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China's Regional Feedgrain Trade Patterns and Responses to Price Changes *

Xian Xin, Guang-Hua Wan, Xiao-Yun Liu

Abstract

This paper aims to examine the optimal regional trade patterns of China's feedgrain market and its response to feedgrain price change using a hybrid transport model. The regional feedgrain demand and production was estimated based on survey data and published data. The simulation concludes that three features dominate China's feedgrain trade flow pattern. Northeastern province ship surplus feedgrain mainly to Hebei, Henan, Fujian and Shanghai, Anhui, Hunan, Beijing and Shandong. The largest pork-producing province, Sichuan, should source feedgrain from most of its neighbors, Guizhou, Gansu, Shaanxi and Inner Mongolia. The imported feedgrain mainly goes to Hunan, Henan, Fujian, Hubei, Shanghai and Guangxi. The sensitive simulations also show that after full adjustment, the demand and production react more sensitively to changes in feedgrain prices.

1 Introduction

China has seen rapid improvements in grain storage facilities and transport infrastructure in last decade. However, China's underdeveloped infrastructure facilities still impediment feedgrain movements within the country. The large price gap between major feedgrain surplus and deficit regions is the evidence of high cost of feedgrain shipment coupled with import restriction (Xin, Tian and Zhou 2001).

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It is commonly accepted that China's feedgrain market will undergo profound changes after China's joining WTO. Feedgrain price decline and real income growth may drive China to import more feedgrain (Tian 1999; Xin, Tian, and Zhou 2001). This will inevitably place significant strains on China's overburdened transport. Yet, the potential increase in feedgrain import may be stagnated by China's already stretched transporting infrastructure facilities.

The improvement of China's transporting infrastructure is still under the way, but by no means rapid changes can be realized within short time. How to keep transportation costs down is of great importance and great interest to policy makers.

Attention to China's feedgrain economy at regional level are far less than it should be, though in the past decade or so, China's feedgrain demand and supply has attracted increased attention from both academia and government departments within and outside (Zhou, Tian, Liu and Wan 2001; Tian and Chudleigh 1999). Previous research has primarily focused on feedgrain market at the national level. Almost little effort has been made to examine feed grain market at the regional level. This is especially the case of regional trade flow. Less attention to regional trade flow analysis may be attributed to the facts that neither government organizations nor other institutions can provide a set of data on regional feedgrain balance sheet and interregional feedgrains trade flows. However, the work done by Hearn, Halbrendt, Gempesaw and Webb (1990) provided some insights into China's corn sector at regional level. With the use of a hybrid spatial equilibrium model, Hearn etc evaluated the impact of transportation improvements on the spatial distribution of China's corn production and consumption. But they did not touch the analysis of feedgrain trade flow.

This paper aims to examine the optimal regional trade patterns of feedgrain market in China given to keep national transport costs at minimum. The estimation will be conducted with the use of hybrid transport model, which allowing for examination of price response via regional demand and production functions.

Since no regional feedgrain supply and demand data are available, it is essential to examine feedgrain surplus/deficit status before trade flows estimation. So section two will report the regional feedgrain balance sheet in China, which will cover regional feedgrain demand and production, import and export. In section three, a hybrid transport model will be constructed. Data resources will be reported in section four. The regional feedgrain market and interregional

trade flows will be simulated under different price changes in section five. The last part of the paper will be a brief summary and policy implications will be drawn in this section. In the following parts of this paper, feedgrain refers to all grains used in feeding livestock.

2 Regional Feedgrain Demand, Production and Surplus/Deficit

In China, livestock sector, and thus derived demand for feedgrain have significant regional characteristics. Careful examination of feedgrain demand shows that different types of livestock have different feedgrain consumption pattern in different regions, due to the facts that different regions possess different resource endowment, different breeds of livestock and feeding style. Feedgrain conversion ratio is one of the most important indicators in reflecting regional feedgrain demand pattern given the varieties of livestock sector and their output. Regional feedgrain demand of each type of livestock can be obtained by multiplying the output of livestock with the corresponding conversion ratios. The total regional demand for feedgrain is the sum of feedgrain demand for all types of livestock.

In order to estimate regional feedgrain demand, feedgrain conversion ratios of different varieties of livestock are obtained based on a large-scale survey conducted national wide by the authors. The livestock sector here includes pig, cattle and cow, sheep and goat, poultry. Then following the procedure, we get the regional demand for feedgrain in 1999 and present in table 1.

Judged on Table 1, feedgrain consumption is concentrated in a few provinces, among which Sichuan, Shandong, Henan and Hebei take a percentage of 40 in the national demand. Hunan, Jiangsu, Anhui, Jilin, Liaoning, Guangdong and Hubei takes 33 percent. The rest 19 provinces take a share of only 27 percent.

(Table 1 here)

Regional feedgrain production data are obtained by multiplying regional grain output with their estimated percentages for feedgrain use and is presented in Table 1. Feedgrain production covers almost all regions in China, however the major producing area are located geographically from the northeast to the southwest. The top ten provinces produce 66 percent of China's national output of feedgrain in 1999. The rest 20 provinces only provide a share of 34 percent.

