinces including Shanxi, Shaanxi, Gansu, Ningxia and Western Inner Mongolia are close to the national average, producing 5.6% of national total. The Southern Chinese provinces just produce 5 Kg beef per agricultural labor, 17.8% of total. Table 2 summarises the regional structure of beef production in China. Regional beef production levels in China are also shown in Map 1.

Table 2: Regional Beef output in China (1996)

Year or region	Beef output 10000 MT	Beef output Kg/ Ag. Labor	Region	Beef output 10000 MT	Beef output Kg/Ag.Labor
1980	26.9	0.90	Jiangxi	5.1	4.62
1985	46.7	1.54	Shandong	80.2	32.40
1990	125.6	3.77	Henan	73.0	25.93
1995	415.4	12.85	Hubei	11.0	8.48
1996	494.9	15.34	Hunan	8.5	4.07
Beijing	1.9	28.4	Guangdong	6.1	4.24
Tianjin	3.0	37.41	Guangxi	9.8	6.20
Hebei	60.8	37.49	Hainan	2.3	13.86
Shanxi	9.2	14.48	Sichuan	20.7	5.30
InnerMong.	11.9	23.15	Guizhou	6.1	4.43
Liaoning	34.3	56.68	Yunnan	7.7	4.69
Jilin	25.7	48.11	Tibet	6.4	72.23
Heilongjiang	31.0	62.27	Shaanxi	7.5	7.17
Jiangsu	7.5	4.9	Gansu	8.7	12.95
Zhejiang	0.9	0.8	Qinghai	6.3	45.95
Anhui	29.6	15.15	Ningxia	2.4	17.25
Fujian	2.3	2.96	Xinjiang	15.2	52.69

Source: China Statistical Yearbook 1997

Inferences about cattle and beef distribution can be made by comparing the regional distribution of beef cattle with the regional patterns of beef production. This is presented in Table 3.

Table 3: Provincial Cattle Herds and Beef Production Levels

Region	Cattle herd as a proportion of national herd (%)	Beef Production as a proportion of national production (%)
<b>Beijing</b>	0.10	0.38
<b>Tianjin</b>	0.16	0.61
<b>Hebei</b>	4.38	12.29
Shanxi	1.91	1.86
Inner Mongolia	2.95	2.40
<b>Liaoning</b>	2.28	6.93
<b>Jilin</b>	2.91	5.19
<b>Heilongjiang</b>	3.87	6.26
Shanghai	0.05	0
<b>Jiangsu</b>	0.75	1.52
Zhejiang	0.38	0.18
<b>Anhui</b>	5.31	5.98
Jiangxi	2.91	1.03
<b>Shandong</b>	9.38	16.2
Fujian	0.97	0.46
<b>Henan</b>	9.49	14.75
Hubei	3.10	2.22
Hunan	3.26	1.72
Guangdong	3.57	1.23
Guangxi	6.04	1.98
Hainan	1.11	0.47
Sichuan	8.45	4.18
Guizhou	4.92	1.23
Yunnan	5.95	1.56
Tibet	4.08	1.29
Shaanxi	2.11	1.52
Gansu	2.80	1.76
Qinghai	3.79	1.28
<b>Ningxia</b>	0.39	0.49
<b>Xinjiang</b>	2.60	3.07
TOTAL	100	100

Provinces highlighted in bold in Table 3 are those where the share of beef production outweighs the share of beef cattle in the national herd. These provinces are Beijing, Tianjin, Liaoning, Jilin, Heilongjiang, Anhui, Shandong, Henan, Ningxia and Xinjiang.

There are a number of reasons why these provinces may have a higher proportion of national beef production than cattle numbers. First, the proportion of cattle slaughtered may be higher than average in these provinces. Second, the proportion of

cattle that are ready for slaughter may be proportionately higher. Third, the meat yield per slaughter animal may be higher. Finally, the provinces may import cattle from other provinces for slaughter.

