Food Security in Asia : A Demand Side Analysis

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Abstract

This paper analyzes the food security issues facing selected Asian countries. The study focuses on the demand side perspective. Specifically, the conflicting evidence on (1) the historical levels of per capita meat consumption among Asian countries and (2) the estimation of income elasticity of grain demand in China is used to illustrate the uncertainties about future food demand prediction and their implications for food security in Asia.

Introduction

This session deals with "Food Problems in Asia". My introductory remarks focus on food security issues. Food security can be viewed either globally, regionally or from the perspective of an individual country. Globally, the question may be "Can the World Feed Itself"? This question has recently been addressed in the Vision 2020 Project conducted by the International Food Policy Research Institute (IFPRI). The results of this study were briefly summarized in Pinstrup-Andersen (1996) and detailed in Rosegrant *et al.* (1995). As pointed out by Pinstrup-Andersen (1996), during the last 25 years global food production increased faster than population and thus, food prices have been declining. However, in the meantime, 800 million people do not have access to adequate food, resulting in malnutrition in one out of every six persons in the world. Therefore, the global food problem has been caused by income distribution, not by insufficient production. By 2020, the same problems may or may persist depending critically on whether or not we accelerate our investments in agriculture and the low income people in the world. Most analysts including those in IFPRI maintain that international food prices will continue to decline, implying that there will be no economic food shortage in the future. A recent study by Mitchell *et al.* (1997) also offers a very optimistic view about the world food outlook. Their simulation results show that "the world can feed twice as many in twenty years"

Closer to home, we may ask, "Can Asia Feed Itself"? The answer to this question is much more complex than the one for the world. The ability for Asians to feed themselves does not simply rest on the ability to increase agricultural productivity. Instead, it is a question of comparative advantages in agricultural production. Over the last 20 years, economic development and rising wages have made small-scale farming in many Asian countries uncompetitive with those in other regions such as North America and Europe. Thus, there has been growing foreign dependence on food supply, a problem perceived as a food security threat by many analysts and policy makers in Asia.

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The objectives of this paper are to discuss the food security problems from the perspectives of regions and individual country and to investigate the demand side uncertainties in projecting the future agricultural demand/supply balance. Japan, Taiwan and South Korea have experienced the most rapid increases in their foreign dependence in agriculture during the last 2-3 decades. Food security is one of the most pertinent issues to these countries. On the other hand, China is the largest country in the world and changing food demand structure creates uncertainties that will have profound implications for the world market of agricultural products. This paper will focus on these selected Asian countries in analyzing food security and its related issues.

Self-sufficiency in food

The most commonly used indicator of food security in a country or region is the self-sufficiency rate. Table 1 shows the historical and projected cereal balances for sub-regions

Table 1 Historical and projected cereal balances in Asia [a]

		Japan, South Korea and Taiwan				China		East + S. E. Asia (Excl. China, Japan, S. Korea, Taiwan)		South Asia		Total Asia	
Item	Unit	1968-72	1978-82	1990-94	2030 (projected)	1990-94	2030	1990-94	2030	1990-94	2030	1990-94	2030
Per Capita Cereal Consumption	kg/year	258	304	334	435	291	380	215	315	184	260	NE	NE
Total Cereal Consumption	Mmt	39	53	63	87	338	580	93	228	214	529	708	1,424
Total Cereal Production	Mmt	21	19	17	14	336	480 [b]	84	192	209	505	646	1,191
Net Cereal Imports Self-Sufficiency	%	53.2	35.7	26.5	16.1	99.7	82.7 [b]	90.0	84.2	97.5	95.4	91.7	83.6

NE: Not estimated.
a. Cereals include wheat, coarse grains, and rice in milled form (i.e., conventional definition of cereals).
b. Based on the medium scenario constructed by Alexandratos (1997).
Source: Alexandratos (1997).

in Asia estimated by Alexandratos (1997). Japan, South Korea and Taiwan have experienced the most notable increases in net cereal imports in Asia and the world. Their self-sufficiency rates in cereals decreased drastically from 53.2% during 1968-72 to 26.5% during 1990-94 and are projected to reach only 16.1% in 2030. On the other hand, China and other countries in East, Southeast and South Asia had self-sufficiency rates in cereals above 90 % during 1990-94. However, the self-sufficiency rate for all of Asia is projected to decrease from 91.7% during 1990-94 to 83.6% in 2030 according to Alexandratos (1997) as a result of future economic development in East and Southeast Asia.

