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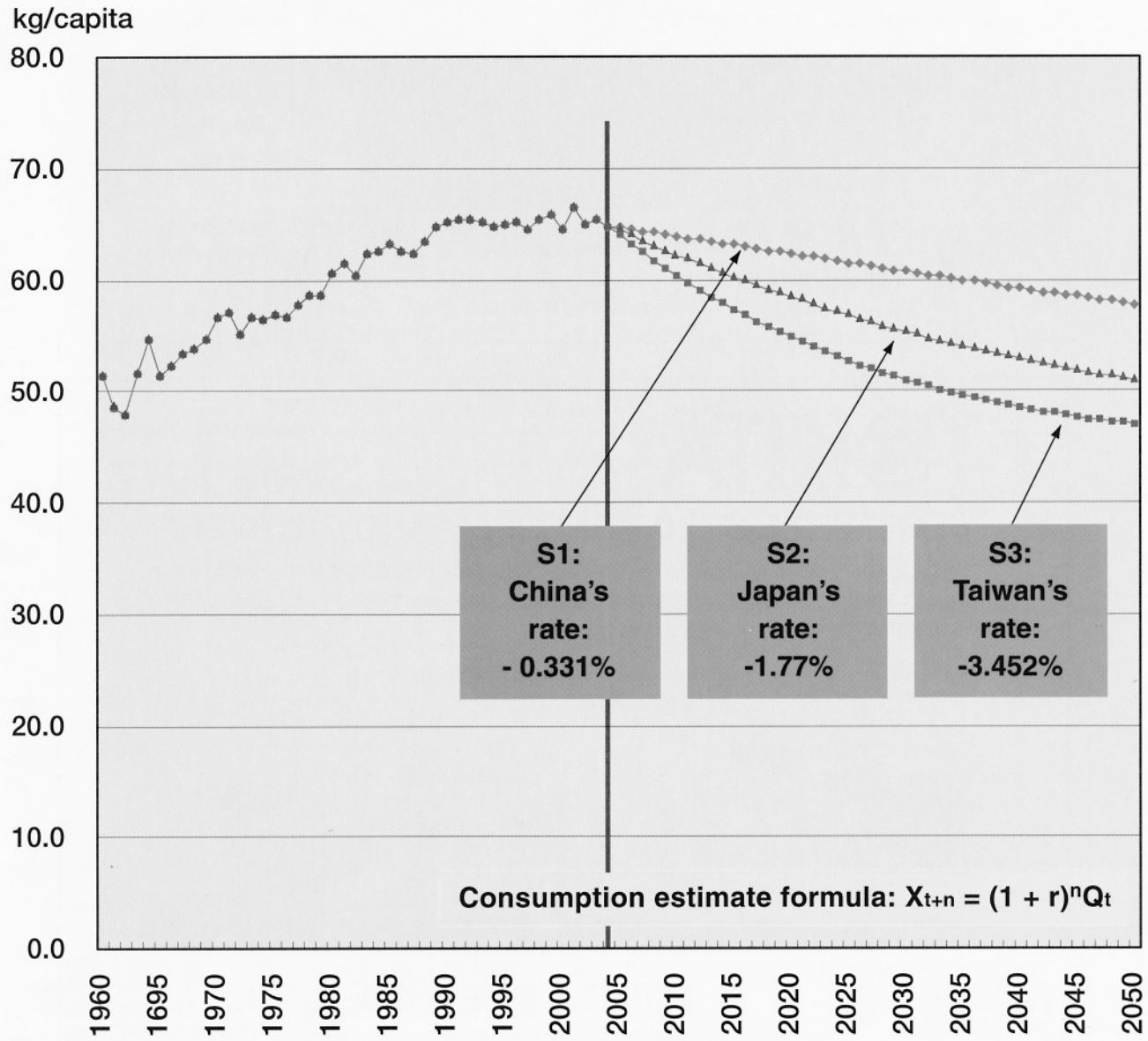
Warning: Declining Rice Demand in the World!

Global trend of per capita rice consumption: 1960-2050



Special Issue :

Rice in the World Verging on a Grave Crisis

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Rice in the World Verging on a Grave Crisis

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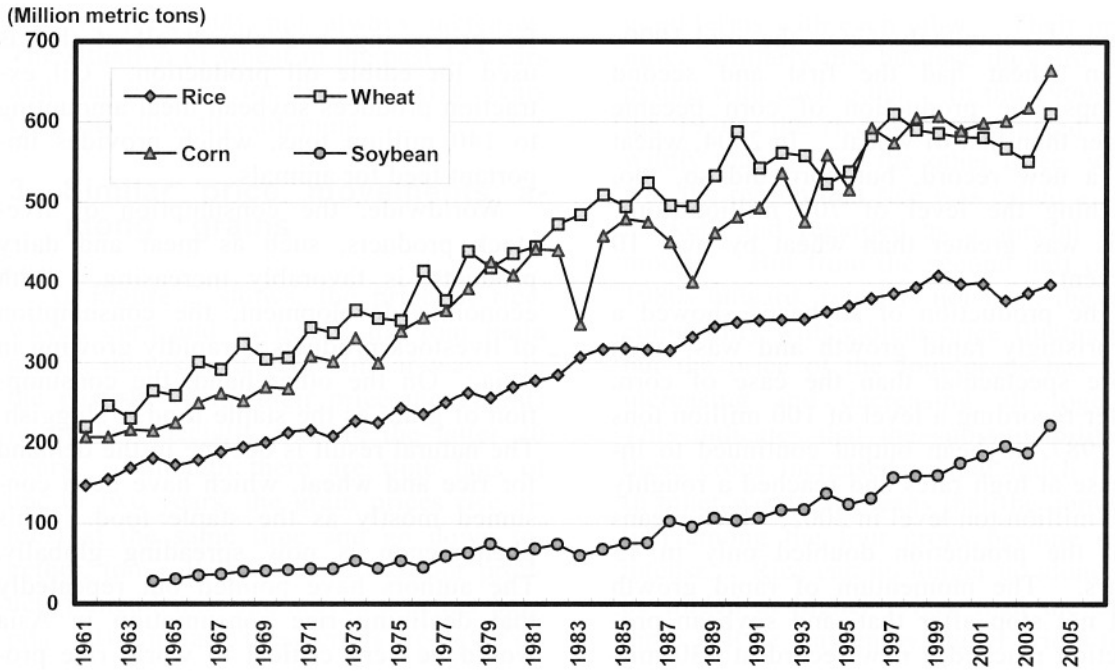
I. Age of International Crop Competition: Rice's Retreat due to Declining Demand

1. Sluggish rice production

The age when rice consumption increased with the growth of the world population is going to end. Even crops are now in the era of competition. If rice is content with its present position and takes it easy, it will be robbed of its share by other crops. Today rice has to fight a frantic race for survival against wheat, corn and soybeans.

When it entered the 21st century, rice was faced with an abnormal situation. In 1999, it attained a worldwide output of over 400 million metric tons (hereinafter "tons" on milled rice basis) first in history. But it has not succeeded in breaking this record in next five years (Fig. 1). This is the phenomenon never seen in the past half century. Thus far, the rice production has shown a yearly growth or has increased in the third year at least. But the figure for 2002 was smaller than the record in 1999 by as much as 7 percent. This is not because resources have been exhausted; instead, it is because rice cultivation has become unprofitable in more and more areas in the world due to lowering international rice prices. The rice price has been picking up in the recent several years, and the output finally reached the 400 million-ton level in 2004, although it failed to beat the record established in 1999. If the international prices remain on the 2004 level in



Source: Ito Laboratory's website (Tottori University); World Food Statistics and Graphics (http://worldfood.muses.tottori-u.ac.jp/graph/ index.html), February 2005.

Fig. 1. World production of rice, wheat, corn and soybeans: 1961-2004

2005, rice production may recover, but there is no guarantee that the price will stay on that level. The situation may possibly continue where neither the price of rice does not increase further nor its output does not go up.

Actually, according to the report of the WASDE published by the U.S. Department of Agriculture (USDA) in August 2005, the global rice production in 2005 will be smaller than the 1999 level, the historic high. The report indicates that the rice price will be about $300 per ton (Bangkok, 100%B), which is an increase of $100 compared to the figure a few years ago, but will not be greater than the prices around 1997. The monthly market price has been on the decline since April 2005.

The situation of wheat is more serious than that of rice. Signs of decreasing wheat output appeared already early in the 1990s. After registering a historic high in 1990 (590 million tons), there was a slump of seven years (the first slump) and the record was finally broken in 1997 when the production exceeded 600 million tons. However, there occurred another seven-year slump (the second slump), and in 2004, the output finally set a new record at 620 million tons, a slightly higher level than the figure seven years ago. The wheat production may experience a third slump any time in the near future.

2. Output of corn and soybeans, mainly for non-food use, increasing

What is the situation of corn and soybeans, then? Historically, the output of corn had been smaller than that of wheat by about 10 to 20 percent. But things

changed completely since the mid-1990s when wheat had the first and second slumps: the production of corn became larger than that of wheat. In 2004, wheat set a new record, but corn did so, too, reaching the level of 700 million tons. This was greater than wheat by over 10 percent.