For provinces such as Shandong, Henan, Hebei and the North-Eastern provinces, the share of national beef production is substantially in excess of the share of national cattle numbers. It is therefore most likely that high levels of beef production are achieved by importing slaughter cattle from other provinces. Probable reasons for this movement of cattle are that these provinces have higher levels of slaughtering capacity and easier access to markets for beef. Chinese consumer preferences are toward consumption of fresh or chilled beef rather than frozen beef. Therefore the distribution pattern seems to be that slaughterhouses are located close to major markets to ensure supplies of fresh beef. Cattle are transported over relatively longer distances to these slaughtering facilities.

## **2. Beef Consumption Patterns**

According to data from the National Statistical Bureau of China, beef consumption is concentrated in urban areas in China. At province level (not including food eaten out of the home), important areas of beef consumption are Beijing, Tianjin and Tibet, where the annual beef consumption level for urban citizens is 75% more than the national average of 1.89kg per year. In Hebei, Jilin, Inner Mongolia and Xinjiang, urban beef consumption is around 50% higher than the national average whilst in Heilongjiang, Liaoning, Anhui, Guangxi and Ningxia the level is around 25% higher than the national average. Urban beef consumption levels for the other provinces are below the national average.

The National Statistical Bureau does not collect detailed information from urban consumers on the amount of beef they consume outside the home. The only information on outside consumption is the total amount spent on eating out per year. The provinces with the highest levels of eat-out spending for 1996 are Guangdong, Shanghai, Beijing, Zhejiang, Hubei, Hunan, Tianjin, Hainan, Guangxi and Yunnan. Most of the provinces in the list have a high average income level, which would be expected to lead to high levels of food consumption outside the home. However, it is interesting to note that the list also contains Hainan, Guangxi and Yunnan, which are amongst the poorest provinces in China. This may indicate that cultural factors, in addition to disposable income levels, have an effect on the level of eat-out food consumption. Using this information we can make inferences about possible centres of demand for eat-out beef consumption. These are generally centred on large Chinese metropolis areas.

These include;

Shanghai-Nanjing-Hangzhou,  
 Beijing-Tianjin-Shijiazhuang-Tangshan,  
 Guangzhou-Shenzhen-Hongkong,  
 Shenyang-Dalian,  
 Harbin-Changchun,  
 Wuhan-Changsha,  
 Chongqing-Chengdo,  
 Xian-Zhengzhou,  
 Jinan-Qingdao,  
 Lanzhou-Baotou.

Other Chinese cities with populations greater than one million are Urumuqi, Taiyuan, Kunming, Guiyang and Fuzhou. Table 4 shows the level of eat-in beef consumption and the expenditure on food outside the home by urban residents in 1996.

Table 4: Urban Beef consumption in China (1996)

Region	Beef consumption Yuan/Urban Cit.	Beef Price Yuan/Kg	Beef consumption Kg/Urban Citizen	Region	Eat-out Spending Yuan/UrbanCit.
China	28.27	15.45	1.83	China	186.21
Beijing	57.10	17.30	3.30	Beijing	359.08
Tianjin	48.14	13.58	3.54	Tianjin	276.14
Hebei	37.62	12.87	2.92	Shanghai	431.39
InnerMong.	43.21	13.89	3.11	Zhejiang	309.03
Liaoning	37.87	14.17	2.67	Hubei	295.75
Jilin	43.13	13.63	3.16	Hunan	289.47
Heilongjian g	33.71	13.59	2.48	Guangdong	508.46
Anhui	32.99	13.77	2.40	Guangxi	268.05
Guangxi	37.12	15.75	2.36	Hainan	269.26
Tibet	220.81	*15.75	14.02	Sichuan	219.32
Ningxia	35.32	15.90	2.22	Yunnan	259.22
Xinjiang	46.49	16.50	2.82	Shaanxi	183.76

Source: Social and Economic Survey Team for Chinese Cities

Source for Beef Price: Department of Livestock Production and Health, Chinese Ministry of Agriculture

\* Data not available, substituted by the data for nearby province Qinghai.