Taiwan and Japan are among the countries with the lowest food self-sufficiency rates in

the world, particularly in cereals (rice, wheat and coarse grains). As shown in Table 2, despite the rice protection policies in these countries, the self-sufficiency rates in total cereals in Japan and Taiwan continued to decline from the 1960s to 1990s. On the other hand, China kept its self-sufficiency rates in total cereals above 95% during the réform periods of 1985 to 1995. These rates are very consistent with the national policy that China holds. As shown in Table 3, Japan and Taiwan have been self-sufficient in rice, but they imported most of the wheat and corn used for domestic food and feed consumption. Table 3 also shows a comparison of self-sufficiency rates for all other major food items between 1985 and 1995 in Japan, Taiwan and China. In Japan, the rates declined for almost every food item as a result of trade liberalization. In Taiwan, notable declines have occurred in sugar, vegetables, fruits, and beef. However, as a result of the increased self-sufficiency rates in pork, aquatic products, and dairy products, the overall self-sufficiency rate in 1995 remained at about 85%. In China, the only notable decreases in the rates occurred in wheat and sugar as the imports of these two products increased during the last decade.

The decreasing self-sufficiency rates in food as observed in Japan and Taiwan were caused by increasing net agricultural imports which resulted from excess demand and loss of comparative advantages in agricultural production. The decline in food self-sufficiency is not necessarily detrimental to a country. In fact, the low self-sufficiency rates can only be sus-

Table 2 Comparison of self-sufficiency rates in cereals in Taiwan, Japan, and China [a]

(Unit : %)

	Taiwan		Japan		China	
Year	Rice	Total cereals	Rice	Total cereals	Rice	Total cereals
1965	113.5	100.3	95	62	b	b
1970	104.2	81.6	106	46	b	b
1975	103.7	70.8	110	40	b	b
1980	113.1	66.4	100	33	100.3	94.4
1985	103.8	59.3	107	31	100.5	97.5
1990	98.5	58.3	100	30	100.5	96.8
1991	95.9	56.6	100	29	100.7	95.0
1992	96.1	54.6	101	29	101.0	97.8
1993	105.3	59.5	75	22	100.6	98.2
1994	99.9	55.3	120	33	98.8	95.0
1995	102.6	54.7	103	30	99.6	95.5

a. Cereals include rice in milled form, wheat, and coarse grains.
b. Blanks indicate data not available.

Sources: (1) Council of Agriculture, "Food Self-sufficiency Rates in Taiwan", unpublished tables, Taipei, Taiwan, 1997.
(2) Statistics Bureau, Management and Coordination Agency, Japan Statistical Yearbook 1996, Japan, 1996.
(3) Ministry of Agriculture, Forestry, and Fisheries, Food Balance Sheet 1996, Japan, 1996.
(4) Economic Research Service, USDA, "The CPPA-China Model", a computer model adopted and run at The Ohio State University, 1996.

tained by economic development and exports of manufacturing products which provide the needed foreign exchanges to import agricultural goods. The high self-sufficiency rates recorded in many Asian countries, particularly in the South, may be due to the lack of economic means to import food. Therefore, these countries may be better-off if they could lower their self-sufficiency rates.