Feedgrain export and import data are also reported in Table 2. In 1999, China exported a total of 4.3 million tons of corn and only imported 0.07 million tons of corn. To ensure grain security, including feedgrain security, import and export of feedgrains is managed under the state trading system. However, the annual feedgrain trade volume varied significantly in the past two decades. Three Northeastern provinces (Jilin, Liaoning, Heilongjiang) and Inner Mongolia, which are the major feedgrain producing areas, are the main feedgrain exporting regions. In 1999, these four regions accounted for more than 98 percent of China's total corn export.

Regional feedgrain balance item was obtained by subtracting demand and net export from production. The balance item was listed in the last column of Table 1 and was depicted in Map 1.

(Map 1 here)

From the last column of Table 1 and Map 1, it is easy to see that northern part of China, except Hebei are featured by feedgrain surplus, while southern part China are featured by feedgrain deficit. It is noted that except Shandong, Guangxi, Jiangxi, Hubei and Jiangsu, the rest provinces are either of feedgrain surplus or of deficit, with the gap more than 20 percent. The deficit/surplus estimation implies great trade volumes flowing among provinces in China, though Chinese government has instituted strict controls on the movement of feedgrian within the country and implemented "Provincial Governor Grain-bag Responsibility System".

3 Theoretical Framework

The essence of transport model is to find out the optimal shipments of commodity from the supply regions to demand regions to arrive at minimum transportation cost. The solution of transport model is very easily carried out with linear programming solvers.

The transport model of n regions can be depicted as follows (MacAulay, 2001):

Objective function

$$\text{Min } Z = T'X = \sum_{i=1}^{n}\sum_{j=1}^{n} X_{ij} \times t_{ij} \qquad (1.1)$$

Subject to

$$-G_y X + \tilde{y} \le 0 \tag{1.2}$$

$$-G_x X - \tilde{x} \le 0 \tag{1.3}$$

$$X \ge 0 \tag{1.4}$$

where $\tilde{y}$ and $\tilde{x}$ are vectors of given demand and supply quantities for each of the n regions;

X is a n^2 x 1 vector of quantities shipped between each of the n regions;

T is a n^2 x 1 vector of transport costs for those shipments;

G_y is a n x n^2 matrix ensuring inflows must equal or exceed the given demand quantity;

G_x is a n x n^2 matrix ensuring outflows can not exceed the supply.

$$G_y = \begin{bmatrix} 1 & & 1 & & 1 & \\ & 1 & & 1 & & 1 \\ & .. & & .. & & .. \\ & & 1 & & 1 & & 1 \end{bmatrix}_{n \times n^2}$$

$$G_x = \begin{bmatrix} -1 -1 ... -1 & & & \\ & -1 -1 ... -1 & & \\ & .. & .. & .. \\ & & & -1 -1 ... -1 \end{bmatrix}_{n \times n^2}$$

The objective function (1.1) is to minimize transportation costs. Equation block (1.2), (1.3) and (1.4) are the constraints imposed on the objective function. Block (1.2) is imposed to ensure that inflows must equal or exceed the given demand quantity, while block (1.3) is to ensure outflows can not exceed the given supply. Block (1.4) requires that the outflows and inflows are non-negative, which is quite intuitive.

In order to examine the feedgrain trade flows response to price changes, we will introduce regional production function and demand function into the basic model.

$$\lambda = \alpha - \beta b^{\lambda} \tag{1.5}$$

$$x = \theta + \Gamma p_x \tag{1.6}$$

where p_y and p_x are n x 1 vectors of unrestricted demand and supply prices in n regions; y and x are n x 1 vectors of demand and supply quantities; α and θ are n x 1 vectors of the intercepts of the demand and supply equations respectively; B and Γ are n x n matrices of slope coefficients for the demand and supply functions respectively.

The standard transport model framework only includes equation (1.1)-(1.4). This why we call the transport model (1.1)-(1.6) a hybrid transport model. It is should be noted here that as demand and supply change reacting to feedgrain price, the national supply and demand may not keep balance. China's feedgrain trade with the rest of world (ROW) happens. To simplify the international trade behavior, it is assumed that China will rely on international market as a "small country". The international transportation costs of feedgrain does not enter into objective function since we assume that government's objective is to minimize domestic transportation costs.

The target of use hybrid transport model outlined above is to examine trade patterns and response to price change. However the model also allows for examination the roles of technology progress in feedgrain production, income growth and other feedgrain production and demand shifters, including policy intervention variables, though these variables are not explicitly included in the basic model as far as now. Mathematically, the shifter variables can easily go into the supply and demand equations, by simply adding the multiplication of coefficients and corresponding shift variables on the right hand side. These examinations will be a topic for future work.

4 Data

Regional price elasticities for feedgrain demand and production are estimated based on survey data conducted by the authors and data taken from *Costs and Benefits of Agricultural Products* published by Chinese State Development and Planning Commission and other organizations. Microeconomic theory dictates that feedgrain demand is derived demand and thus should be expressed as a function of feedgrain and livestock prices. However, the regression results indicate low R-squares and the coefficients of the livestock price variable make no economic sense in many cases. Consequently, livestock output is used to replace livestock price in the final regressions. To obtain regional feedgrain price elasticity for feedgrain production, lagged feedgrain production is introduced into the models, which reflects long run effect of feedgrain price changes on feedgrain production. The intercepts and coefficients of price variable of demand and supply functions are

derived from elasticity at the mean value[1].