The production of soybeans showed a surprisingly rapid growth and was much more spectacular than the case of corn. After recording a level of 100 million tons in 1987, soybean output continued to increase at high rates and reached a roughly 200 million ton level in 2002, which means that the production doubled only in 15 years. The momentum of rapid growth did not stop after that, and soybean production reached a new record at 230 million tons in 2004. Tremendous efforts to increase the output have been made, especially in Brazil, and it may be only a question of time that the production of soybeans exceeds that of rice.

Competition among crops in the international market is fierce. Why are rice and wheat declining gradually? What is common to rice and wheat is the fact that both of them are mostly consumed by people directly as food. Of the total wheat output of 600 million tons, only 100 million tons are used as feed. The ratio is much lower for rice: the rice for feed is only less than 10 million tons of its global production of 400 million tons (FAOSTAT). The rest is consumed directly by people as a staple food.

The situation of corn and soybeans differs greatly. In addition to their low production costs, much of these crops is used as feed for domestic animals. Nearly 70 percent of the corn production at present (estimated output for 2004: 700 million tons) is consumed as feed. In the case of soybeans, 90 percent of the output of 230 million tons (estimate for 2004) is for processing, and almost all of this is used for edible oil production. Oil extraction produces soybean meal amounting to 140 million tons, which provides important feed for animals.

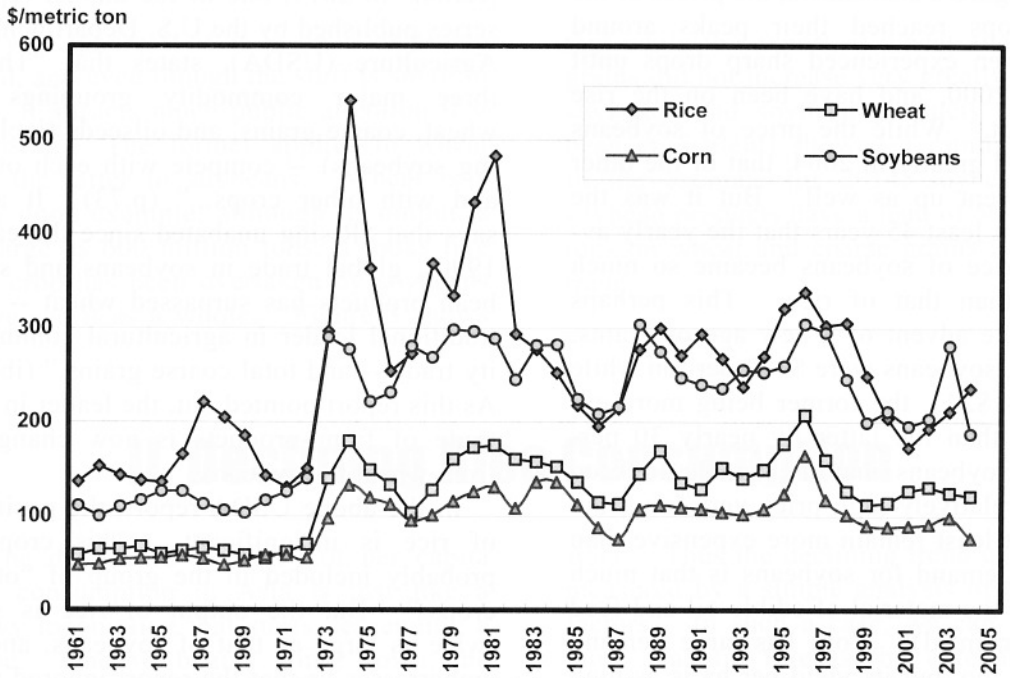
Worldwide, the consumption of livestock products, such as meat and dairy products, is favorably increasing. With economic development, the consumption of livestock products is rapidly growing in Asia. On the other hand, the consumption of grain as the staple food is sluggish. The natural result is decline in the demand for rice and wheat, which have been consumed mostly as the staple food. This phenomenon is now spreading globally. The authors have pointed out repeatedly that declining rice consumption in Asia would be very critical to world rice production. This downward tendency has not ended yet in Japan and many other Asian countries. In China, too, per capita rice consumption has steadily been decreasing since 1990 (Fig. 5 below), which may soon result in the decrease in consumption in the whole country. China's wheat consumption already dropped by nearly 10 percent from 110 million tons in 2000 to 100 million tons in 2004. As a consequence, the output also showed a rapid decrease of 25 percent from 120 million tons in 1997 to 90 million tons in 2004.

If the consumption falls in any form, the production declines. If the consumption grows, whether it is as food, as feed or as the material of a fuel or other products, the production increases, and vice versa. To increase the production before any growth in consumption, a new technology should have been developed and the production costs should have been lowered first. Otherwise, farmers could not cope with low market prices and would reduce the output. Therefore, even if the world population increases, demand for particular

type of food may not always increases. The situation of wheat in the past 15 years and that of rice for the past five years typically show this dilemma.

3. Similar price movements among grains

As Figure 2 shows, the price of rice, wheat, corn and soybeans, the four main grains, moves in a very similar way. In the past 45 years, their price movements resemble especially well in the latter 20 years. Although there are time lags of one or two years, the grain prices rise almost at the same time and go down together, too. It looks as if the four products joined hands and moved together happily. But in fact, these crops are never on good terms with each other. Their prices move similarly just because they are competing with each other. In the 1960s and the 1970s, the rice price fluctuated more wildly than that of the other three, which was the reason that rice was called a "thin market" and regarded as a special commodity. But from the second half of the 1980s onward, rice has not been the only commodity with violent price fluctuations but the price of the four crops has been increasing and decreasing all together. This indicates that the substitutability of these crops increased to that much level. In other words, it means that the competition among the four crops became more intense. Rice can no longer go alone and be traded at higher prices than the other three. Rice may enjoy higher prices for a



Source: Quoted directly from the annual data of the International Financial Statistics (IFS) (http://ifs.apdi.net/imf/).

Notes: 1. Rice: Bangkok, 5% broken, milled; wheat: No.1, Hard Red, US Gulf; corn: Yellow No.2, Gulf; soybeans: U.S. c.i.f. Rotterdam.

2. Calendar year.

Fig. 2. International prices of rice, wheat, corn and soybeans: 1961-2004 (annual average; nominal price in $/metric ton)

short period of time but will be unable to continue going by itself for a several year period. If its price remains high, the other three will soon follow suit. Farmers all over the world would never sit idly by and watch the situation; they will try to cultivate the crop once its price rises. Consumers now won't continue to eat the same food as before once the price goes up; they will instead switch to a relatively inexpensive food. Although every person will not do so, such a move of the consumer, even if they account for only several percentage points, will immediately influence the price on a global level, and price increases will be checked. This is why the prices of the four main grains are moving together as if to "join hands with one another."

As Figure 2 also shows, the prices of the four crops reached their peaks around 1996, then experienced sharp drops until around 2000, and have been on the rise after that. While the price of soybeans increased greatly in 2004, that of the other grains went up as well. But it was the first in at least 45 years that the yearly average price of soybeans became so much higher than that of rice. This perhaps means the advent of a new age of grains. In 2004, soybeans were $312 per ton while rice was $243, the former being more expensive than the latter by nearly 30 percent. Soybeans may be unable to keep such a relatively high price very long, but might at least remain more expensive than rice. Demand for soybeans is that much great as the material of edible oil and feed (soybean meal). Corn has large demand as feed, too, but its yield per ha is as high as 10 tons in the U.S., the major corn producing country, as compared with the yield of soybeans, which is only less than 3 tons per ha. This clearly shows that the production costs of corn per ton are far lower than those of soybeans.

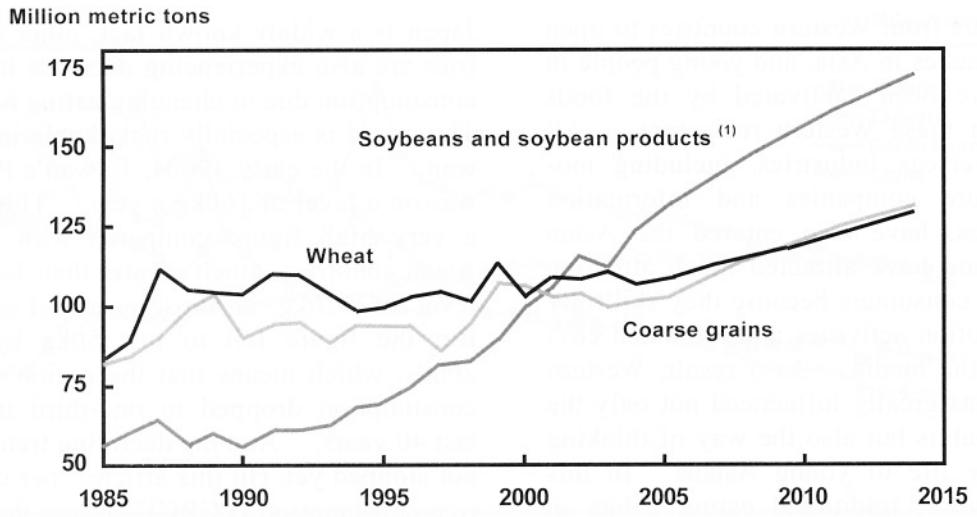
How about the situation of rice, then? Even in the U.S., the yield of rice per ha is 5 tons (on milled rice basis). Moreover, rice cultivation needs high costs mainly for land preparation and irrigation, making it difficult to earn profits if the price is on the same level as the other grains. This was why the price of rice was higher than that of the other three. But this is the story in the past. In recent years, as Asian people are reducing their rice consumption and demand for rice is declining as a result, the rice price is now becoming lower than that of soybeans.

