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Chinese grain supply and demand in 2010 : regional perspective and policy implications

Chinese Grain Supply and Demand in 2010: Regional Perspective and Policy Implications

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Abstract

Production and consumption of rice, wheat and maize in China is projected until the year 2010 at both the national and regional level using a multiregional and multimarket net trade model for Chinese agricultural markets. The results show that China can ensure a stable grain market development under more liberalized internal and external conditions. Transmission of the world market prices as projected by the World Bank (2003) to the internal Chinese market would lead to a long-run recovery of the growth in grain production. Total production of paddy rice, wheat and maize is forecast to increase from 390 million tons in the base period 2002 to over 420 million tons in 2010. Because of a lower expansion than in the baseline of demand, the rate of self-sufficiency in these three grain types will rise to about 91 % under world market conditions. This may be significantly lower than the target of the Chinese government. The corresponding deficit amounts to 40 million tons, three fifth of it is of wheat. China would also become a net importer of maize. The regional results indicate an increasing grain deficit in East and South China. Northeast and North China will achieve higher production growth mainly owing to maize production. The Central South will be able to increase production faster than consumption. The Southwest and Northwest will maintain their current deficit. Finally, some implications for future market policies as regards food security, prices and grain imports are discussed.

Key words: China, grain market, projection, multimarket model, market policy.

Zuammenfassung

Getreideangebot und -nachfrage in China bis 2010: Regionale Perspektive und Folgerungen für die Politik

Für die chinesischen Getreidemärkte (Weizen, Reis und Mais) werden Produktion und Verbrauch bis zum Jahr 2010 unter verschiedenen Bedingungen prognostiziert. Dazu dient ein partielles, regionalisiertes Multimarktmodell. Die Ergebnisse zeigen, dass China eine stabile Entwicklung an zum Weltmarkt offeneren Märkten sicher stellen kann. Die Transmission der von der Weltbank (2003) projizierten internationalen Preise auf den chinesischen Markt lässt die Getreideproduktion von 390 Mio. t in der Basisperiode auf über 420 Mio. t bis zum Jahr 2010 steigen. Wegen der kräftigeren Ausdehnung der Getreidenachfrage sinkt der Selbstversorgungsgrad bei den drei wichtigsten Getreidearten auf 91 %, was wahrscheinlich deutlich hinter der Zielsetzung Chinas zurück bleibt. Das Getreidedefizit würde auf 40 Mio. t steigen, darunter vor allem Weizen, aber China würde unter diesen Bedingungen auch Nettoimporteur von Mais. Sonderentwicklungen sind in den Regionen zu beobachten. Aus den Ergebnissen lassen sich Schlüsse für die zukünftige Getreidemarktpolitik des Landes ziehen, die stark auf das Ziel der Versorgungssicherheit ausgerichtet ist.

Schlüsselwörter: China, Getreidemarkt, Projektion, Multimarkt-Modell, Marktpolitik.

1 Introduction

Stable and sustainable growth in grain production is thought to be of fundamental importance for food security in China where farmland is scarce and the large population continues to grow though at a decreasing rate. After comprehensive agricultural policy reforms initiated in the late 1970s, total grain production increased from 300 million tons in 1978 to 512 million tons in 1998, so that the market situation changed from deficit to nearly full self-sufficiency. However, stagnant domestic production coupled with rapidly reduced grain stocks and climbing domestic prices since the end of the 1990s has triggered new nation-wide concerns about future grain supplies in China. The key question being asked in this context in political and academic discussions is whether grain production can keep pace with expanding demand.

Since Lester Brown (1995) raised the question "Who will feed China", a number of model analyses have been conducted to answer this question. A general review with discussion is given in Fan and Agcaoili-Sombilla (1997). The results of the analyses as included in the survey differ widely due to model structure, parameters and other data and assumptions underlying the analyses. In general, China is treated as only one region.

China is a very large country as far as area, population and the agricultural sector are concerned. There are significant regional differences in factors that impact on production, consumption, trade and prices of agricultural products. Therefore, it appears recommendable to take account of regional aspects in the deliberations on agricultural market developments in China. For this purpose, a multiregional multimarket model is applied to project production and consumption of agricultural products in China until 2010. In this paper, only the results for wheat, maize and paddy rice are presented.[3] First, the model structure and data sources are described. Second, the projection results as obtained in two scenarios are presented. Finally, the implications for future grain security and market policies are discussed.