The distance between regions is simplified by using the railway distance between provincial capitals. The railway distances are obtained from Ministry of Transportation. In our feedgrain market, we have altogether 30 provinces. China's feedgrain import and export is embodied in the shipments of 30 provinces with the rest of the world (ROW). The quality of feedgrain produced in each region is assumed to be homogenous, namely feedgrain is considered of the same quality, wherever it is produced.

It should be noted that regions importing feedgrain are assumed to be all via Guangdong. Import feedgrain and domestic feedgrain are also assumed to be perfect substitutes in this paper. In this sense, Guangdong becomes a net supplier if import quantity is larger than its deficit figure.

5 Empirical Results

5.1 Base Scenario

The regional trade flows between supplier and destination, presented in Table 2, are obtained by solving the hybrid transport model with linear programming solvers for the reference year. The figures in Table 2 are trade flows from column regions to row regions. For example, the value of 631.8 represents a net outflow of 631.8 thousand tons of feedgrain from Liaoning to Beijing.

(Table 2 and Map 2 here)

Under base scenario, most of internal trade with volume over 2 million tones originates from the three northeast provinces and Inner Mongolia. To keep China's feedgrain transport cost at minimum, the surplus feedgrain of Heilongjiang goes mainly to Hebei, Henan, Fujian and Shanghai, while the Jinlin ships its surplus feedgrain to Anhui and Hunan. Most of the surplus feedgrain of Liaoning is shipped to Beijing and Shandong. Most of Inner Mongolia's feedgrain goes to its neighbor, Hebei. The largest pork producing province, Sichuan, should source feedgrain from most of its neighbors, Guizhou, Gansu and Shaanxi.

The simulation tells that long-distance shipment of feedgrain dominates China's feedgrain

[1] For more detail, please refer to Xin, Wan and Liu (2001).

domestic marketing. This finding confirms the claim, such as Liu (2000), that the distance feedgrain was shipped from north to the south could be as much as 3000 kilometers or more.

5.2 Trade Flows Responses to Feedgrain Price Fall

As stated before, China will see a decline in feedgrain price after its joining into WTO. The concrete percentage of price fall hinges on many factors, both domestically and internationally. This section examines the effects of feedgrain price decreases by 5 and 10 percent respectively, on inter-regional flows using the hybrid transport model.

The results (Table 3 and 4) show that declines of feedgrain price will lead to an increased demand and a decreased domestic supply. In the long run, the demand and production react more sensitively to changes in feedgrain prices. As a consequence, China has to resort to increasing imports. Assuming a 10 percent decrease in feedgrain price, China has to import some 13 million tons of extra feedgrain to meet its increased demand in the short run. While in the long run, the number is 17.9 million tons.

Table 3 and 4 also concludes that regions with surplus will experience decrease in feedgrain surplus, while deficit will enlarge for regions with feedgrain deficit in the base scenario. This implies that interregional trade flow pattern will change.

Table 5 and 6 show the simulations of short run interregional trade flows, while the long run counterpart are reported in Table 7 and 8.

The results tell that interregional trade flow pattern differs among different feedgrain prices changes. The trade flow pattern differs not only in trade volume but also routes. However, the different trade patterns also share some common feature. The simulation concludes that three features dominate China's feedgrain trade flow pattern. Northeastern province ship surplus feedgrain mainly to Hebei, Henan, Fujian and Shanghai, Anhui, Hunan, Beijing and Shandong. The largest pork-producing province, Sichuan, should source feedgrain from most of its neighbors, Guizhou, Gansu, Shaanxi and Inner Mongolia. The imported feedgrain mainly goes to Hunan, Henan, Fujian, Hubei, Shanghai and Guangxi.

It should be noted that Guangdong (Guangzhou) is assumed to be the only provinces that import feedgrain, while China may import feedgrain from Fujian (Fuzhou), Shanghai, Tianjin and Dalian.

Since Fuzhou is very near Guangzhou, this will not hurt the main results essentially. For the other three cases, the trade flow pattern differs. It will be more complicated when China imports feedgrain from all possible ports. The selection of ports and the share are endogenous, depending on international transport costs, port facilities etc. These examinations will be taken in future research.

6 Summary

This paper examined China's feedgrain trade flow and its response to feedgrain price fall using a hybrid transport model. The regional feedgrain demand and production was estimated based on survey data and published data. The simulation concludes that three features dominate China's feedgrain trade flow pattern. Northeastern province ship surplus feedgrain mainly to Hebei, Henan, Fujian and Shanghai, Anhui, Hunan, Beijing and Shandong. The largest pork-producing province, Sichuan, should source feedgrain from most of its neighbors, Guizhou, Gansu, Shaanxi and Inner Mongolia. The imported feedgrain mainly goes to Hunan, Henan, Fujian, Hubei, Shanghai and Guangxi. The sensitive simulations show that in the long run, the demand and production react more sensitively to changes in feedgrain prices.