4. "Competition among crops" mentioned in a USDA report

The USDA Agricultural Baseline Projections to 2014, one of the annual report series published by the U.S. Department of Agriculture (USDA), states that "These three major commodity groupings -- wheat, coarse grains, and oilseeds (including soybeans) -- compete with each other and with other crops..." (p.73) It also says that "Rising unabated since the early 1990s, global trade in soybeans and soybean products has surpassed wheat -- the traditional leader in agricultural commodity trade -- and total coarse grains." (ibid.) As this report pointed out, the leader in the trade of farm products is now changing from wheat to soybeans.

In the above USDA report, the position of rice is insignificant. This crop is probably included in the group of "other crops." But the output of rice is still twice as large as that of soybeans, and it embarrasses us that the report ignored rice so utterly. This fact suggests, however, that rice can actually become a useless "commodity" of which nobody would take account if it contents itself with the status quo.

Even if the stuff has a large body, peo-



Note: 1. Soybeans and soybean meal in soybean-equivalent units.
Source: USDA (2005), p.73.

Fig. 3. Global trade: Wheat, coarse grains, and soybeans and soybean products

ple will ignore it if it is on a declining trend, and even though the stuff is small in size, it attracts much public attention if it is rising. The former applies to wheat and the latter to soybeans. Wheat is a very good example; although its output is as large as 600 million tons, it looks like this crop has been overtaken by soybeans if we see it as a whole. Figure 3 shows that while the export of wheat and coarse grains did not increase very greatly, that of soybeans and soybean products (in soybean equivalent) showed a rapid growth. In the estimate for 2014, soybeans and soybean products have a lead of 50 million tons on wheat and coarse grains in global trade.

II. Declining Rice Consumption

The downward tendency of per capita rice consumption in Asia is just like a heavy locomotive that starts descending a slope. Once it begins going down, the locomotive would not stop easily because of the law of inertia. Even if there are some uneven parts, it continues running down as if to ignore these sections. The way like this is the characteristic of the decrease in per person rice consumption in Asia. Thus the declining trend cannot be measured by a simple analysis of external factors. In such a case, we can make a more realistic forecast by extending the downward trend to the future as it is. In particular, in Japan and some other Asian countries, rice consumption is little affected by its price and does not increase even if the price goes down.

Meanwhile, economic growth has urged

restaurants from Western countries to open their branches in Asia, and young people in Asia have been captivated by the foods served at these Western restaurants. All other overseas industries, including motion-picture companies and information businesses, have also entered the Asian market and have attracted much attention of Asian consumers because they skillfully do promotion activities and are much covered by the media. As a result, Western culture has greatly influenced not only the dietary habits but also the way of thinking and daily life of young Asians. In this circumstance, traditional eating habits in Asia are gradually fading away by the influence of Western culture.

1. Declining rice consumption in Asia

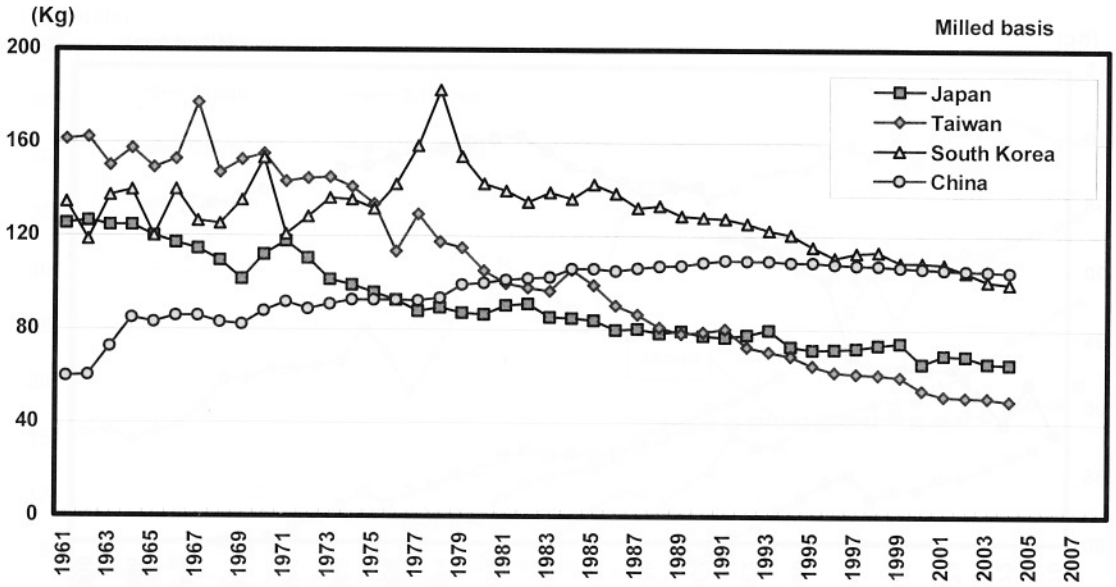
Demand for rice in Asia is likely to keep on decreasing in the future. In the Asian region, where people eat rice as a staple diet, rice consumption per person is over 100kg per year in general. In Japan, too, per capita rice consumption (PCRC) was well over 100kg a year until the early 1960s. If the yearly consumption exceeds 100kg, it means that, on average, all people, young and old, eat rice three times a day. But affected by the post-war economic growth and Western dietary habits, the content of meals taken by Japanese was westernized, resulting in increasing demand for bread and other wheat foods and livestock products. In the state of affairs like this, traditional rice-based Eastern eating style has been put under pressure by Western diets little by little, pushing down the rice consumption. Ito *et al.* (1989) had already foreseen such a situation and had warned about it, and the tendency is more alarming at present, nearly 20 years after that.

While declining rice consumption in Japan is a widely known fact, other countries are also experiencing decrease in rice consumption due to changing eating habits. This trend is especially remarkable in Taiwan. In the early 1960s, Taiwan's PCRC was on a level of 160kg a year. This was a very high figure compared with other Asian countries, much greater than Japan's level of 120kg in those years (Fig. 4). But the figure fell to just 50kg by the 2000s, which means that the region's rice consumption dropped to one-third in the last 40 years. And the declining trend has not stopped yet. (In this article, "per capita rice consumption (PCRC)" means the figure obtained by dividing the country's total rice consumption (including processed rice products and rice for feed) by its population.)

The PCRC in Japan was 65kg in 2004, and this figure shows that Japan's decreasing rate was lower than Taiwan's. But rice consumption still continues declining in Japan now, and it would be no surprise even if Japan's figure would go down to the level of Taiwan in the future. A similar tendency can be seen in South Korea where the dietary habit resembles that in Japan. As its rice production increased in the 1970s, South Korea enjoyed a growth in per capita rice consumption. But thereafter South Korean consumers began to prefer high quality rice with the country's economic growth, and their PCRC has since been declining steadily. South Korea's rice consumption is already expected to fall below 100kg in 2004, and its downward trend is likely to continue in the future.

Rice consumption decreases in China as well

A noteworthy country regarding decreasing rice consumption is China. China, the world's largest country with a population of 1.3 billion, has recently



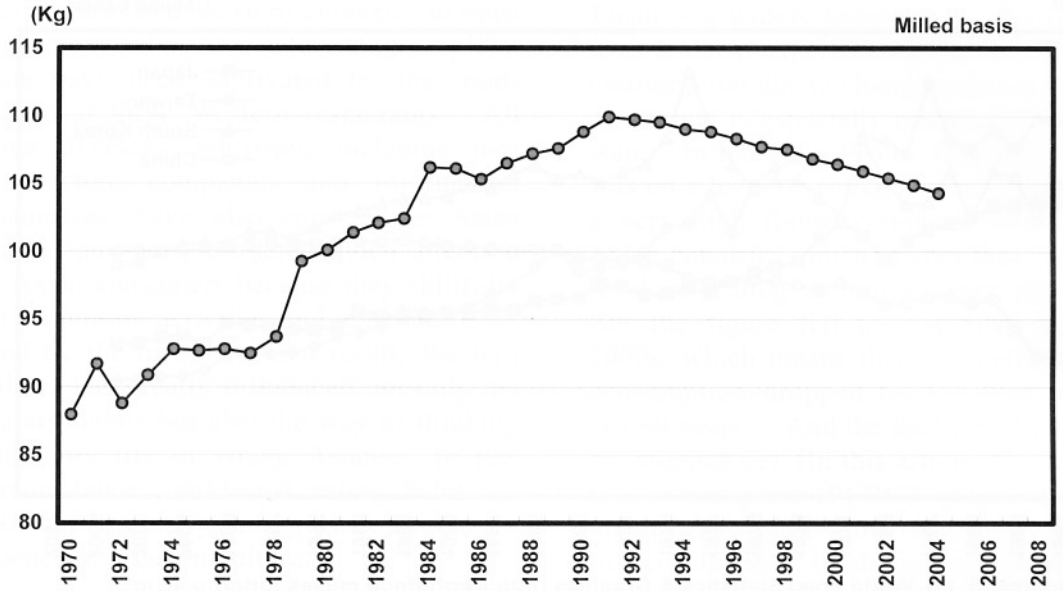
Source: S. Ito, World Food Statistics & Graphics (http://worldfood.muses.tottori-u.ac.jp).
Original data sources: USDA, PS&D Online, November 2004; USBC, International Data Base, March 2005.