2 Model and data

China's Agricultural Regional Market Equilibrium Model (CARMEM) is based on the Swopsim modeling framework as described in ERS-USDA in 1992 (Sullivan et al.) and on Tyers' GLS model in the form described in Tyers and Anderson (1989).[4] The model is synthetic, par-

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[3] Wheat, rice and maize and not wheat, rice and coarse grains are included because of the particulars of Chinese statistics in this respect.

[4] For more recent descriptions of Swopsim and the slightly modified GLS model, see Roningen (1997) and Tyers (1994), respectively. The model as applied here was first used as an auxiliary instrument to shift the supply and demand functions of a spatial quadratic programming model (Kersten, 1997).

tial, static, deterministic, multiproduct and multiregion. It is embedded in a spreadsheet file (Excel), with one worksheet for each region and an additional worksheet for the market clearing mechanism. It is variable in terms of both the regional and commodity coverage. The model is solved either for pre-fixed net-trade restrictions using the solver or by transmitting world market prices to the national and regional markets. The latter variant is used here.

The structure of the model is a system of supply, demand and technical equations. The regional supply of a product in period t is a function of supply in the base period, an external shift factor which may stand for a policy measure or an external disturbing factor, an annual growth rate due to technical progress or other external factors, and by changes in own and cross prices according to the respective elasticities:

$$S_{i,t}^k = S_{i,to}^k \left(1 + a_{i,to}^k\right)\left(1 + r_i^k\right)^t \prod_h \left(\frac{R_{i,t}^h}{R_{i,to}^h}\right)^{\eta^{kh}}$$

for i = 1, …, I; k = 1, …, K

with S = supply, a = shift factor, r = autonomous growth, R = producer price, to = base period, t = period, k, h = product, i = region, and η = supply elasticity. The parameters a, r, and η may be positive, negative or zero.

The regional demand functions for the products are established along the same principles, in this case with income Y and population POP as the external shifters of the function and d as the income elasticity and e as the price elasticity of demand. The demand for agricultural products, which are fed to livestock, depends also on the development of animal production:

$$D_{i,t}^f = D_{i,to}^f \frac{POP_{i,t}}{POP_{i,to}} \left(\frac{Y_{i,t}}{Y_{i,to}}\right)^{\partial_{i,t}^f} \prod_g \left(\frac{P_{i,t}^g}{P_{i,to}^g}\right)^{\varepsilon_{i,t}^{fg}} \prod_g \left(\frac{SL_{i,t}}{SL_{i,to}}\right)^{\gamma_{i,t}^f}$$

for i = 1, …, I; k = 1, …, K

with D = demand, POP = population, Y = income (GDP per capita), P = market price, SL = livestock products supply, t = time period, to = base period, f, g = product, δ = income elasticity of demand, ε = price elasticity of demand, γ = feed elasticty of demand.

The regional producer and consumer prices are linked with the respective world market prices through the "national price" and the international-national-regional price transmissions. In the model, both domestic and

world market prices are initialized at one for the base period in all regions. The price equation is as follows:

$$NP_t^k = NP_{to}^k \left(\frac{WP_t^k}{WP_{to}^k} \right)^{b^k}$$

for k = 1, …, K

with NP_t^k, NP_{to}^k = national price for product k in period t and the base period, WP = world market price, b = transmission elasticity from the world market to the national market.

The national price is transferred to the regions in the same manner. In this case, the transmission elasticity is assumed to be one.

The model calculations start from a base period which, because of its large influence on the results, should be broadly based and should represent a "normal situation". Here the data in the year 2002 taken from different official statistics, serve as the starting point. The regional production of each product is taken directly from "China Statistic Yearbook 2003" of the Chinese National Bureau of Statistics (NBS). The regional product-specific consumption is a sum of rural direct consumption, urban direct consumption, feed use, seed use, manufactured use and waste which are calculated from the statistical data in "China Statistic Yearbook 2003", "China Rural Household Survey Yearbook 2003" and "Yearbook of China Prices and Survey of Urban Household" of the NBS and "China Domestic Balance of Agricultural Products" of the Chinese Ministry of Agriculture. The population growth rates in 2002 and the growth of gross domestic product in 1997-2002 from the NSB are used for the model projections toward 2010. The elasticities and technical coefficients used in the model are taken from past studies as referred to before and adjusted if felt necessary. The price scenario uses the grain prices in constant dollars (current prices deflated by the MUV index, 1990=100) as given by the World Bank (Table 1).