Since long-distance shipment of feedgrain dominates China's feedgrain domestic marketing, to improve China's transport infrastructure is of great importance to formulate integrated market and realize economy of scale in feedgrain production. China may rely on relocation of livestock production from south to north by easing the pressure of large feedgrains trade volume on its overburden transport infrastructure. Further analysis on the economic efficiency needs to be done.

References

Hearn, D., C. Halbrendt, C.M. Gempesaw II and Shuw-Eng Wbb. 1990, ' An Analysis of Transport Improvements in China's Corn Sector: A Hybrid Spatial Equilibrium Approach', Journal of Transportation Research Forum 31(1).

Liu, X.R. 2000, " WTO Accession on China's Corn Production and Marketing", Chinese Grain Economy, No. 8, pp. 6-9.

MacAulay, T.G. (2001), "Spatial Equilibrium Modeling", Materials prepared at the workshop on Spatial Equilibrium Model, August 4-5, 2001, Asian Agribusiness Research Center, the University of Sydney.

State Statistical Bureau (SSB), 2000, *Rural Statistical Yearbook of China, China Statistical Press*, Beijing.

Tian, W.M. 1999, 'Impacts of Trade Liberalization on China's Feedgrain Market', paper presented at the symposium *China Agricultural Trade and Policy: Issues, Analysis, and Global Consequences*, San Francisco, California, June 25-26, 1999.

Tian, W.M. and Chudleigh, J. 1998, 'China's Feedgrain Market: Development and Prospect', AARC Working Paper Series, No.06, the University of Sydney.

Xin, X. 2001, 'Production, Consumption and Trade of Food in China', Paper presented at *workshop on Factors which Affect Supply and Demand of Food, and APEC Economies Response to them,* Tokyo, Japan, March 7-9, 2001

Xin, X., Tian, W.M., and Zhou, Z.Y. 2001, 'Changing Patterns of Feedgrain Production and Marketing in China', AARC Working Paper Series, No.16, the University of Sydney.

Xin, X., Wan, G.H., and Liu, X.Y. 2001, 'A Spatial Equilibrium Model for China's Feedgrain Economy', Paper presented to the International Conference on " China's Economy: Confronting Restructuring, Stability and International Competitiveness" held at the University of Wollongong, Australia, 14-15 July, 2001

Zhou, Z.Y., Tian, W.M., Liu, X.A., and Wan, G.H. 2001, 'An Issue of Debate: China's Feedgrain Demand and Supply', AARC Working Paper Series, No.15, the University of Sydney.

Table 1: Regional Feedgrain demand and production of China in year 1999 (1000 tons)

	Demand [a]	Production [a]	Export [b]	Import [b]	Surplus [c]
Beijing	1382	776	26	0	-632
Tianjin	903	593	0	0	-310
Hebei	14212	9641	20	0	-4591
Shanxi	2108	3206	37	0	1060
Inner Mongolia	3354	6610	741	0	2516
Liaoning	6520	9078	834	0	1724
Jilin	6993	14688	2229	0	5645
Heilongjiang	5011	12713	418	0	7284
Shanghai	1764	446	0	0	-1318
Jiangsu	7742	7564	0	0	-179
Zhejiang	2428	3029	0	0	601
Anhui	7219	5467	0	50	-1702
Fujian	3656	1897	0	0	-1759
Jiangxi	4262	4137	0	0	-125
Shandong	15252	13882	0	0	-1370
Henan	14642	11326	0	20	-3296
Hubei	6212	6051	0	0	-161
Hunan	10404	6972	0	0	-3432
Guangdong	6304	4639	0	0	-1665
Guangxi	4930	4617	0	0	-312
Hainan	764	464	0	0	-301
Sichuan	16726	12619	0	0	-4107
Guizhou	1588	3907	0	0	2320
Yunnan	4211	5188	0	0	977
Tibet	313	31	0	0	-283
Shannxi	2292	3977	0	0	1684
Gansu	1395	2243	0	0	849
Qinghai	460	69	0	0	-391
Ningxia	485	1071	0	0	586
Xinjiang	1945	2632	0	0	687
National	155476	159532	4305	70	0

Notes: Chongqing is included in Sichuan. Taiwan, Hong Kong and Macao are not included..

[a] Feedgrain demand and production data are author's own estimation based on sample survey data.