Fig. 4. Per capita consumption of rice in Japan, Taiwan, South Korea and China: 1961-2004

shown a similar tendency. Until the early 1990s, the country's PCRC had gradually increased, but when we pick out China's curve only from Figure 4 above and check it carefully, we can see a clear declining trend in the recent decade (Fig. 5). After reaching a peak of 110kg in 1991, the PCRC fell gradually and went down to 106kg in 2002, a decrease of 3.6 percent. On average, it fell by 0.4kg a year in the recent decade, but a more detailed observation indicates that the amount of yearly decline amount was 0.2kg to 0.3kg in the first half of the 1990s but rose to 0.5kg in the 2000s, indicating that the decreasing rate was greater in the latter period. The price of rice was more sluggish around 2000, which means that lower prices made no great contribution to increase in rice consumption.

The fact that the decrease ratio of China's PCRC is 0.5kg a year means that the consumption is falling at an annual ratio of about 0.5 percent. Moreover, this decrease ratio tends to grow higher. The growth rate of China's population was about 0.6 percent in 2002. This rate is expected to lower in the years ahead, and the country's population will begin to decrease after reaching a peak around 2030. This means that China's total domestic rice consumption will begin declining within less than 10 years from now if things go as predicted. The country's rice consumption in 2001 was 134.58 million tons, which is only a small increase of 0.17 percent (240,000 tons) over the previous year.

A decrease by 1kg a year in the PCRC in China means that 1.30 million tons of rice are left over. If this tendency continues, the declining quantity of the country's PCRC will reach 1kg a year before long. Here, let's watch the situation in Taiwan, where the people's diet quite resembles that of China. During the past 40 years, Taiwan's PCRC decreased by 110kg from



Source: S. Ito, World Food Statistics & Graphics (http://worldfood.muses.tottori-u.ac.jp).
Original data sources: USDA, PS&D Online, November 2004; USBC, International Data Base, March 2005.

Fig. 5. Per capita consumption of rice in China: 1970-2004

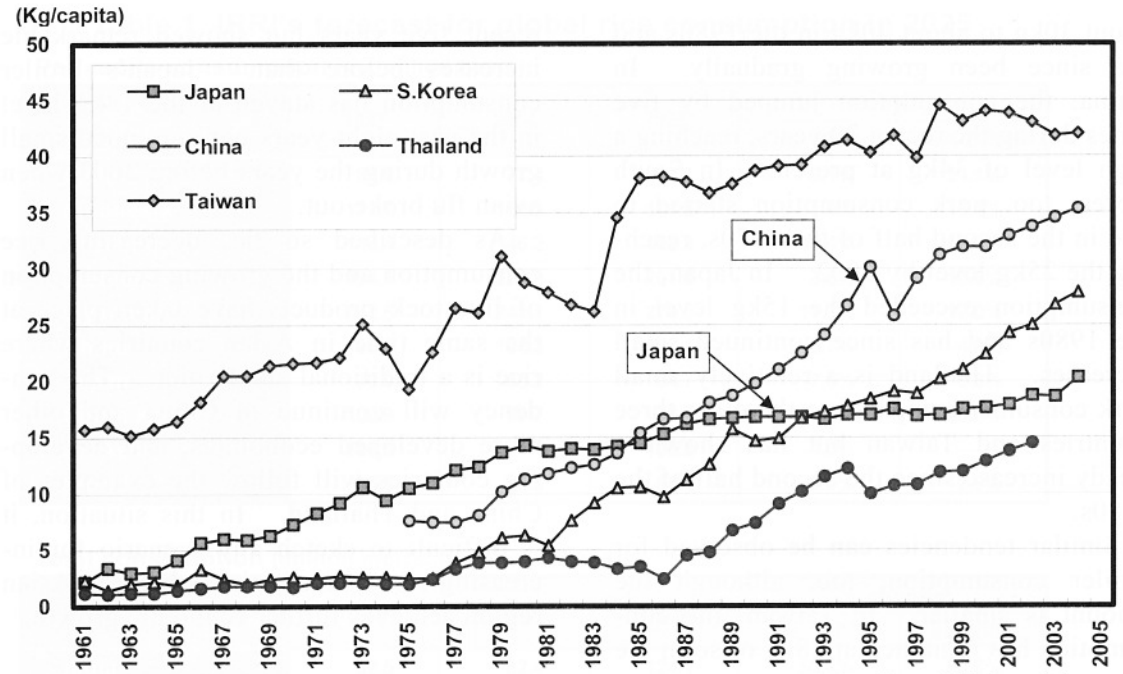
160kg to 50kg, which indicates that the yearly average declining rate was 2.7 percent. Considering the fact that in Japan, the rate was 1.3 percent in the same period, Taiwan's rice consumption fell at the rate twice as rapid as in Japan. While it is unknown at present that the PCRC in China will decrease at such a high rate, it is likely that China's consumption will fall at a quite high rate in the future in light of the past tendency because its dietary habit is fairly similar to Taiwan's.

According to the report of Chien (2004), rice consumption in big cities in China has been decreasing steadily, and the PCRC excluding eating out was 46kg in 2000, a decrease of as much as 12 percent as compared to 1995. The decline was much smaller in rural areas: the per capita consumption in 2000 was 89kg, a small drop of 1kg from 1995.

If China's PCRC continues decreasing at a rate of 1 percent a year in the future, it will fall to about 87kg by 2020. Because the country's population in the year is estimated at 1.4 billion, the total consumption will be 121 million tons or a decline of 15 million tons or so from the present level. As already stated, downward trends of PCRC like this have been seen in many Asian countries, and the decreasing momentum could be gathered in India, Bangladesh and Indonesia, which are very populous countries, too. In such a case, rice consumption will decline in entire Asia even though the population grows.

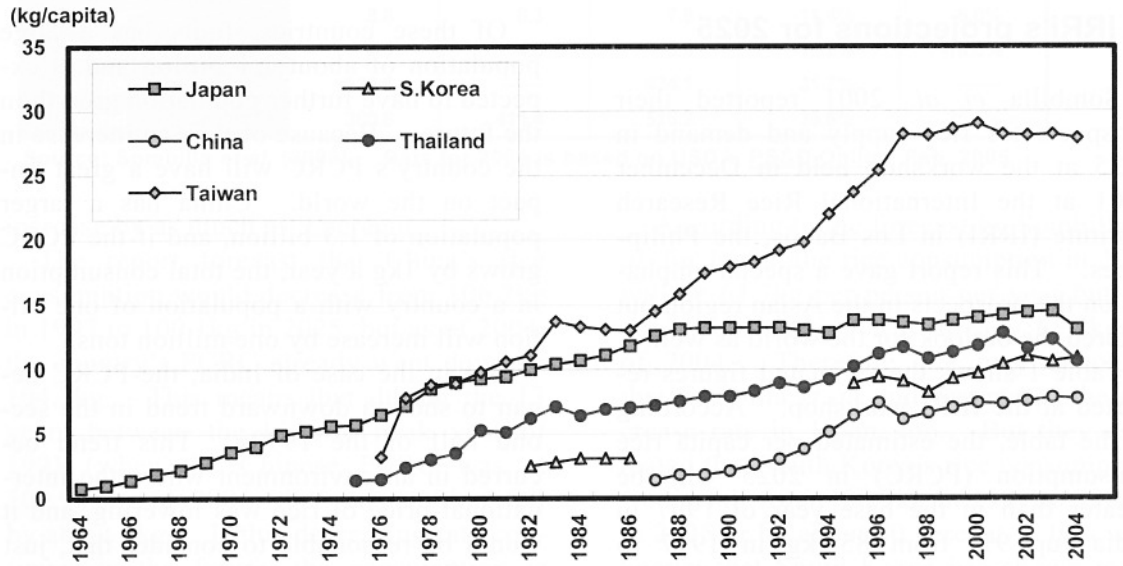
2. Increasing consumption of livestock products

The upward tendency of the consumption of livestock products can be observed in many Asian countries. Figures 6 and 7 show the per capita consumption of pork and broilers in four Asian countries and Taiwan, including Japan, for the past 40 years or so. In Taiwan, pork consumption per person showed a rapid increase from



Sources: USDA, PS&D Online, September 2004; Ito Laboratory's website (Tottori University); World Food Statistics & Graphics (http://worldfood.muses.tottori-u.ac.jp/graph/index.html), March 2005.

Fig. 6. Per capital pork consumption in Japan, South Korea, China, Taiwan and Thailand: 1961-2005



Sources: USDA, PS&D Online, September 2004; Ito Laboratory's website (Tottori University); World Food Statistics & Graphics (http://worldfood.muses.tottori-u.ac.jp/graph/index.html), March 2005.