Carmem covers various products from the grains-oilseeds-livestock sector in China, including wheat, corn, paddy rice, soybeans, rapeseed, cotton, sugar, roots and tubers, vegetable oils and meals, beef, mutton, pork, poultry, eggs, milk and milk products. Processing is included for oilseeds and milk. The 32 provinces of the PR China are aggregated into seven regions, namely North China (Beijing, Tianjing, Hebei, Shanxi and Inner Mongolian), Northeast (Liaoning, Jiling and Helongjiang), East China (Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi and Shandong), Central South (Henan, Hubei Province and Hunan), South China (Guangdon, Guangxi and Hainan), Southwest (Choqing, Sichuan, Guizhou, Yunnan and Tibet) and Northwest (Shaanxi, Gansu, Qinghai, Nixia and Xinjiang). Table 2 shows some economic and natural characteristics in the model regions.

Table 1:
World market prices for grains with projections to 2010

Product	1970	1980	1990	2000	2002	2005	2010
	(in constant USD)						
Maize	208.2	159.0	109.3	91.0	102.9	97.1	102.6
Rice	450.3	521.4	270.9	208.0	198.9	209.5	215.1
Wheat	195.7	219.3	135.5	117.2	153.5	132.8	141.7

Note: World Bank projections as of June 24, 2003.- Nominal prices deflated by MUV-G5.- As for price definitions, see source.
Source: World Bank (2003): GEP 2004, p. 276.

Table 2:
Key indicators for the Chinese regions in 2002

	North	North-east	East	Central	South	South-west	North-west
Total Population (million)	149	108	370	224	136	204	93
Urban population (% of total population)	38.8	52.1	39.7	29.7	44.5	26.3	30.4
Population density (persons/kilometer^2)	95.7	134.7	468.8	396.9	298.0	86.7	30.6
GDP (100 million Yuan)	15138	11587	45090	15485	14829	10425	5466
GDP per capita (Yuan)	10128	10735	12176	6915	10918	5119	5852
Agricultural share of GDP (%)	11.3	12.8	11.7	18.36	12.5	20.5	16.9
Farmland per capita (ha)	0.138	0.199	0.069	0.076	0.062	0.102	0.173

Source: China Statistic Yearbook 2002; own calculations

3 Model scenarios and simulation results

In the late 1970s, a comprehensive agricultural market policy reform was initiated (Lu, 2002). Since then, the policy of grain procurement quota has been abolished in most Chinese provinces and the grain market has been nationally and internationally integrated to some extent. Chinese markets were further opened to world markets by China joining the WTO in 2001. As for future general developments, high rates of economic growth and a further growing population are assumed. The question to be answered is how food demand and its structure will change in the medium to long term and whether grain production can keep pace with demand. Moreover, the impacts of changes in the world market on the domestic market have to be taken into account.

Two scenarios are used to simulate grain market developments toward 2010. In the baseline, it is assumed that regional economic and population growth of the recent past continues. The product prices remain unchanged. The second scenario takes the real product prices as projected by the World Bank (Table 1)[5]. In the following sections, the results are presented for the Chinese grain markets only. It should be kept in mind that the regionalization is a first step only because most of the data are preliminary estimates.

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5 According to the World Bank (2003), the world market price for almost all products covered in this model is expected to strengthen over the projection period in nominal terms, but to continue to trend downwards in real terms. Here the projected real world market prices for grains, sugar, soybean, soybeanmeal, soybeanoil, cotton and beef are used as the expected world prices in this model simulation. In addition, a 5 % price decrease for pork, poultry, eggs and 5 % price increase for milk in 2010 against the base year 2002 are also assumed.