[b] Export and import data are from SSB 2000, pp.229-230

[c] Negative values mean deficits

Table 2: Base scenario of inter-regional feedgrain trade flows (1000 tons)

	Xinjiang	Shanxi	Inner M	Liaoning	Jilin	Heilongjiang	Zhejiang	Guizhou	Yunnan	Gansu	Ningxia	Shannxi	Total
Beijing				632									632
Tianjin						310							310
Hebei			2516			2075							4591
Shanghai					252	1067							1318
Jiangsu					179								179
Anhui					1702								1702
Fujian						1158	601						1759
Jiangxi					125								125
Shandong				931		439							1370
Henan		1060				2236							3296
Hubei				161									161
Hunan					3388			44					3432
Guangdong								1001	664				1665
Guangxi									312				312
Hainan								301					30
Sichuan	398							974		458	587	1685	4101
Tibet	283												283
Qinghai										391			391
Total	681	1060	2516	1724	5645	7284	601	2320	977	849	587	1685	25927

Table 3: Changes in Feedgrain Demand and Supply in Short Run: Feedgrain Price Decrease

	1999 Deficit/surplus	Deficit/surplus (1,000 tons) [a]		Deficit/surplus Change (%)[b]	
Decrease by (%)	(1,000 tons)	5	10	5	10
Beijing	-632	-678	-725	7.31	14.61
Tianjin	-310	-341	-372	9.95	19.91
Hebei	-4591	-5079	-5567	10.63	21.26
Shanxi	1060	975	891	-7.98	-15.95
Inner Mongolia	2516	2370	2225	-5.58	-11.16
Liaoning	1724	1498	1272	-12.68	-25.36
Jilin	5645	5179	4892	-4.76	-9.52
Heilongjiang	7284	7058	6833	-3.04	-6.09
Shanghai	-1318	-1380	-1441	4.67	9.34
Jiangsu	-179	-496	-814	177.93	355.86
Zhejiang	601	496	390	-17.52	-35.04
Anhui	-1702	-1985	-2267	16.65	33.30
Fujian	-1759	-1895	-2030	7.72	15.45
Jiangxi	-125	-300	-475	139.64	279.28
Shandong	-1370	-1988	-2605	45.07	90.14
Henan	-3296	-3899	-4502	18.30	36.59
Hubei	-161	-432	-703	168.78	337.55
Hunan	-3432	-3847	-4262	12.09	24.18
Guangdong	-1665	-1922	-2178	15.41	30.82
Guangxi	-312	-525	-738	68.18	136.36
Hainan	-301	-331	-361	9.93	19.87
Sichuan	-4107	-4752	-5397	15.71	31.41
Guizhou	2320	2240	2160	-3.44	-6.88
Yunnan	977	801	624	-18.04	-36.07
Tibet	-283	-293	-304	3.78	7.55
Shannxi	1684	1476	1268	-12.35	-24.70
Gansu	849	728	606	-14.28	-28.56
Qinghai	-391	-411	-430	4.99	9.97
Ningxia	586	535	484	-8.70	-17.39
Xinjiang	687	534	380	-22.38	-44.77
National	0	-6662	-13146		

Notes: [a] Regional feedgrain deficit/ surplus. Minus means deficit. The surplus/deficit figures include export and import of feedgrain of 1999.

[b] The percentages of changes in deficit/ surplus compared to 1999 as results of price changes. Minus means the region has net outflow, vice versa.

Table 4: Changes in Feedgrain Demand and Supply in long Run: A Feedgrain Price Decrease

	1999 Deficit/surplus (1,000 tons)	Deficit/surplus (1,000 tons) [a]		Deficit/surplus Change (%)[b]	
Decrease by (%)		5	10	5	10
Beijing	-632	-689	-745	8.91	17.82
Tianjin	-310	-349	-388	12.53	25.07
Hebei	-4591	-5209	-5827	13.46	26.92
Shanxi	1060	932	804	-12.01	-24.02
Inner Mongolia	2516	2281	2046	-8.73	-17.46
Liaoning	1724	1489	1253	-13.16	-26.32
Jilin	5645	5164	4862	-4.98	-9.97
Heilongjiang	7284	7046	6808	-3.21	-6.42
Shanghai	-1318	-1383	-1448	4.92	9.85
Jiangsu	-179	-553	-928	209.69	419.37
Zhejiang	601	473	345	-21.30	-42.60
Anhui	-1702	-2026	-2350	19.08	38.16
Fujian	-1759	-1909	-2059	8.53	17.07
Jiangxi	-125	-331	-537	164.44	328.87
Shandong	-1370	-2092	-2813	52.67	105.34
Henan	-3296	-4301	-5306	30.52	61.03
Hubei	-161	-647	-1133	302.41	604.81
Hunan	-3432	-4094	-4757	19.30	38.60
Guangdong	-1665	-2086	-2507	25.30	50.60
Guangxi	-312	-689	-1066	120.65	241.30
Hainan	-301	-347	-393	15.41	30.81
Sichuan	-4107	-5051	-5994	22.97	45.95
Guizhou	2320	2148	1975	-7.42	-14.85
Yunnan	977	678	379	-30.59	-61.19
Tibet	-283	-294	-306	4.03	8.06
Shannxi	1684	1445	1205	-14.24	-28.48
Gansu	849	710	570	-16.40	-32.79
Qinghai	-391	-411	-431	5.13	10.25
Ningxia	586	527	467	-10.16	-20.32
Xinjiang	687	513	338	-25.45	-50.89
National	0	-9057	-17935		

Notes: [a] Regional feedgrain deficit/ surplus. Minus means deficit. The surplus/deficit figures include export and import of feedgrain of 1999.

[b] The percentages of changes in deficit/ surplus compared to 1999 as results of price changes. Minus means the region has net outflow, vice versa.