Fig. 7. Per capital broiler consumption in Japan, South Korea, China, Taiwan and Thailand: 1964-2004

about 30kg to about 40kg in the 1980s and has since been growing gradually. In China, the consumption jumped by five times during the recent 30 years, reaching a high level of 34kg at present. In South Korea, too, pork consumption started to rise in the second half of the 1970s, reaching the 25kg level by 2002. In Japan, the consumption exceeded the 15kg level in the 1980s and has since continued small increases. Thailand is a relatively small pork consumer compared to the other three countries and Taiwan but has shown a steady increase since the second half of the 1980s.

Similar tendencies can be observed for broiler consumption, too, although the amount is smaller. In Taiwan, the consumption has remained at 28kg or so in the recent five years but showed remarkable increases before that. Japan's broiler consumption has stayed at the 14kg level in the past eight years but continued small growth during the years before 2003 when avian flu broke out.

As described so far, decreasing rice consumption and the growing consumption of livestock products have taken place at the same time in Asian countries where rice is a traditional staple diet. This tendency will continue in China and other more developed economies, and developing countries will follow the examples of China and Thailand. In this situation, it is difficult to sketch any scenario for increasing rice consumption when the Asian region achieves further economic growth.

III. Projections for Rice Supply and Demand

1. IRRI's projections for 2025

Sombilla *et al.* 2001 reported their prospects for rice supply and demand in 2025 at the workshop held in December 2001 at the International Rice Research Institute (IRRI) in Los Banõs, the Philippines. This report gave a special emphasis on the prospects in the Asian region but offered the outlook for the world as well.

Table 1 shows the estimated figures reported at the IRRI workshop. According to the table, the estimated per capita rice consumption (PCRC) in 2025 will be greater than in the base year of 1997 in India (up 9% from 85.9kg in 1997 to 93.7kg in 2025), Bangladesh (up 2% from 151.6kg to 154.6kg), Indonesia (up 2% from 171.7kg to 174.9kg), Vietnam (up 3% from 194kg to 201kg) and Myanmar (up 12% from 242kg to 279kg).

Of these countries, India has a large population of about 1.1 billion and is expected to have further population growth in the future. Because of this, an increase in the country's PCRC will have a great impact on the world. China has a larger population of 1.3 billion, and if the PCRC grows by 1kg a year, the total consumption in a country with a population of one billion will increase by one million tons.

But in the case of India, the PCRC began to show a downward trend in the second half of the 1990s. This trend occurred in an environment where the international price of rice was lowering, and it would be reasonable to consider that, just as in Taiwan and Japan, people's diet was changing little by little toward less rice consumption in India, too. Thus, we have to doubt the above-mentioned forecast by Sombilla *et al.* that India's PCRC would

Table 1. IRRI's forecast for global rice consumption in 2025

Per capita consumption (kg, milled basis)

	1997	2004	2025	% change	
				vs 1997	vs 2004
India	85.9	77.4	93.7	9.1%	21.1%
Indonesia	171.7	150.3	174.9	1.9%	16.4%
Thailand	146.4	146.2	128.2	-12.4%	-12.3%
Vietnam	194.1	224.9	201.0	3.6%	-10.6%
Myanmar	242.5	241.1	270.0	11.3%	12.0%
China	106.2	104.3	100.1	-5.7%	-4.0%
Japan	70.0	65.2	64.7	-7.6%	-0.8%
South Korea	100.9	99.7	73.4	-27.3%	-26.4%
All Asia	106.3	—	105.2	-1.0%	—
World	65.8	64.5	66.4	0.9%	2.9%

Total consumption (million metric tons, milled basis)

	1997	2004	2025	% change	
				vs 1997	vs 2004
India	82.5	82.4	124.1	50.4%	50.6%
Indonesia	34.9	35.8	47.8	37.0%	33.5%
Thailand	8.7	9.5	9.3	6.9%	-2.1%
Vietnam	14.8	18.6	21.7	46.6%	16.7%
Myanmar	11.2	10.3	16.5	47.3%	60.2%
China	132.6	135.1	148.8	12.2%	10.1%
Japan	8.8	8.3	7.8	-11.4%	-6.0%
South Korea	4.6	4.8	3.9	-15.2%	-18.8%
All Asia	329.6	—	434.1	31.7%	—
World	380.8	411.4	516.2	35.6%	25.5%

Source: Sombilla *et al.* (2003). Data for 2004 is based on USDA, PS&D Online, Feb. 2005.

increase by as much as 9 percent.

The report forecast that China's rice consumption would decrease from 106.2kg in 1997 to 100.1kg in 2025, but as of 2004, the country's PCRC already went down to 104.3kg. This means that during the 13 years between the historic peak year of 1991 (when the Chinese PCRC was at 109.9kg) and 2004, the consumption fell by about 5kg. If this decreasing rate continues in the future, the consumption is highly likely to be less than 100kg already in 2015, ten years from now, and to decline to 95kg or so by 2025, another decade thereafter.

According to the forecast by Sombilla *et al.* for Japan, the rice consumption in 2025 will be 64.7kg per person per year but Japan's consumption was already 65.2kg as of 2004. Therefore, we may conclude that Sombilla *et al.* underestimated the decrease rate in Japan, too. But they estimated that South Korea's rice consumption would fall from 100.9kg in 1997 to 73.4kg in 2025 or by about 30 percent. It is well known that South Korea has shown rapid decreases in recent years.

Sombilla's team estimated that global PCRC would show a small increase from 65.8kg in 1997 to 66.4kg in 2025, but not

many other research institutes have forecasted any increase. As noted later, both the Food and Agricultural Policy Research Institute of the U.S. (FAPRI at the University of Iowa) and the U.N. Food and Agriculture Organization (FAO) predicted that rice consumption would fall.

Finally, let's examine the team's estimate for the global demand for rice. They forecasted that the world's PCRC would grow, and this forecast naturally swells the amount of consumption in the world due to the effect of population growth. Sombilla *et al.* estimated the global total demand for rice in 2025 at 515.6 million tons. This represents an increase of 36 percent over the total demand for 1997, the base year they used, which was 380.80 million tons. It is a growth of 26 percent as compared with 2003 when the consumption rose to 410 million tons.

This indicates as a whole that the team overestimated the pace of increase as to the countries where the consumption is on the rise, whereas they underestimated the declining rate of the countries with a downward trend; as a result, they overestimated global demand for rice in the future.

Because the team overestimated an increase in rice consumption in India and underestimated the downward trend in China, their forecast figure for global demand in 2025 may be unrealistically greater than the real situation. In the period just before 2000 when they made this estimation, rice production rapidly increased as its market price rose in the second half of the 1990s, reaching the 400 million ton level in 1999 first in history. Rice consumption went on growing, too, in those years. Therefore, the team's forecast would have been apt to be affected by these general conditions, inducing them to forecast such a substantial increase in demand for rice in the future.

2. Projections by the U.S. and FAO

How did other research institutes estimate rice consumption, then? The world's PCRC already began to decrease from 66.5kg in 2001, and the figure for 2004 was 64.5kg, a decline of 2kg in those three years. In such a situation, the Food and Agricultural Policy Research Institute (FAPRI) at the University of Iowa reported in its forecast for 2014 that the consumption would fall to 63kg by that year. The FAPRI publishes its outlook for global food supply and demand every year, and it was not the first time for the institute to simulate a downward trend in its projections for the global rice consumption. In its prospect published in 2004, the FAPRI predicted that the consumption would decrease from 65.6kg in 2003 to 64.2kg in 2013. As described above, the institute reported that the world's PCRC would fall to 63kg by 2014 and its estimated total consumption in the world in that year was about 448 million tons.

Let's compare this figure with the estimate by Sombilla *et al.* Sombilla *et al.* did not publish its estimate for 2015 and the years before and after that year, but if we suppose that the increase in rice consumption predicted by the team would take place at the same yearly rate from 1997 to 2025, the consumption in 2014 would be like 453 million tons. The team's actual estimate for that year should have been a little greater than this figure because the population growth during these years is expected to be higher than in the subsequent years. Therefore, the FAPRI's estimate is less than the Sombilla team's estimate by at least five million tons (Fig. 8). But the FAPRI made a downward revision of its simulation in 2004 in its projections in 2005 by about 1.5% (Fig. 9).