In general, there are two groups of countries with high self-sufficiency rates in food. The first group consists of countries like the U.S., Canada, Australia, France and Germany with a relatively high per capita arable land area and thus, the ability to capture the advantage of large-scale farming and produce agricultural products at a low cost. The other group including China, India and the Philippines, has a relatively small per capita arable land area and is characterized by relatively low labor costs in agricultural production. One would expect that when the countries in the second group further develop their economy and raise their labor wages, they would follow the other Asian countries like Japan, Taiwan and South Korea to lower the self-sufficiency rates in food, and particularly in grains. So far, we have seen that this is happening in Thailand, Malaysia, and Indonesia. So what is wrong with the low self-sufficiency rates in food? In peace time when food supply is abundant, consumers will benefit from imports if the cost of importing food is lower than that of domestic production. Based

Table 3 Comparison of self-sufficiency rates of major food products in Taiwan, Japan and China

(Unit : %)

	Taiwan		Japan		China	
Product	1985	1995	1985	1995	1985	1995
Rice	103.8	102.6	107	103	100.5	99.6
Wheat	0.3	0.4	14	7	93.4	90.2
Corn	6.6	5.5	a	a	109.2	99.0
Sugar	147.9	84.9	33	35	85.7	78.8
Soybeans	0.8	0.3	5	2	110.3	101.7
Vegetables	138.3	96.3	95	85	a	a
Fruits	105.5	88.6	77	49	a	a
Meats	91.9	110.4	81	57	a	a
Pork	109.2	120.5	86	62	101.4	101.0
Beef	12.8	8.9	72	39	104.6	101.9
Mutton	3.8	16.0	a	a	a	a
Poultry	100.3	101.0	92[b]	69[b]	101.5	101.5
Eggs	100.3	99.7	98	96	103.0	100.2
Aquatic products	107.8	114.3	96	74	100.0	100.0
Dairy products	13.5	25.4	85	72	100[c]	100[c]
Total food	85.5	85.1	74	62[d]	a	a

a. Blanks indicate data not available.
b. Chicken.
c. Milk.
d. This figure is for 1994. The 1995 rate was not published.

Sources: Same as those listed under Table 2.

on this economic principle, we should have found many countries giving up agricultural production because of the scarcity of land and high labor costs. However, the truth of the matter is that none of the countries in the world would give up agriculture. On the contrary, many countries including both developing and developed ones have continued to protect their agriculture. Even in the United States, with its agricultural surplus, many agricultural commodities were highly protected until recently.

Whether or not agricultural goods should be treated differently from manufacturing goods in an economy is a matter of controversy. One thing is certain ; if a country like Taiwan foregoes its rice production for a long period of time, it can never easily recover its production capability. In an agrarian society such as in Taiwan during the 1960s, sons of a farmer were highly dependent upon their father because they had to learn the skills of rice production directly from him. Today, the farmer's sons are much more independent because they can learn the ways to make computers from the manual and machine tools. The point is that agricultural goods can not be produced in a controlled environment and that the skills in producing rice or wheat are often passed from generation to generation without interruption. This unique characteristic must be one of the reasons why agriculture has been highly protected in the world. Since staple food is essential and critical to our livelihood, it is often considered a strategic good in a country.

Of course, how low the self-sufficiency in food can a country tolerate is a matter of subjective judgment. In China, the government has set a target of no less than 95% of self-sufficiency in grains. Based on the historical experience of agricultural protection and the uniqueness of agricultural production, Japan, Taiwan and South Korea appear to have a legitimate reason to be concerned with their low and declining self-sufficiency rates in total cereals (Tables 1 and 2).

Demand side analysis

The self-sufficiency rate is determined by the net import of agricultural goods in a country. Similarly, it reflects the aggregate demand/supply balance. In order to assess a country's future import demand, one needs to forecast the aggregate supply and demand. Domestic demand plays a very important role in this kind of supply/demand balance assessment. However, most analysts tend to focus on the supply side rather than the demand side. For example, Fan and Sombilla (1996) recently reviewed several projections of the grain supply/demand balance for China and found a wider range of supply projections than demand, indicating more uncertainties in food supply for the future. Analysts tend to think they know food consumption and its determinants relatively well as compared to supply. Specifically, many analysts feel very comfortable in using the observed historical consumption-income relationship in their projections of food demand.

The case in point is the future cereal balance projected by Alexandratos (1997) as shown in Table 1. According to his projection, the per capita cereal consumption in South Asia will increase from 184 kg during 1990-94 to 260 kg in 2030. The projected figure of 260 kg in 2030 is even smaller than the consumption levels of Japan/South Korea/Taiwan and China observed during 1990-94. In other words, 33 years from today, the people in South Asia will

still consume far less than the people in Far East Asia because the projected per capita consumption of cereals in South Asia in 2030 is only 59.7% of the level projected for Japan/South Korea/Taiwan and 68% of the projected consumption level for China. Can we be so sure about the projected differences in cereal consumption level among these regions/countries? The key parameter in his projection is the income-consumption relationship observed historically.