3.1 Grain total

Since 1998 China has experienced a remarkably continuous decrease in grain production. Total production of the three important grains which are included here (wheat, rice and maize) has fallen from 442 million tons in 1998 to 386 million tons in 2002. The fall in China's grain harvest is largely due to the reduction of the harvested area from 62 million hectares in 1998 to 54 million hectares in 2002. Yields, after a long period of increasing, have stagnated since the end 1990s. Several trends are converging to reduce the grain area, including the conversion of cropland to nonfarm uses, the shift to higher-value crops, and a decline in double-cropping due to the abolishment of the grain procurement quota policy as started in 2001 in the more prosperous coastal provinces. It is assumed that these changes are lasting. On the other hand, grain consumption in China is expanding. It reached 423 million tons in 2002. The rate of grain self-sufficiency dropped to only 90 % with a domestic deficit of 38 million tons, of which 66 %, 22 % and 2 % are wheat, rice and maize, respectively. This implies that Chinese domestic grain supply in recent years has depended considerably on the utilization of the large stocks. Thus, China's grain imports could be limited to relatively small quantities.

As shown in Table 3, production of the three included grains is forecast to rise from 386 million tons in 2002 to 421 million tons in 2010 in the baseline. Aggregate grain demand is projected to reach 477 million tons by 2010. The gap between projected production and consumption implies a rising deficit, so that the rate of grain self sufficiency will fall from 89.4 % in 2002 to 88.3 % in 2010. In the price scenario, grain production is projected to reach 429 million tons in 2010, so that the deficit will fall below the level reached in 2002 and the self-sufficiency rate will rise at least by 1.5 %. It is thus expected that grain production will recover in China if the domestic grain market

Table 3:
Chinese regional grain market situation in 2002 and 2010 (million tons)

| | 2002 Basis | | | | 2010 Projection | | | | | | | |
| | | | | | Baseline Scenario | | | | Price Scenario | | | |
	P	C	B	SSR	P	C	B	SSR	P	C	B	SSR
North China	40.7	46.5	-5.8	87.6	46.0	52.4	-6.4	87.8	46.9	52.0	-5.1	90.2
Northeast	52.7	35.9	16.9	147.1	57.2	38.9	18.3	147.0	59.6	38.3	21.3	155.6
East China	109.4	129.0	-19.6	84.8	17.9	141.5	-23.6	83.3	118.7	139.8	-21.1	84.9
Central South	78.4	82.2	-3.8	95.4	86.0	90.3	-4.4	95.2	87.4	89.0	-1.6	98.2
South China	27.9	41.2	-13.3	67.7	30.1	45.9	-15.8	65.7	30.6	45.2	-14.6	67.8
Southwest	52.2	67.9	-15.8	76.8	56.6	75.3	-18.7	75.2	57.3	73.8	-16.5	77.6
Northwest	25.0	29.5	-4.5	84.7	27.9	33.3	-5.4	83.8	28.3	32.9	-4.7	85.9
National	386.3	432.1	-45.8	89.4	421.8	477.7	-55.9	88.3	428.9	471.1	-42.2	91.0

Note: P = production, C = consumption, B = production - consumption, SSR = self-sufficiency rate in %.
Source: China Statistic Yearbook 2002; own calculations

is further integrated into the world market. This notwithstanding, a deficit of 42 millions tons will have to be covered by imports from international markets.

As for the seven regions of China, except the Northeast, all other regions were in a deficit position in 2002. This applies especially to South China and the Southwest where the self-sufficiency ratio was below 70 % and 80 %, respectively. According to the projections, grain production in North China and Northeast will grow faster than consumption in both scenarios, which results in an increasing surplus in Northeast and a slightly higher self-sufficiency ratio in North China. Only under the price scenario, the production in Southwest, Central South and Northwest is expected to increase more than consumption, so that the Central-South will tend to reach its grain self-sufficiency and the Southwest and Northwest can slightly raise their rate of grain self-sufficiency. In both scenarios, the current gap between supply and demand in East and South China is expected to widen until 2010. The regional differences in the grain markets will be further exacerbated if increasing labor migration from western to southeastern provinces is taken into account.