Map 2 shows the distribution of beef consumption levels in China. Per person consumption of beef in rural areas of China is not as high as that of urban dwellers. However, as the Chinese population is predominately rural, the absolute amount of beef consumed by rural households far exceeds that consumed by urban households. Table 5 outlines the annual levels of per person beef consumption in rural areas in

China. Provinces marked in bold are those where per person rural beef consumption is above the national average.

Table 5: Rural per person beef consumption levels (1996)

Province	Per Person Beef Consumption (Rural Areas)
<b>Beijing</b>	0.97
<b>Tianjin</b>	0.85
<b>Hebei</b>	0.47
Shanxi	0.10
Inner Mongolia	0.09
<b>Liaoning</b>	0.37
<b>Jilin</b>	0.73
Heilongjiang	0.26
<b>Shanghai</b>	0.44
<b>Jiangsu</b>	0.42
<b>Zhejiang</b>	0.52
Anhui	0.30
Fujian	0.18
Jiangxi	0.29
<b>Shandong</b>	0.36
Henan	0.22
Hubei	0.17
Hunan	0.18
<b>Guangdong</b>	0.48
Guangxi	0.19
<b>Hainan</b>	0.87
Sichuan	0.07
Guizhou	0.08
Yunnan	0.28
<b>Tibet</b>	1.73
Shaanxi	0.06
Gansu	0.09
<b>Qinghai</b>	1.11
Ningxia	0.82
<b>Xinjiang</b>	1.71
China Average	0.35

By comparing the distribution of beef producers and consumers, we can propose possible routes for beef transportation in China. Level 1 routes are from Northeast, Eastern Inner Mongolia, Shanxi and Center Plain Region to Beijing-Tianjin-Shijiazhuang-Tangshan Region; from Henan, Shandong, Northern Anhui, Sichuan, Yunnan and Guizhou to Shanghai-Nanjing-Hangzhou Region; from Henan, Anhui, Hunan and Guangxi to Guangzhou-Shenzhen-Hongkong Region.

Level 2 routes are from Henan, Anhui, Hunan and Hubei to Wuhan; from southern Gansu, northern Shaanxi, Shanxi and Henan to Xian; from Qinghai, Xinjiang and Gansu to Lanzhou; from Eastern Inner Mongolia to Baotou. Level 3 routes are local transportation actions to support central cities inside one province and consumption region.

Level 1 transportation routes are described in Map 3. Level 2 and 3 transportation routes are shown in Map 4.

### **3. Transport Linkages**

Until recently, transport and distribution of foodstuffs and other products was strictly controlled, and in many cases was monopolised by government agencies. Deregulation of the sector has increased competition by opening the industry up to private operators and international joint venture companies. This has had the effect of increasing the amount of road transportation vehicles, decreasing the cost of rail and road transportation, increasing inter-regional trade and opening up many new distribution channels.

Fresh, chilled and frozen beef is usually transported by truck or rail in China. Occasionally, beef will be transported by air, but the high cost means that this is usually restricted to transport of very high quality meat. Beef can also be transported by inland waterway. Imported chilled or frozen beef can be transported to China by sea or, more commonly, by air. Exports of beef are made by air, ship or rail.

Live cattle are commonly transported by road or rail. Trucks are commonly used for short distance/low volume transport, whilst trains are used for longer distance/high volume transport. Live cattle are occasionally transported by inland waterway. Imports of live cattle are made by ship or air. Usually, air transport is reserved for high value breeding animals, where the marginal cost of air transport is low. For imports of slaughter or feeder cattle, ship is the most economical alternative. Exports of live cattle from China are usually made by train (Hong Kong, Russia) or ship (DPR Korea).

#### **3.1 Railroads**

China has a well developed railroad system linking the main beef production areas and demand areas. These regions and routes are outlined in Table 6.