Table 5: Inter-regional trade flows: 5 percent decrease of feedgrain price in the short run (1000 tons)

	Xinjiang	Shanxi	Inner M	Liaoning	Jilin	Heilongj	Zhejiang	Guizhou	Yunnan	Gansu	Ningxia	Shannxi	Guangd	Total
Beijing				303		375								678
Tianjin						341								341
Hebei			2370		2709									5079
Shanghai				1195	185									1380
Jiangsu						496								496
Anhui					1985									1985
Fujian						504	496	333					562	1895
Jiangxi					300									300
Shandong						1988								1988
Henan		975				2922								3897
Hubei						432								432
Hunan													3847	3847
Guangxi									525					525
Hainan													331	331
Sichuan	241							1907	276	317	535	1476		4752
Tibet	293													293
Qinghai										411				411
Total	534	975	2370	1498	5179	7058	496	2240	801	728	535	1476	4740	28630

Table 6: Inter-regional trade flows: 10 percent decrease of feedgrain price in the short run (1000 tons)

	Xinjiang	Shanxi	Inner M	Liaoning	Jilin	Heilongj	Zhejiang	Guizhou	Yunnan	Gansu	Ningxia	Shannxi	Guangd	Total
Beijing						725								725
Tianjin						372								372
Hebei			1616			3951								5567
Shanghai							390						1051	1441
Jiangsu						814								814
Anhui					1296	971								2267
Fujian													2030	2030
Jiangxi													475	475
Shandong					2605									2605
Henan		891		1272	991								1348	4502
Hubei													703	703
Hunan													4262	4262
Guangxi													738	738
Hainan													361	361
Sichuan	76		609					2160	624	176	484	1268		5397
Tibet	304													304
Qinghai										430				430
Total	380	891	2225	1272	4892	6833	390	2160	624	606	484	1268	10968	32993

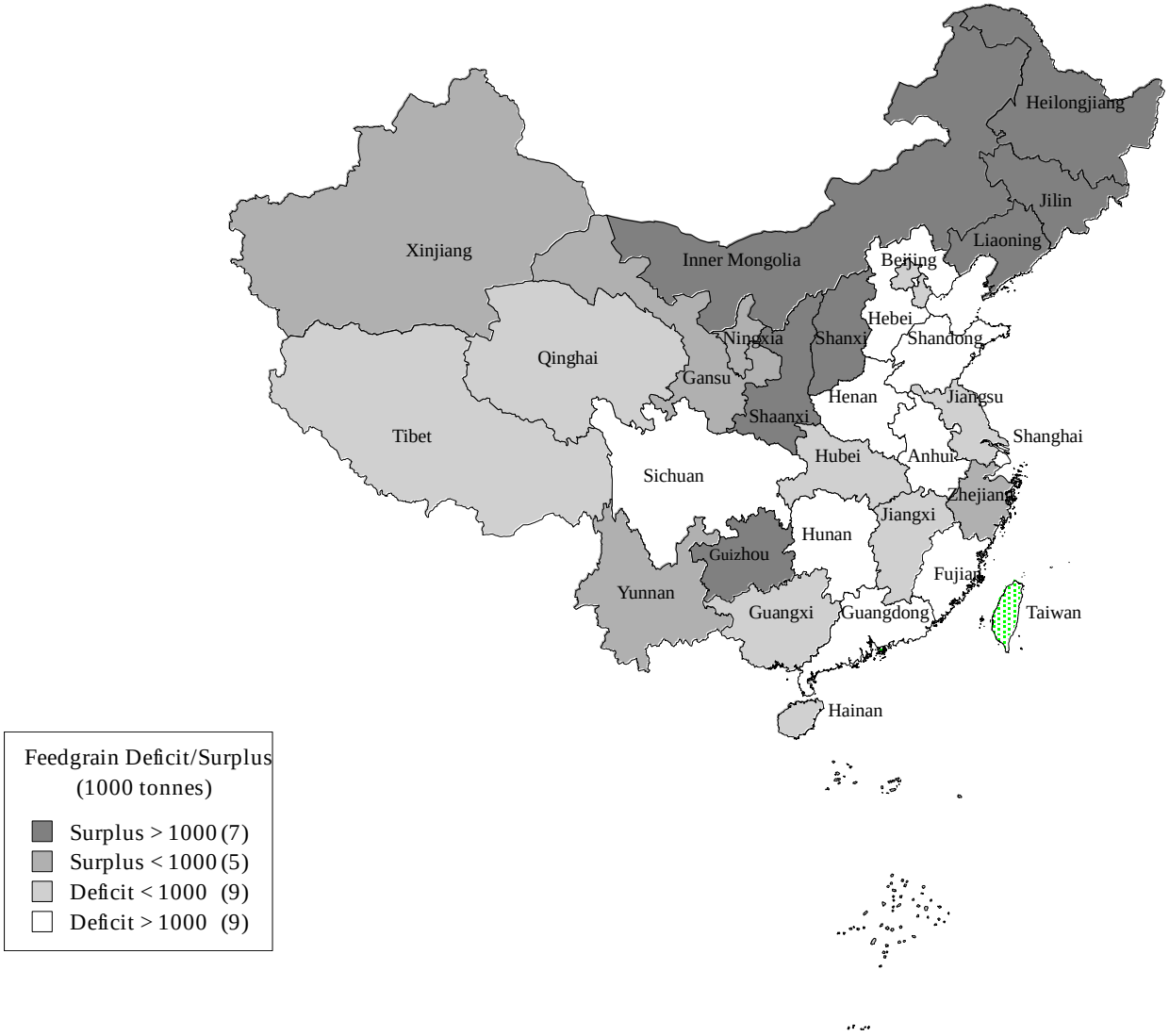
Table 7: Inter-regional trade flows: 5 percent decrease of feedgrain price in the long run (1000 tons)