Let us begin asking the question whether or not we really know the historical consumption levels. Table 4 shows a comparison of per capita consumption of major food items in 1993 between China, Taiwan, and Japan. In China, two household surveys were conducted by the State Statistical Bureau (SSB), one for rural households and the other for urban residents. China never published its food balance sheet; the data for 1992-94 were obtained from Alexandratos (1996a and 1996b) of the Food and Agriculture Organization (FAO). The consumption figures from the surveys should be smaller than those from the balance sheet because these surveys collected the data for at-home consumption and they did not include the losses occurring in processing and distribution and food consumed away from home. On the other hand, the data in the balance sheet reflected the total availability of the food supply. In Taiwan, the survey data were available for grains only. Note also that these sets of data are not entirely comparable. In China, the grain figures from the rural survey are expressed in raw grains while those from the urban survey in processed or milled grains. In Japan, the meat figures are the net weights without bones while in Taiwan and China the figures are the

Table 4 Comparison of per capita food consumption among China, Taiwan, and Japan 1993

(Unit : Kg)

	China			Taiwan		Japan	
	Household survey		Balance sheet	Household survey	Balance sheet	Household survey	Balance sheet
Food Item	Rural	Urban	1992-1994	1993	1993	1993	1993
Total grain	266.02	97.78	257.17	a	99.61	a	103.0
Rice	a	52.64	140.13	70.76	60.70	34.3	69.2
Flour	a	32.47	81.77	14.91	28.93	1.09	32.2
Total meat	13.30	25.96	32.72	a	70.33	12.77	29.9
Pork	10.86	17.4	24.52	a	39.65	4.71	11.4
Beef & Mutton	0.82	3.36	3.19	a	3.58	3.37	7.4
Beef	a	2.08	1.99	a	2.72	3.37	7.4
Poultry	1.62	5.20	5.02	a	27.08	3.62	10.3
Aquatic products	2.76	8.02	a	a	47.46	14.30	36.7

a. Blanks indicate data not available.

Sources: (1) State Satistical Bureau, Income and Expenditure Survey of Chinese Urban Households, unpublished tables.
(2) Alexandratos (1966b)
(3) Food Bureau, Taiwan Provincial Government, Taiwan Food Satistics Book, 1996.
(4) Council of Agriculture, Food Balance Sheets in Taiwan, unpublished, 1993.
(5) Personal Communication with Professor Tadashi Hasebe, University of Tohoku, Japan.

gross weights. Despite these measurement problems, comparing these sets of consumption data shows a great deal of uncertainty about historical consumption levels.

In China, even though the consumption figures for grains appear to be reasonable, there are several peculiarities. First, rural households consumed more than twice the amount of grains but only half the meat used by urban households. It is not unreasonable to expect these patterns of differences. However, if we compare the grain consumption figure of 97.78 kg by urban households with the balance sheet figures of grain consumption in Taiwan and Japan, we find that Chinese urban households actually consumed somewhat less or at most an equivalent amount of grains than the households in Taiwan and Japan. Is this reasonable? At this stage of economic development in China, we would expect that Chinese urban households should consume more grains than those in Taiwan and Japan, especially in view of the relatively low consumption of animal products in China.

Consumption of animal products is the key to determine the demand for feed grains. It is, therefore, very important to know the consumption levels of meat and poultry. The data from China show very different patterns. Based on the urban survey data, the total meat consumption in 1993 was 25.96 kg compared with only 13.3 kg in the rural survey. On the other hand, the balance sheet estimated by Alexandratos shows 32.72 kg which can not be reconciled with the survey data. Recently, the Ministry of Agriculture in China has questioned the validity of the survey data because they are not consistent with the aggregate data of livestock production. In fact, the Ministry of Agriculture (Jia, 1996) claimed that the per capita meat consumption was 43.8 Kg in 1995, a figure considerably higher than 32.72 kg estimated by Alexandratos (1996 b) for 1992-94. We checked the data from the 1992 Food Intakes and Nutrition Survey conducted by the Chinese Academy of Preventive Medicine (1996) and found the data to be very similar to the SSB data presented in Table 4 for both rural and urban households. These conflicting sets of data show great uncertainty on how much we know about the historical and current food consumption in China.