3.2 Rice

Rice is the most important grain crop in China contributing more than 40% of total grain output. China's rice production had been decreasing from 199 million tons in 1998 to 175 million tons in 2002. Total consumption in 2002 reached 193.5 million tons, thus a domestic deficit of 18.5 million tons emerged (Table 4). Traditionally, China was self-sufficient in rice with small imports and exports. According to the baseline scenario, it is expected that China will produce 187 million tons paddy rice and consume 209 million tons in 2010. The higher growth in consumption will lead to a rice deficit increasing to over 21 million tons. In the price scenario, China's paddy rice pro-

duction is forecast to increase by 9 % to 192 million tons while consumption will slightly rise to 201 million tons in 2010. As a result, an increase in the rice self-sufficiency ratio by about 4 % is expected; the total domestic deficit, compared with the baseline, will fall by more than 8 million tons to about 10 million tons. This suggests that China still has a relatively stable potential for the production of rice despite contracting farmland.

Rice is the main grain crop in East China where more than one third of total Chinese rice output is grown. In this region, its own production has been lower than consumption since the end 1990s. The baseline projection shows that East China will have a limited growth in rice production, but an increasing deficit toward 2010. The self-sufficiency ratio is forecast to fall from 95 % in 2002 to 93.5 % in 2010. On the other hand, as the price scenario shows, it is expected that the growth in production will be higher than in consumption, so that the projected rice price change in the world market could lead to a 4% increase of the rice self-sufficiency ratio in the region East China.

In 2002, North China had the largest rice deficit of all regions, but its consumption accounted for only 6 % of the national demand. According to the model results, the future relation between production of and demand for rice in North China will be constant, and the self-sufficiency ratio will remain at 11%. Similar results are obtained for the region Northwest. As China's only region with a rice surplus in 2002, the Northeast will expand its rice surplus because of higher production growth under the two scenarios. The regions Southwest, South China and Central-South, where supply and demand of rice are almost in balance, will realize a higher production growth and thus achieve a rice surplus in the price scenario.

Table 4:
Chinese regional rice market situation in 2002 and 2010 (million tons)

| | 2002 Basis | | | | 2010 Projection | | | | | | | |
| | | | | | Baseline Scenario | | | | Price Scenario | | | |
	P	C	B	SSR	P	C	B	SSR	P	C	B	SSR
North China	1.3	12.2	-11.0	10.4	1.4	13.4	-11.9	10.6	1.5	12.8	-11.4	11.3
Northeast	17.0	15.7	1.3	108.3	18.3	16.5	1.8	111.1	18.8	15.8	3.0	119.2
East China	60.4	63.6	-3.2	95.0	63.6	68.1	-4.4	93.5	64.5	66.2	-1.7	97.5
Central South	39.3	39.1	0.1	100.3	42.0	42.3	-0.3	99.3	43.4	40.8	2.6	106.3
South China	25.6	25.9	-0.2	99.0	27.6	28.3	-0.7	97.6	28.0	27.5	0.5	101.8
Southwest	28.9	28.9	0.0	100.0	31.4	31.2	0.1	100.4	32.4	29.7	2.7	109.0
Northwest	2.6	8.1	-5.5	31.7	2.8	9.1	-6.3	31.0	2.9	8.8	-5.9	32.8
National	175.0	193.5	-18.5	90.4	187.1	208.8	-21.7	89.6	191.5	201.6	-10.1	95.0

Note: P = production, C = consumption, B = production - consumption, SSR = self-sufficiency rate in %.
Source: China Statistic Yearbook 2002; own calculations

Table 5:
Chinese regional wheat market situation in 2002 and 2010 (million tons)

| | 2002 Basis | | | | 2010 Projection | | | | | | | |
| | | | | | Baseline Scenario | | | | Price Scenario | | | |
	P	C	B	SSR	P	C	B	SSR	P	C	B	SSR
North China	15.3	16.4	-1.0	93.6	17.6	18.0	-0.4	97.6	17.5	18.3	-0.8	95.4
Northeast	1.1	6.0	-4.9	18.2	1.2	6.3	-5.1	19.8	1.2	6.4	-5.2	19.2
East China	29.2	31.0	-1.8	94.2	32.3	33.6	-1.4	95.9	31.9	34.0	-2.0	94.0
Central South	24.2	19.7	4.5	122.8	27.3	21.2	6.1	128.6	26.9	21.6	5.3	124.5
South China	0.1	7.1	-7.0	1.4	0.1	7.9	-7.8	1.4	0.1	8.0	-7.9	1.4
Southwest	8.0	21.2	-13.2	37.8	9.1	23.2	-14.1	39.1	9.0	23.3	-14.4	38.5
Northwest	12.0	14.7	-2.8	81.3	13.5	16.3	-2.8	82.9	13.4	16.4	-3.0	81.8
National	89.9	116.1	-26.2	77.4	101.1	126.7	-25.6	79.8	100.0	128.1	-28.1	78.1