Table 6: Railway Transport Infrastructure

Demand/Supply Region	Railway Routes
Beijing-Tianjin-Shijiazhuang-Tangshan	Harbin-Changchun-Shenyang; Tongliao-Chifeng; Erenhot-Datong-Zhangjiakou; Yuncheng-Taiyuan-Yuanping; Taiyuan-Shijiazhuang; Xinyang-Zhengzhou; Fuyang-Shangqiu; Xuzhou-Jinan
Shanghai-Nanjing-Hangzhou	Luohe-Fuyang-Hefei-Nanjing; Zhengzhou or Jinan-Xuzhou-Nanjing; Chongqing or Kunming-Guiyang-Changsha.
Guangzhou-Shenzhen-HongKong	Zhengzhou-Wuhan-Changsha; Shangqiu-Fuyang-Nanchang; Liuzhou or Nanning-Litang-Maoming.
Wuhan	Rail routes from Fuyang, Luohe, Xiangfan, and Changsha
Xian	Rail routes from Lanzhou, Yanan, Taiyuan and Zhengzhou.
Lanzhou	Rail Routes from Xining and Urumuqi.
Other	Tongliao - Batou (Grassland Railway)
Northeast China	Harbin - Changchun - Shenyang - Dalian - Beijing - Tianjin.

Double tracked, electrified and equipped with refrigerators, railways can support beef and cattle transportation in China. Some factors that has hampered the extensive use of railroads for transport of chilled/frozen beef are the relatively high cost of railway transport and the waiting periods for suitable cars. Important railroad back hauling gaps for beef transportation in China are from Qiqihar to Harbin and from Dezhou to Tianjing.

### 3.2 Highways

A national highway (single or dual carriageway) network covers all of China. many government and private transport operators use refrigerated and non-refrigerated trucks for beef and cattle transport. These range from three wheeler open tray trucks (capacity less than 500kg) to 2 ton Jiefang transport trucks. The usage various types of truck transport is dependent on the cost, distance of transport and the perishability of the goods.

The creation of a national express highway network is very important for the truck transportation of beef. Regional express highways have been developed separately to link local capitals and their nearby large cities. Liaoning, Beijing-Tianjin-Hebei-Shanxi, Shandong, Shanghai-Nanjing-Hangzhou Region, and Guangdong are all have extensive local express highway systems.

Currently, China has two large express highway clusters, the northern one covers Beijing, Tianjing, Hebei, Shanxi and Henan and the southern one covers Shanghai, Zhejiang, Jiangsu and Anhui. Inter regional express highways systems are also being built. The Central Government has planned an express highway network that will link all of China except Tibet, Qinghai, Inner Mongolia and Yunnan by the year 2000. By the year 2000, inter-regional express highways that can be used for beef transportation will be: Beijing-Shenyang-Harbin, Beijing-Jinan-Shanghai, Beijing-Wuhan-Hongkong, Shanghai-Wuhan-Chengdo and Lianyungang-Xian-Urumuqi. Regional express highways for beef transportation will be Manzhouli-Suifenhe, Shenyang-Dalian, Beijing-Zhangjiakou, Taiyuan-Shijiazhuang, Datong-Yuncheng and Jinan-Qingdao. The Chengdo-Chongqing-Wuhan-Nanjing-Shanghai express highway will be very important for beef transportation and production in China. It make it possible for beef or cattle from Sichuan and Chongqing to be transported directly to Wuhan, Nanjing and Shanghai by road. This may lead to greater stimulation of beef production in the Sichuan basin which has many natural resources suited to beef production.

### **3.3 Inland Waterways**

Inland waterways that can be used for beef transportation in China are: Nanjing - Shanghai and Wuzhou-Guangzhou(more than 10000 MT capacity); Nanjing-Wuhan-Chongqing(1000-10000 MT capacity); Yibin-Chongqing, Xuzhou-Zhenjiang, Fuyang-Bengbu and Qiqihar-Harbin-Jiamusi (300-1000 MT capacity).

Cargo-out weight is far more than cargo-in weight at Nanjing's river-port, so it can serve as a beef-in river-port to accept beef from the upstream Changjiang River area. Yueyang and Changsha have a much higher cargo-in weight than cargo-out. Therefore they are suitable for accepting beef produced in the Sichuan Basin area.