Further comparisons are made with data from Taiwan and Japan. According to the balance sheet data, households in Taiwan consumed much more meat than those in Japan. Specifically, the per capita total meat consumption in Taiwan was 70 kg in 1993, a figure which was more than twice of that reported in Japan. Even though the Japanese figure is measured on a boneless basis, the difference is highly significant. A common observation suggests that the Japanese consume less meat but more seafood than Taiwanese. However, the data also show that Taiwanese households consumed more aquatic products than Japanese households. Can that be true? It is a puzzling question. We further compare the data between the household survey and balance sheet in Japan. The differences are staggering. The survey shows that the per capita total meat consumption in Japan was only 12.77 kg in 1993, being less than half of the figure from the balance sheet. This level of meat consumption was even lower than the 13.3 kg consumed by rural households in China. How can we use these different sets of data to establish the baseline consumption level for future projection? Without a valid baseline consumption figure it would be difficult to provide a reasonable assessment of the future demand for food. Many analysts used the consumption levels in Taiwan and Japan as the benchmark figures in projecting the future food demand in China. According to the data presented in Table 4, dramatically different conclusions can be reached. If one uses

the meat consumption figure of 70 kg from Taiwan, the potential for increases in China's meat consumption would be enormous. However, if one uses the 12.77 kg from the household survey in Japan, the projected increases in China's meat consumption would be minimal.

Income-food consumption relationship

Income elasticity is the most important parameter for predicting long-term demand for food. Chern (1997) recently conducted a review of studies on food demand in China and found a wide range of estimated income elasticities. Specifically, the estimated income elasticities for the grain demand by rural households ranged from 0.14 obtained by Lewis and Andrews (1989) to 0.58 from Halbrendt *et al.* (1994). Huang and Rozelle (1996) also obtained an estimate of 0.57 while the estimate from Gao *et al.* (1996) was 0.52, all very close to the figure from Halbrendt *et al.* For urban households, the range of the estimated income elasticities is much wider, from −0.032 (Shi *et al.*, 1995) to 0.99 (Chen, 1996). It is interesting to note that some analysts tend to consider that the demand for grain by Chinese urban households may have a negative income elasticity because of the slightly declining per capita grain consumption trend observed in recent years. Can grain become an inferior good in urban China so soon? We examined the data provided by the SSB and found that per capita grain consumption was still higher in the upper level income group of households in recent years. For example, in 1995, the urban Chinese households in the highest income group consumed 103.57 kg of grain per annum as compared with 93.14 kg in the lowest income group, showing a consumption pattern of a normal good.

There are many causes for the wide range of estimated income elasticities for grain demand in China. The differences may be due to different data sets (such as national vs. provincial, or household vs. aggregate data, etc.), sample periods, model specification and estimation methods. In order to demonstrate the difficulties in demand modeling, we recently estimated and compared two complete demand systems − the linear approximate almost ideal demand system (LA/AIDS) and the linear expenditure system (LES). The two models were estimated using the provincial level data from the urban survey from 1993 to 1995, a sample reflecting consumption behavior without grain rationing which was eliminated in May 1993.