Note: P = production, C = consumption, B = production - consumption, SSR = self-sufficiency rate in %.
Source: China Statistic Yearbook 2002.- Own calculations.

3.3 Wheat

Because of a tendency downward since 1998, China's wheat production dropped to 90 million tons in 2002, about 27 % lower than the output in 1997, but consumption was above 115 million tons in 2002. This resulted in a deficit of 25.4 million tons or 57 % of the total domestic grain deficit in 2002.

The model results show that production will increase slightly faster than consumption until 2010 in both scenarios (Table 5). Changes in the wheat market will be really small so that, more or less, the situation will stay where it was in the base period. However, to cover the expected domestic deficit, more wheat will have to be imported in 2010. In 2002, the gap between domestic production and consumption could be closed by drawing down abundantly available stocks.

The Central South is the only region with a wheat surplus in China. The region is projected to have a significant growth of production under both scenarios. North China is expected to achieve a higher growth in production than in consumption, so that its current deficit will be reduced and the self-sufficiency rate will rise at least by 2 %. Northeast, Northwest and East China will keep their own deficit level of the base year until 2010. In the Southwest, where the deficit amounts to 50 % of the national wheat deficit in 2002, the rate of wheat self-sufficiency will increase by 1 % in 2010 against 2002. Wheat demand in South China is expected to expand from 7 million tons in 2002 to 8 million tons in 2010, but the supply has to be imported from other regions and the world market since regional wheat production is very small indeed.

Table 6:
Chinese regional maize market situation in 2002 and 2010 (million tons)

| | 2002 Basis | | | | 2010 Projection | | | | | | | |
| | | | | | Baseline Scenario | | | | Price Scenario | | | |
	P	C	B	SSR	P	C	B	SSR	P	C	B	SSR
North China	24.1	17.9	6.2	134.8	27.0	21.0	6.0	128.5	28.0	20.9	7.1	133.9
Northeast	34.7	14.2	20.5	244.0	37.7	16.2	21.5	233.4	39.5	16.1	23.5	246.1
East China	19.8	34.4	-14.6	57.4	22.0	39.8	-17.8	55.2	22.2	39.6	-17.4	56.1
Central South	15.0	23.3	-8.4	64.1	16.7	26.8	-10.2	62.1	17.2	26.6	-9.4	64.5
South China	2.2	8.2	-6.0	26.6	2.4	9.7	-7.2	25.1	2.5	9.6	-7.1	26.0
Southwest	15.3	17.9	-2.6	85.5	16.2	20.9	-4.7	77.7	15.9	20.8	-4.9	76.6
Northwest	10.4	6.6	3.8	157.1	11.5	7.8	3.7	147.4	12.0	7.8	4.2	154.2
National	121.4	122.5	-1.1	99.1	133.5	142.1	-8.6	93.9	137.4	141.4	-4.0	97.2

Note: P = production, C = consumption, B = production - consumption, SSR = self-sufficiency rate in %.
Source: China Statistic Yearbook 2002.- Own calculations.

3.4 Maize

In 2002, China produced 121.4 million tons of maize and consumed 122.5 million tons, which was a well equilibrated market situation. Under the baseline scenario it is expected that total maize production will grow by 10 % to over 133.5 million tons in 2010 while demand will expand by 16 % to 142 million tons. A domestic deficit of 4 million tons will come up in the price scenario. Therefore, although China's maize production will achieve high growth rates, it will not be able to keep pace with the higher demand expansion. Therefore, China will become a net importer of maize in the projection period mainly due to expanding feed demand.

The existing regional pattern of the maize market in China, which is characterized by a surplus in the north and a deficit in the south, does not change much in the scenarios for 2010.