	Xinjiang	Shanxi	Inner M	Liaoning	Jilin	Heilongj	Zhejiang	Guizhou	Yunnan	Gansu	Ningxia	Shannxi	Guangd	Total
Beijing				689										689
Tianjin						349								349
Hebei			1868			3341								5209
Shanghai						910	473							1383
Jiangsu				553										553
Anhui				231	1795									2026
Fujian													1909	1909
Jiangxi													331	331
Shandong						2092								2092
Henan		932			3369									4301
Hubei				16		354							277	647
Hunan													4094	4094
Guangxi									678				11	689
Hainan													347	347
Sichuan	219		413					2148		299	527	1445		5051
Tibet	294													294
Qinghai										411				411
Total	513	932	2281	1489	5164	7046	473	2148	678	710	527	1445	6969	30375

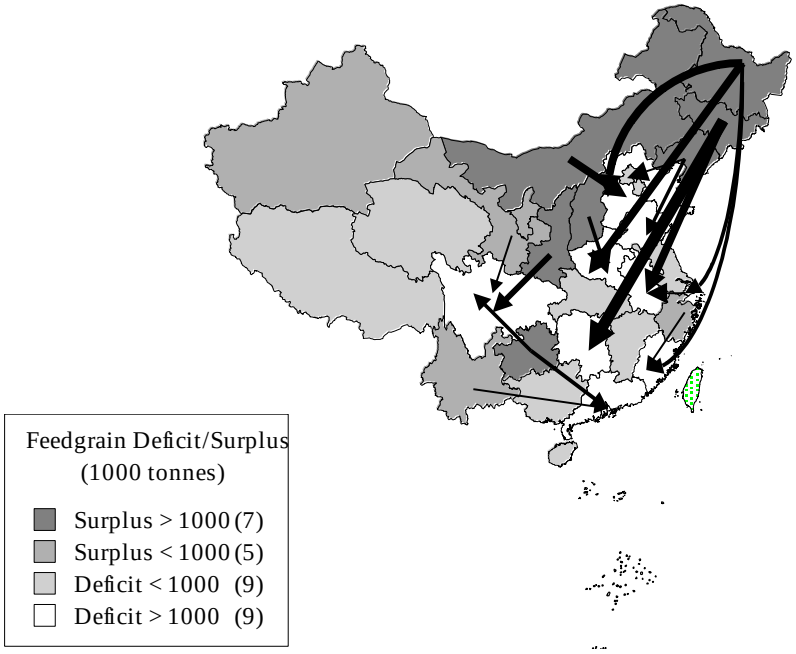
Table 8: Inter-regional trade flows: 10 percent decrease of feedgrain price in the long run (1000 tons)

	Xinjiang	Shanxi	Inner M	Liaoning	Jilin	Heilongj	Zhejiang	Guizhou	Yunnan	Gansu	Ningxia	Shannxi	Guangd	Total
Beijing				746										746
Tianjin						388								388
Hebei			250	386	2049	3142								5827
Shanghai							345						1103	1448
Jiangsu						928								928
Anhui						2350								2350
Fujian													2059	2059
Jiangxi													537	537
Shandong					2813									2813
Henan		804		122									4380	5306
Hubei													1133	1133
Hunan													4757	4757
Guangxi													1066	1066
Hainan													393	393
Sichuan	32		1797					1975	379	139	485	1205		6012
Tibet	306													306
Qinghai										431				431
Total	338	804	2047	1254	4862	6808	345	1975	379	570	485	1205	15428.1	36500