The FAO's reports predicting the future

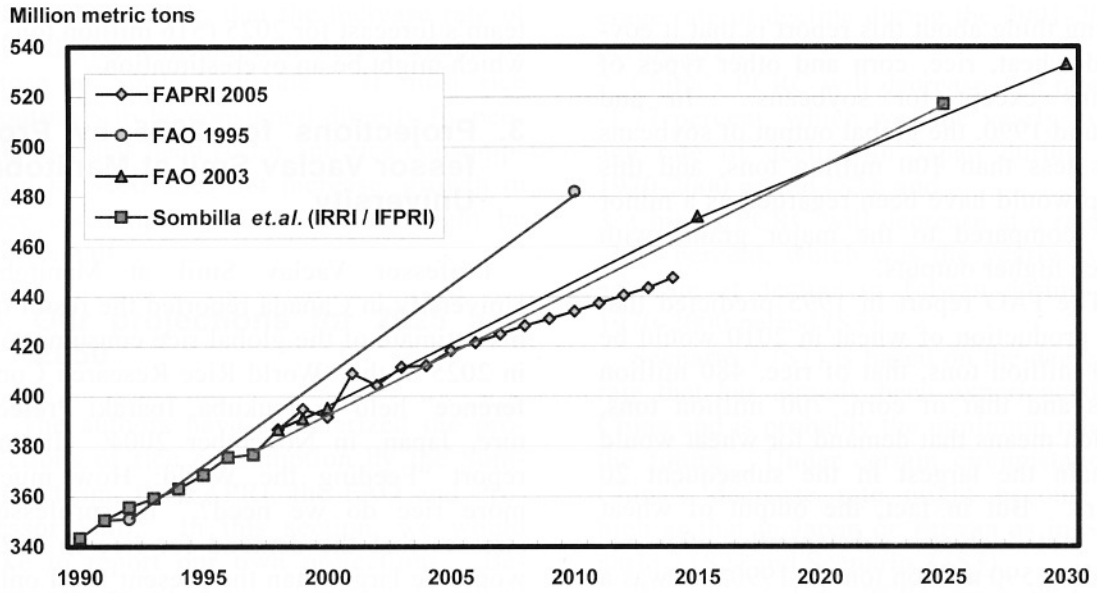


Fig. 8. Main forecasts for the global total rice consumption

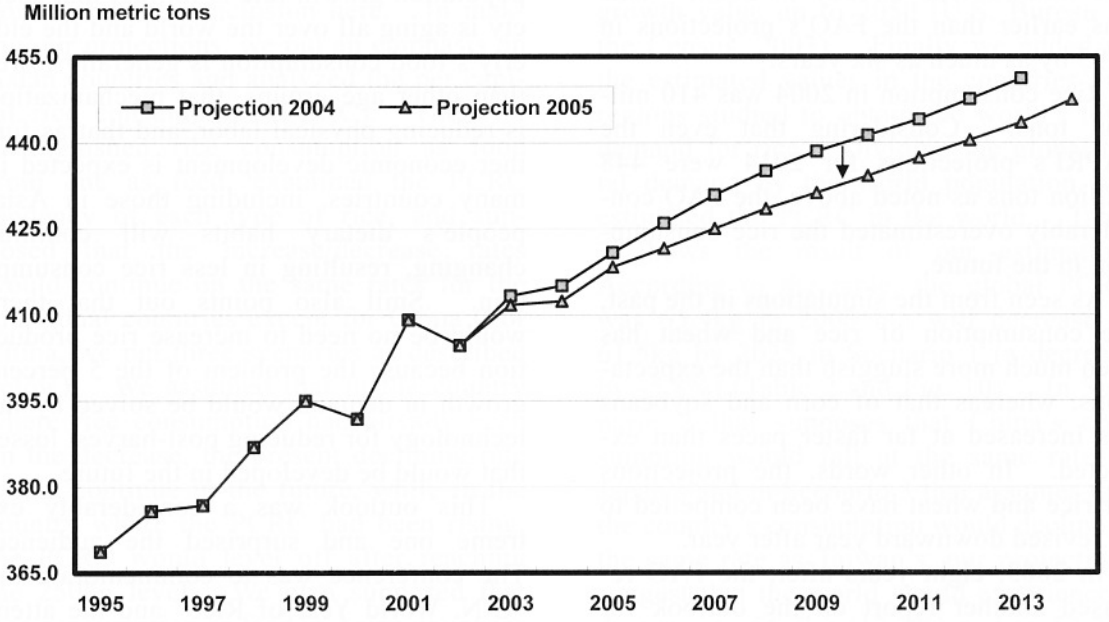


Fig. 9. Change in the FAPRI's forecasts for the global total rice consumption

consumption are described later. In 1995, ten years ago from now, the FAO published a report of 488 pages entitled "World Agriculture: Toward 2010." This report estimated the situation in 2010, 20 years after the year when the estimates were conducted, on the basis of the three-year average between 1988 and 1990. An inter-

esting thing about this report is that it covered wheat, rice, corn and other types of grains except for soybeans. In and around 1990, the global output of soybeans was less than 100 million tons, and this crop would have been regarded as a minor one compared to the major grains with much higher outputs.

The FAO report in 1995 predicted that the production of wheat in 2010 would be 710 million tons, that of rice, 480 million tons and that of corn, 700 million tons, which means that demand for wheat would remain the largest in the subsequent 20 years. But in fact, the output of wheat did not increase substantially after recording 590 million tons in 1990 and was a little over 600 million tons even in 2004. By contrast, corn registered an output of 700 million tons already in 2004. This was earlier than the FAO's projections in 1995 by as much as six years.

Rice consumption in 2004 was 410 million tons. Considering that even the FAPRI's projections for 2014 were 448 million tons as noted above, the FAO considerably overestimated the rice consumption in the future.

As seen from the simulations in the past, the consumption of rice and wheat has been much more sluggish than the expectations, whereas that of corn and soybeans has increased at far faster paces than expected. In other words, the projections for rice and wheat have been compelled to be revised downward year after year.

In 2003, eight years after, the FAO released another report on the outlook for 2015 and 2030 (FAO, 2003). In this report, the FAO predicted that the world's demand for rice would be 472 million tons in 2015 and 533 million tons in 2030. But the estimate for 2015 is larger than the FAPRI's figure for 2014 (448 million tons) by about 20 million tons, and that for 2030 is only a little bit smaller than the Sombilla team's forecast for 2025 (516 million tons), which might be an overestimation.

3. Projections for 2025 by Professor Vaclav Smil at Manitoba University

Professor Vaclav Smil at Manitoba University in Canada reported the result of his estimate of the global rice consumption in 2025 at the "World Rice Research Conference" held in Tsukuba, Ibaraki Prefecture, Japan, in November 2004. In his report "Feeding the World: How much more rice do we need?," the professor stresses that the demand for rice in 2025 would be larger than the present level only by 5 percent. According to him, the main reasons for this small increase are that the population growth rate is falling, that society is aging all over the world and the elderly's food consumption is generally lower than other age groups, that mechanization is reducing physical labor, and that as further economic development is expected in many countries, including those in Asia, people's dietary habits will continue changing, resulting in less rice consumption. Smil also points out that there would be no need to increase rice production because the problem of the 5 percent growth in demand would be solved by the technology for reducing post-harvest losses that would be developed in the future.

This outlook was a considerably extreme one and surprised the audience. The conference was to commemorate the "U.N. World Year of Rice" and the attendance expected a prediction of increase in consumption from the professor as from other reporters. The authors feel sympathy for and would like to show respect to the professor's bold estimate. While we cannot readily believe that rice production does not need to increase from the present level in 20 years after, we cannot deny the

possibility, either, that the increase rate of global rice consumption may perhaps be close to Smil's estimate. If most rice continues to be consumed directly by people as it has been so far and rice consumption for feed does not increase, growth in rice consumption in the future might be very small.

4. Our projections for 2025 and 2050

The authors have summarized the projections of rice consumption by the Sombilla team, the FAPRI, the FAO and Professor Smil. In this section, we would like to report our own projections. Because the result of our estimate is described in detail in a separate paper (Abdulla, Ito & Kimura, 2005), we state only the main points and the conclusion here. In making our projections, we put an emphasis on Asian countries and analyzed the per capital rice consumption (PCRC). Then we distinguished rice consumption as food from one as feed, examined the PCRC tendency of each type of rice, and supposed that the increase/decrease rates would continue on the same rates for the individual countries except for China (For China, we put three scenarios as described below). We assumed that in the country where rice consumption had already been on the decrease, the present declining rate would continue in the future, while in the country where the PCRC had been rising, the PCRC would level off after reaching the 250kg level. We also supposed that rice consumption as feed in Asian countries would remain on the present level in the future.

As for China, the largest rice consumer in the world, we envisioned three scenarios as follows:

1. China's PCRC will decrease at a rate of -0.331 percent, which was the yearly average rate of decline during the 2001-2003 period (S1);
2. China's PCRC will decrease at a rate of -1.77 percent, which was the yearly average rate of decline in Japan during the 1970-2000 period (S2); and
3. China's PCRC will decrease at a rate of -3.45 percent, which was the yearly average rate of decline in Taiwan during the 1970-2000 period (S3).

Scenario 1 (S1) is based on the decrease rate that has already been experienced in China and is probably the minimum rate in the future. Under certain circumstances, China's decrease rate might become as high as that in Japan or Taiwan as in Scenario 2 (S2) and Scenario 3 (S3).

We estimated the PCRC for both Asian and other countries and multiplied the PCRC figure by the estimated population growth value up to 2050 (U.S. Bureau of the Census, 2003). Finally we added up the estimated values in the countries and regions studied to obtain the world's total demand for rice. Dividing the global total demand by the world population, we estimated the PCRC in the world. Table 2 shows the result of our estimation. According to the table, the global PCRC was 65.4kg in 2003 but will decrease to 61.5kg by 2025 in Scenario 1 (a decrease by -5.8%) (Table 2 and Fig. 10). In Scenario 2 that supposes that China's consumption would fall at the same rate as Japan's and in Scenario 3 that assumes that the country's consumption would decline at the same rate as Taiwan's, our projections suggest that the world would experience a decrease to 56.7kg (13.2%) and to 52.7kg (19.3%), respectively. The PCRC in 2050 in the three scenarios was estimated at 57.8kg, 50.9kg and 47.0kg, respectively.