Other large back hauling gaps in the Chinese inland waterway system are: Pixian (northern Jiangsu), Yichang (Hubei), Guigang (Guangxi) where the cargo-out weight is far more than its cargo-in weight; Harbin, Jiamusi (Heilongjiang), Zhenjiang(Jiangsu), Hangzhou where the cargo-in weight is far more than the cargo-out weight. However, these have no particular advantage for beef transportation.

### **3.4 Seaports**

Important seaports relating beef transportation (from north to south) are:

Dalian, Yingkou, Qinhuangdao, Tianjin, Qingdao, Rizhao, Lianyungang (beef-out); and Shanghai, Ningbo, Fuzhou, Xiamen, Shekou, Guangzhou, Hongkong (beef-in).

Both Dalian and Yingkou have railroad and express highway links with Shenyang, so both of them can serve as the sea port of Shenyang accepting import beef and feeder

cattle and transporting exports of beef and cattle. Tianjin has a railroad and express highway linking it with Beijing, it serves as sea port of Beijing; To the south, Qingdao is the seaport of Jinan, Shanghai is the seaport of Nanjing, Ningbo is the seaport of Hangzhou and Shekou is the seaport of Shenzhen. For Guangxi Autonomous Region, Fangcheng and Beihai are seaports of Nanning, from where feeder and slaughter cattle could be transported throughout Southwest China by railway, highway and express highway. Land-and-water and train-and-bus container coordinated transports are developing rapidly, which will assist beef transportation, import and export.

Currently, Nanjing river port can accept 10000 MT capacity ships. Once the Three Gorges Dam is completed, and the path of the Changjiang around the dam is completed, 10000 MT capacity ships will be able to travel as far upstream as Chongqing river. This will give a way to transport import feeder cattle direct to inland China by co-ordinated sea-and-river systems.

Important seaport back hauling gaps are: cargo-out weight is far more than cargo-in at seaports Dalian, Yingkou, Qinhuangdao, Qingdao, Rizhao and Lianyungang; cargo-in weight is far more than cargo-out weight at sea-ports Shanghai, Ningbo, Fuzhou, Xiamen, Shantou, Guangzhou and Zhanjiang. However, the demand for beef transportation on these routes would not necessarily be large.

### **3.5 Airports**

Major transportation hubs for domestic and imported beef and imported breeding cattle are airports located at major population centres. They are Shanghai, Beijing, Tianjin, Shenyang, Wuhan, Guangzhou, Chongqing, Harbin, Nanjing, Xian and Chengdu, which all have one or two airports for cargo transportation.

There are also 47 airports throughout the main beef production areas in China. They are Harbin, Changchun, Qiqihar, Jilin, Hailar, Jinzhou, Chifeng, Anshan, Chaoyang, Heihe, Xilinhot, Jiamusi, Ulanhot and Tonghua in Northeast China and Inner Mongolia;

Zhengzhou, Jinan, Hefei, Shijiazhuang, Luoyang, Nanyang, Xuzhou, Weifang, Jining, Bengbu, Xingtai in Northern China;

Taiyuan, Hohhot, Yinchuan, Dunhuang, Baotou, Yulin, Jiayuguan, Changzhi, Yanan, Datong in Mid West China and;

Urumqi, Lhasa, Kashi, Xining, Yining, Hetian, Kurla, Aksu, Altay, Qiemo, Tacheng, Karamay in Far West China.

#### **4. Conclusion**

The last decade has seen dramatic developments in the Chinese cattle and beef industries. This has been accompanied by deregulation and capacity expansion of the transportation sector in China. This has meant that new distribution systems for beef and cattle have developed. With further growth of the industry, and changes in the market, these distribution systems will continue to rapidly evolve. New production centres and new beef markets are certain to develop in China over the next decade, as the industry consolidates on its recent rapid growth phase. The constant expansion of transportation infrastructure in China will impact upon this evolution, as will the further deregulation of the sector.