Map 1: Feedgrain Deficit/Surplus: Base Scenario

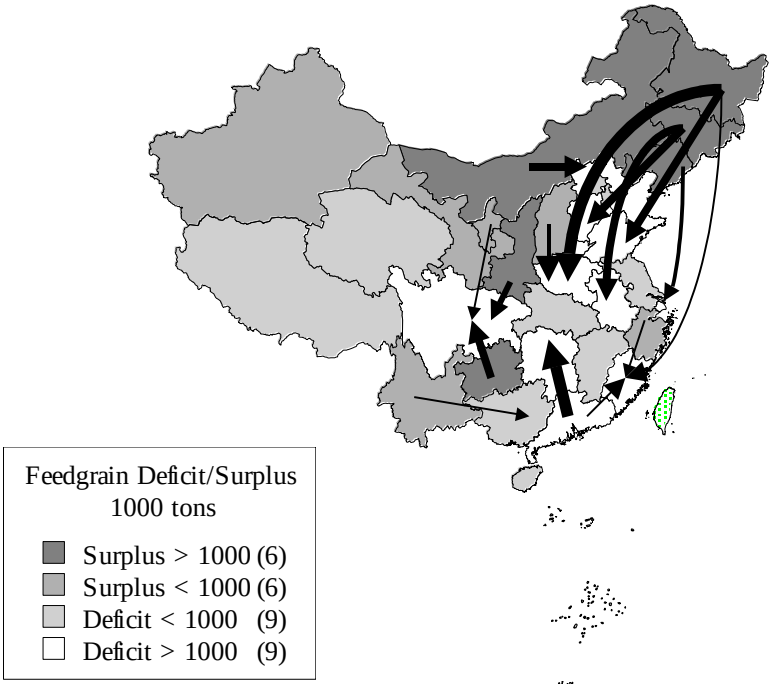


Map 2: Feedgrain Trade Flows: Base Scenario

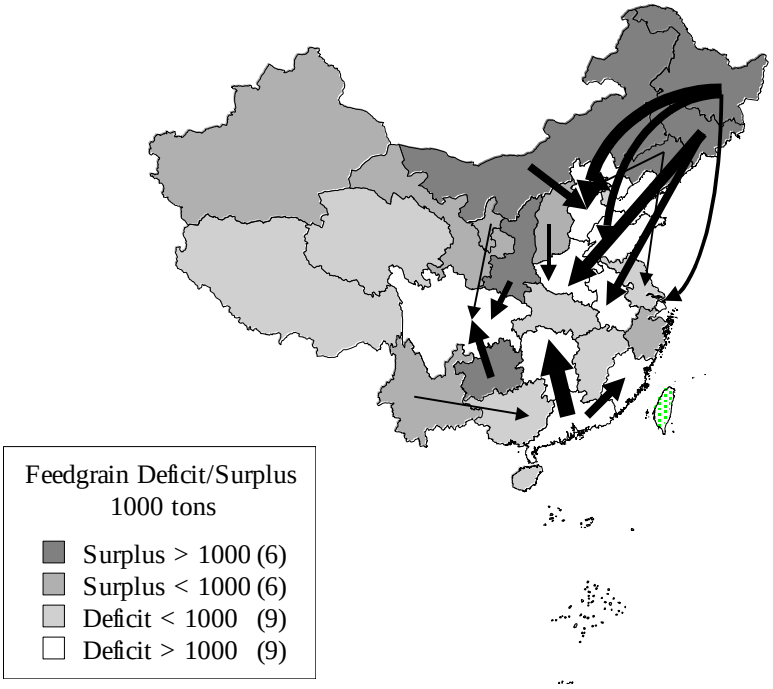


Note: The boldness of lines roughly denotes the magnitude of trade volume. Only trade volume greater than 0.5 million tons are showed in the map. For more detail information, please refer to Table 2.

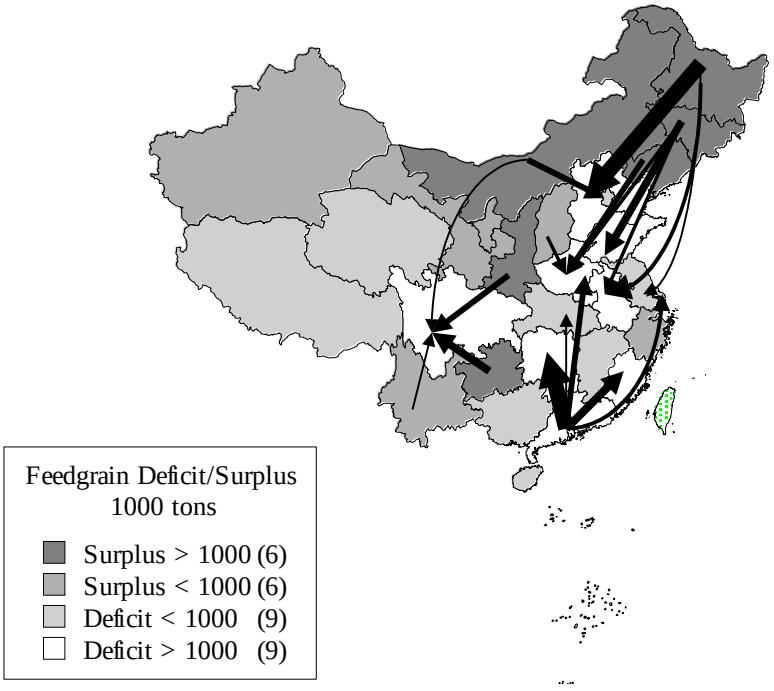
Map 3: Feedgrain Trade Flows: Feedgrain Price Fall by 5 percent (Short Run Model)



Map 4: Feedgrain Trade Flows: Feedgrain Price Fall by 5 percent (Long Run Model)



Map 5: Feedgrain Trade Flows: Feedgrain Price Fall by 10 Percent (Short Run Model)



Map 6: Feedgrain Trade Flows: Feedgrain Price Fall by 10 percent (Long Run Model)