Northeast, North China and Northwest, which produced more than 70 % of the national maize output in 2002, are projected to further increase production. Moreover, the projected growth in these three regions will be higher in the price scenario than in the baseline situation, which reveals the price impact on production. On the other hand, the existing maize deficit in the southern regions is expected to widen rapidly as demand is expanding faster than production. This especially applies to Southwest and East China.

3 Conclusions and policy implication

The model results for the Chinese grain market indicate that production will follow total consumption if the World Bank's projected world market prices are transmitted into the internal market. Total production of rice, wheat and maize, 386 million tons in the base period 2002, is forecast at 426 million tons in 2010 under such conditions or seven million tons more than in the baseline projection. The country's deficit would amount to 43 million tons, to be compared with 46 million tons in 2002 when China had huge grain stocks available, and 56 million tons in the baseline projection. The self-sufficiency ratio will be around 90 %, i.e., 88 % in the baseline and 91 % in the price scenario. China will become a net importer of maize. Three fifths of the grain deficit, however, is wheat. In East and South China, the gap between grain production and consumption will widen through time, but less so in the price scenario than in the baseline.

As far as the regional results are concerned, an increasing grain deficit in East and South China will emerge. Northeast and North China will achieve a higher production growth mainly due to a rapid increase in maize production. The Central South will be able to improve its supply situation. The Southwest and Northwest will maintain the level of their existing deficit. The projection results

imply that grain security will remain a serious challenge in the projection period. From the preceding grain market analysis, the following five points may be derived as important components of future Chinese grain market policies:

(1) Strengthen farmland protection by legislation and the introduction of land markets: Though China is a farmland-scarce country, high-yielding farmland has still been converted to nonfarm use by rapid urbanization and industrialization during recent years.[6] If the Chinese economy continues to grow at high rates, a loss of farmland on a similar scale as in the last decade will be the result. To stop the loss of farmland, the Chinese government should take measures to keep farmland in agricultural production, and it should also establish a market system for farmland exchange in order to raise the efficiency of land use. The last mentioned measure will be an important prerequisite for maintaining future capacity of grain production growth.

(2) Domestic regional grain market integration and free trade: The model results show that there is a widening gap between production and consumption in some regions. The integration of the domestic market into the international markets will contribute to considerably improve grain supply. The target of grain self-sufficiency at regional level should be abandoned. The government should remove the existing internal trade barriers and integrate the regional grain markets as fast as possible, in order to allow free grain trade between the regions in China. For this purpose, the government should encourage private traders to enter the market, especially in the surplus regions. On the other hand, China should adapt the regional structure and scale of the state grain stocks to the changing market situation especially in deficit regions to improve the effectiveness of grain market stabilisation policies.

(3) Full impact of price changes on production growth: The model results demonstrate a significant effect of price changes on grain supply and demand in China. In particular in times of production shortfalls there is obviously a conflict between short-term stabilisation through releasing stocks and medium- to long-term adjustments through the response of supply and demand to market signals. Government policies should allow the market enough scope for adjustment, viz. less intervention, more reliance on the market solution.

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[6] According to the official statistics of the Ministry of Land and Resources of China, farmland totaled 123.4 million hectares by the end of 2003, having dropped by 6.7 million hectares since 1996. Urban expansion, industrial construction, and highway construction are all shrinking the land available for crops.

(4) Establishment of international cooperation for grain supply security in China: It must be expected that China's self-sufficiency in grains will fall below 95% in this decade. Normally, China will be able to procure the imports to cover the deficit. However, there may emerge certain circumstances, be it natural, political or otherwise, that could prevent China from importing the required quantities of grains. Therefore, first deliberations could go in the direction to use the WTO import quotas as a favorable starting-point on which to build a strategic cooperation in grain trade with other countries.

(5) Set up facilitating and supporting services for market policies in China: In China, steps have been taken to liberalize the grain markets, and the policy has been increasingly market oriented for more than two and a half decades now. Nevertheless, market interventions are still extensively used at the production, processing and marketing levels. Market developments are influenced by a wide range of factors as for example demography, climate, ecology, policy and world markets, the internal and external economic developments, exchange rates, etc. Therefore, market policies need to be based on sound analyses to support decisions. For this purpose, central and provincial administrations should establish market research services to monitor, analyse and project market developments.

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