The global total consumption was 412 million tons in 2003 and it was supposed that it would increase to 482 million tons by 2025 in Scenario 1 (Fig. 11). This

Table 2. Projections for rice consumption in Asian countries and in the world: estimated per capita and global total consumption in 2015, 2025 and 2050

Per capita consumption (kg)

	2003	2015			2025			2050		
Japan	68.1	56.0			48.7			34.4		
South Korea	103.6	82.6			69.7			45.4		
Taiwan	50.9	45.9			42.9			36.2		
India	81.0	69.2			63.0			49.9		
Thailand	158.7	159.4			165.9			103.2		
		S1	S2	S3	S1	S2	S3	S1	S2	S3
China	104.9	101.0	86.1	71.2	97.8	72.0	50.1	90.0	46.0	20.8
Asian countries	95.2	89.3	84.5	79.8	85.8	77.9	71.3	78.4	66.8	60.1
World	65.4	63.1	60.2	57.3	61.5	56.7	52.7	57.8	50.9	47.0

Total consumption (million metric tons)

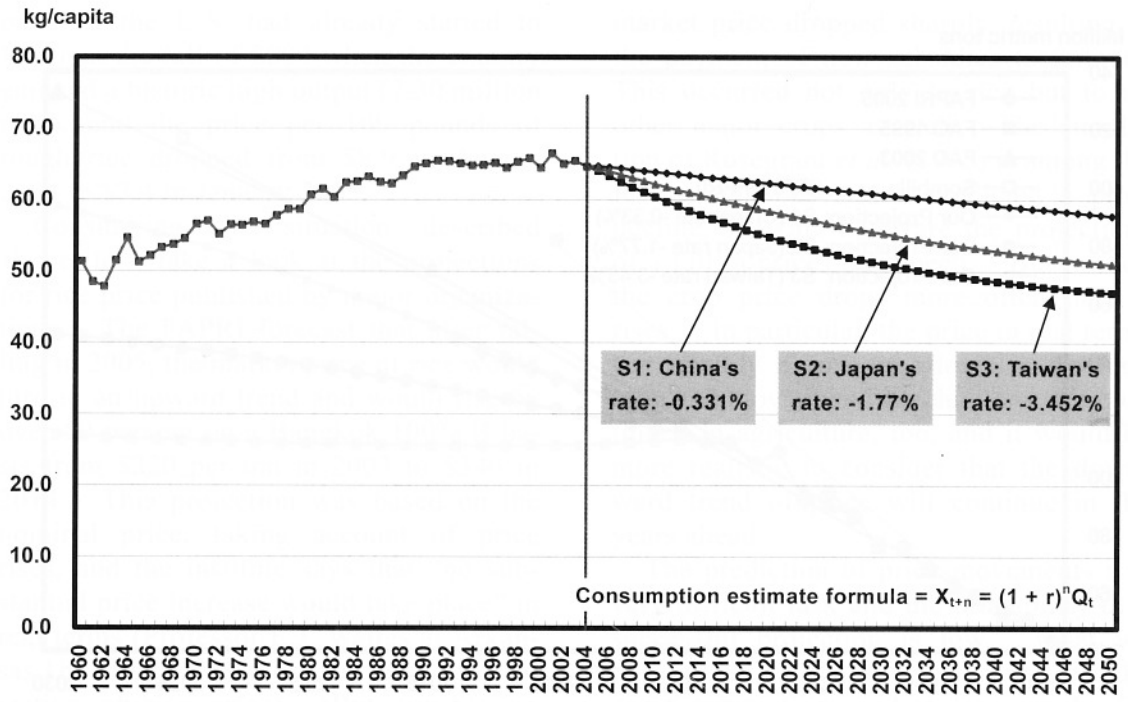
	2003	2015			2025			2050		
Japan	8.7	7.0			5.8			3.4		
South Korea	5.0	4.2			3.6			2.2		
Taiwan	1.2	1.1			1.1			0.8		
India	85.0	85.0			85.3			79.9		
Thailand	10.2	11.2			12.2			13.6		
		S1	S2	S3	S1	S2	S3	S1	S2	S3
China	135.0	140.2	119.4	98.8	141.6	104.3	72.6	127.6	65.3	29.5
Asian countries	360.0	388.9	368.1	347.5	407.7	370.4	338.7	419.6	357.3	321.5
World	412.3	452.5	431.7	411.1	481.9	444.6	412.9	525.0	462.8	427.0

Note: The decrease rate applied to the three scenarios for China:
a. Scenario 1(S1): -0.331% (average rate in China during the 2000-2003 period);
b. Scenario 2(S2): -1.772% (average rate in Japan during the 1970-2000 period);
c. Scenario 3(S3): -3.452% (average rate in Taiwan during the 1970-2000 period).

Source: Abdulla, Ito and Kimura, 2005

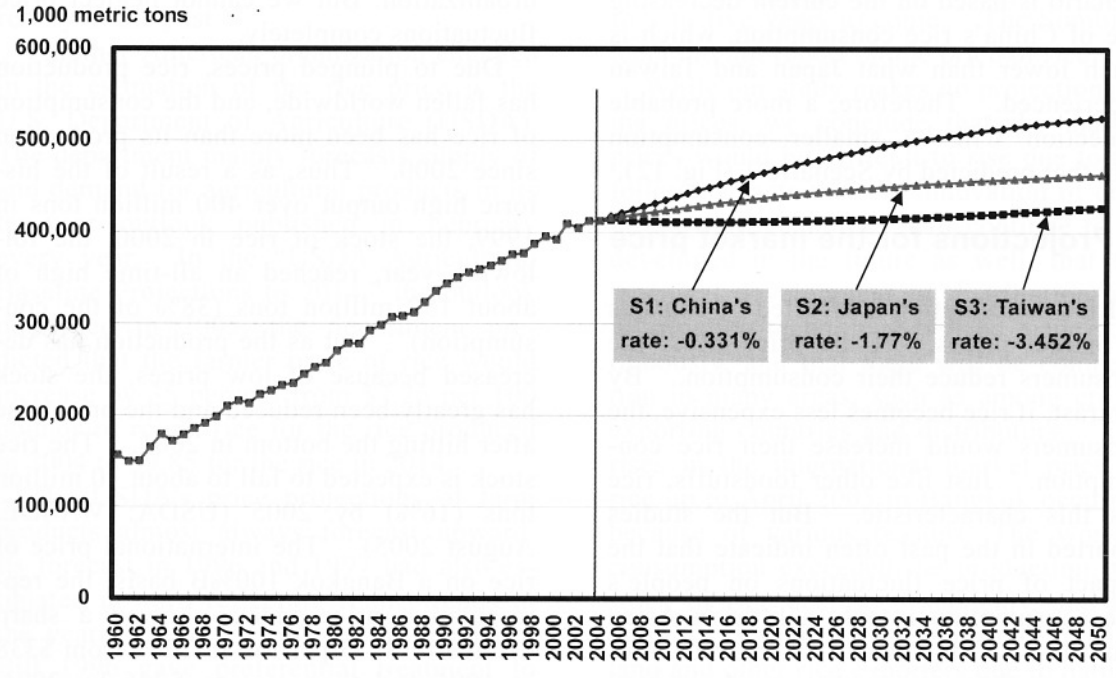
figure is smaller by about 30 million tons than the estimate by the Sombilla's team at 516 million tons. The estimated consumption in 2025 was 445 million tons in Scenario 2 and 413 million tons in Scenario 3, which means that the consumption would increase only a little over the level in the early 2000s, which was about 410 million tons. Only Scenario 1 predicts that the world's total consumption would go over 500 million tons but it would occur only after the mid-2030s. According to Scenario 1, the total consumption in 2050 would be only as much as 530 million tons. Scenarios 2 and 3 forecast that the global total consumption in 2050 would be far below the 500 million ton level.