The estimated income and price elasticities are summarized in Table 5. Considering the estimated expenditure and price elasticities, the differences between these two sets of results are substantial. Specifically, the estimated expenditure elasticity of grain demand is 0.15 under LES, but 1.30 under LA/AIDS. The expenditure elasticities can be converted to income elasticities by multiplying with the aggregate income elasticity of total food which has been estimated to be about 0.75 in the literature. Since most coefficient estimates are statistically significant and all theoretical restrictions such as homogeneity and symmetry imposed in both models, it appears that this set of data can be represented by the two demand systems equally well. Actually, the high estimate of the income elasticity of grain demand obtained from LA/AIDS can be rationalized. During 1993-95, grain prices surged following the elimination of grain rationing with an increase of 102% during this period. On the other hand, per capita grain consumption declined only slightly from 97.78 kg in 1993 to 97.00 kg in 1995, a decrease of only 0.8 %. If we just consider the own-price and income effects, a high expendi-

Table 5 Comparison of demand elasticities estimated for Chinese urban households by model, 1993-1995

Food item	Budget share	LA / AIDS		LES	
		Expenditure elasticity	Price elasticity	Expenditure elasticity	Price elasticity
Grain	0.20	1.30	−0.43	0.15	−0.16
Vegetable oil	0.06	1.28	−0.40	0.34	−0.30
Sugar	0.01	0.62	−0.43	0.79	−0.56
Pork	0.17	0.46	−1.70	1.28	−0.97
Pountry	0.06	0.10	−1.03	2.37	−1.48
Other meats	0.03	1.03	−1.46	3.13	−2.36
Aquatic products	0.09	0.37	−0.83	2.26	−1.28
Eggs	0.06	1.40	−1.12	0.85	−0.76
Milk & products	0.02	1.13	−1.57	1.46	−1.13
Vegetables	0.16	1.10	−1.05	0.42	−0.39
Fruits & melons	0.10	1.17	−1.06	1.19	−0.94
Wine	0.04	2.48	−0.51	0.74	−0.68

ture elasticity (like 1.30 under LA/AIDS) is necessary, otherwise, the own-price effect (with an elasticity of −0.45 under LA/AIDS) should have yielded a much lower per capita grain consumption than that observed in 1995.

The problem is that an income elasticity of grain demand at the magnitude of 0.975 (= 1.30 × 0.75) would certainly produce a long-term projection of grain demand far from being acceptable. For example, consider the case of grain consumption by Chinese urban households. In 1995, the average consumption of grain was 97 kg per person. Let us assume a 6% annual rate of increase in per capita income for Chinese urban households from 1995 to 2020. Using the estimated income elasticity of 0.15, the projected per capita grain demand would be 121.4 kg in 2020. However, if we use an income elasticity of 0.975, the projected grain demand would be 401.8 kg, a figure few, if any, would find acceptable. Even with a moderate income elasticity of 0.50, the projected per capita grain demand would be 203.1 kg, a figure hardly reasonable in view of the recent declining trend of direct grain consumption by urban Chinese households.

The above analysis illustrates the difficult task in estimating food demand elasticities and associated uncertainties in projecting future food demand and thus, the food demand/supply balances in a country. As a country's economy develops, its food consumption pattern is likely to change. Any projection needs to take into consideration this structural change in food demand, and that is not an easy task.

Conclusions

This paper attempts to analyze the food security issues from the demand side perspective. Food security may be considered globally, regionally or by an individual country. For many Asian countries, the food security issues are related to the increasing foreign dependence.

This view is very similar to those of energy security issues facing the United States and Western Europe during the energy crisis of 1973-74. Due to the unique characteristics of agricultural production, staple food may be considered as a strategic good in a country. As such, countries like Taiwan, Japan and South Korea may have a legitimate reason to be concerned with their low and declining self-sufficiency rates in total cereals. This paper does not address the food insecurity issues facing many individuals in many countries including the United States.

Demand side plays a very important role in future food balance and in determining the net import demand. Analysts tend to focus on the supply side when conducting the future projections. In fact, we often have difficulties in obtaining accurate and reliable baseline data on food consumption in simulation. In this paper, we use the meat consumption data from China as an example to demonstrate the problem of data accuracy. Furthermore, the estimated income elasticities are often not robust. The wide range of estimates raises doubt about the projected future food demand and the potential need for foreign imports of food. We need to improve the databases used in estimating food demand and demand projection so that we may be able to assess the future food balance more accurately. The recent debates about China's ability to feed its people have generated a great deal of interest in revisiting the food security issues facing many Asian countries. The debates have been helpful to Chinese agricultural development because as a result, the Chinese government responded by paying increasing attention to the need for agricultural research and development.

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