While the world's total rice consumption in 2014 was estimated by the FAPRI at 448 million tons, the projections in Scenarios 1, 2 and 3 were 449 million tons, 430 million tons and 411 million tons, respectively. The FAPRI's figure is very similar to the estimated result of Scenario 1, but this



Source: Abdulla, Ito and Kimura, 2005

Fig. 10. Simulations of the world's per capita rice consumption for 2050



Source: Abdulla, Ito and Kimura, 2005

Fig. 11. Simulations of the global total rice consumption for 2050

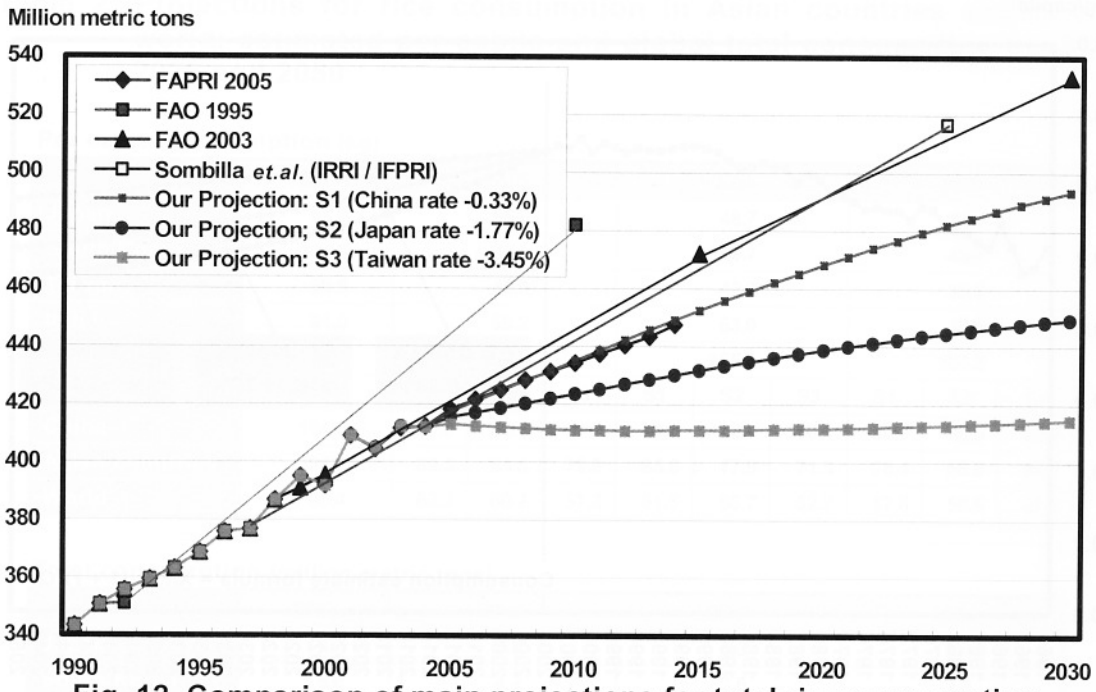


Fig. 12. Comparison of main projections for total rice consumption
(world, million metric tons)

scenario is based on the current decreasing rate of China's rice consumption, which is much lower than what Japan and Taiwan experienced. Therefore, a more probable projection will be smaller consumption than that predicted by Scenario 1 (Fig. 12).

5. Projections for the market price

Rice consumption is affected by changes in market prices. If the price rises, the consumers reduce their consumption. By contrast, if rice becomes less expensive, the consumers would increase their rice consumption. Just like other foodstuffs, rice has this characteristic. But the studies reported in the past often indicate that the impact of price fluctuations on people's rice consumption is only a little in Asian countries. This means that the effects of non-price factors are that much greater. These other factors include changes in the consumer's taste, changes in income, and urbanization. But we cannot neglect price fluctuations completely.

Due to plunged prices, rice production has fallen worldwide, and the consumption of rice has been more than its production since 2000. Thus, as a result of the historic high output over 400 million tons in 1999, the stock of rice in 2000, the following year, reached an all-time high of about 150 million tons (38% of the consumption). But as the production has decreased because of low prices, the stock has greatly been reduced and the price rose after hitting the bottom in 2001. The rice stock is expected to fall to about 70 million tons (16%) by 2005 (USDA: WASDE, August 2005). The international price of rice on a Bangkok 100%B basis, the representative price index, showed a sharp decline to $173 per ton in 2001 from $338 in 1996 and then rose to $246 by 2004, registering some recovery in these three years. On the other hand, the farmer

price in the U.S. had already started to lower in the fall of 2004 when the country enjoyed a historic high output (7.30 million tons), and the price per 100 pounds of rough rice dropped from $8.9 in August 2004 to $7.4 in January 2005.

Considering the situation described above, let's take a look at the projections for rice price published by major organizations. The FAPRI forecast that after falling in 2005, the market price of rice would turn to an upward trend and would rise by over 50 percent on a Bangkok 100% B basis from $220 per ton in 2003 to $340 in 2014. This projection was based on the nominal price, taking account of price rises, and the institute says that "no substantial price increase would take place" in real terms (Professor E.J. Wailes at Arkansas University who took charge of the projection of rice price). But considering that the rice price has been decreasing in real terms, the institute's forecast of price rises can be seen as inconsistent with the reality in the past.

Another American organization engaged in the estimation of the rice price is the U.S. Department of Agriculture (USDA). The department mainly forecasts supply of and demand for agricultural products in its ten-year outlook published in February every year. In the "USDA Agricultural Baseline Projections to 2014," the outlook published in 2005, the department predicted that the farmer price of rice would increase by 35 percent from $7.25 per 100 pounds of rough rice for the rice produced in 2004 to $9.85 for the rice in 2014.

The USDA's price projections of farm products almost always forecast upward. Its forecast in 1996 and 1997 had also estimated upward reflecting rising trends in the years before. However, as the Farm Bill 1996 gave preferential treatment to American farmers, rice production was spurred and rapidly increased; therefore, its market price dropped sharply, resulting in the payment of new subsidies to farmers. This occurred not only to rice but to all other major crops as well. The simulation of Rosegrant *et al.* (1995) is among the few simulations which predicted a price decline, showing how rare the projections of a fall in prices have been. But in fact, the crop price drops more often than it rises. In particular, the price in real terms has steadily been going down in the long term. Innovations in technology are continued in agriculture, too, and it would be more realistic to consider that the downward trend of price will continue in the years ahead.

The prediction of price movements is a very difficult task and the probability of a successful projection is low. What we have to do in the simulation is to make some assumptions and to forecast the future situation based on these assumptions. In any case, it is a virtually impossible task to precisely forecast the market price in the four to five years to come. The Sombilla team did not report on the price of rice.

While our study makes no projections of the prices, we conclude that the market prices would be difficult to rise due to the following facts that the innovation of crop production technology will continue to be developed in the future as well, that the technical development of distribution and information technology will be made continuously, and that there will be competition in many areas, such as among crops, exporting countries and distributors. The rises in the international market price of rice up to April 2005 in Bangkok occurred because of various reasons: The world's consumption exceeded the production, the stock of rice decreased suddenly, and the output was smaller than expected in Thailand and other rice exporters due to natural disasters or other causes, which seriously affected rice exports. But higher market

prices will boost rice production, resulting in the price hitting the ceiling and going down again. In this case, it will be favorable that demand for rice increases first and then the rice production grows and sets a new production record. But if demand did not go up, the price would not rise and the production growth would become limited as a result.

IV. Summary: The Key is to Increase the Demand

The outlook for rice in the world is by no means bright. Unless the present situation is improved, rice would be overwhelmed by other grains. There is a possibility that people in the world can survive all right without rice. Then, by whom on earth is rice consumed? There has been a global boom of sushi and other Japanese foods, but this does not have such a large scale as can offset the weakening demand for rice in Asia. Asia accounts for roughly 90 percent of the world's rice production; rice culture is so much concentrated in Asia, where rice production is advantageous because of the monsoon climate with much rainfall. Rice is the key point of Asian agriculture. But demand for rice is decreasing in Asia. If rice production in Asia drops, Asia's competitiveness in agriculture will decline, worsening the problem of poverty in rural areas in Asia at the same time. Not only Asia but other rice producing regions in the rest of the world will incur the same heavy losses.

Rice has to win in the competition among crops as described above. What is important to rice and rice producing areas in the world including Asia is to increase the needs for rice and to expand its demand. One of the ways to achieve this is to raise productivity taking account of rice as feed and to create the situation where the production can continue growing even if the price is low. To realize this, production costs have to be cut down so as to compete in price as feed with corn and soybeans.

Rice and corn have different nutrition structures, and rice cannot totally take the place of corn as feed as it is. But feed factories in Thailand have estimated in pig farming that almost all of corn feed could be switched to rice feed if the price of rice decreases to the level of corn. At present, rice prices in the international market are higher than that of corn by twice to 2.5 times. Although rice has become relatively inexpensive compared to the level in the 1970s and the 1980s, it is still too expensive for livestock producers. This is why all the rice used at feed factories is now cheap broken rice and rice brans.

Serious efforts will have to be made to develop the method for producing the rice for feed that can compete with corn. It would be possible to breed the high-yield varieties of feed rice more easily because there will be no need to pay much attention to the taste in this category.

Another strategy is to put a more effort to develop new rice products. You can no longer afford to insist that rice must be consumed as cooked rice. One should try anything that has a possibility. In this way, you should utilize the agricultural resources in Asia and other rice-producing

regions as much as possible and maintain and increase the competitive power of rice against corn and soybeans. To win in the international competition among crops and producing areas, Japan is expected to lead in the projects aiming at attaining these objectives.

Notes: [1] The figures of rice consumption used in this article are all on a milled rice basis. [2] The data used in this article is contained in our website of Tottori University: http://worldfood.muses.tottori-u.ac.jp.

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Rice in the World Verg

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Sushi and Asian food are becoming very popular in Western societies (Photo at Skipol Airport, Amsterdam). This is a great help for rice but not enough to compensate the declining demand for rice in Asia

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Recently, many kinds of rice bread are being developed in Japan

A lavish dinner party in China, where rice is often excluded from the menu; the same path that Japan and Taiwan mistakenly proceeded

g their rice-based lunch outside. The rice-based lunch may be critical in maintaining the rice consumption at once stopped giving rice-based school lunches but has esume them since the late 1970s

The U.S. rice industries have been putting a great deal of efforts to develop new rice products. This photo shows the Lundberg Family Farms' 100%-organic-brown-rice chip products