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GLOBAL GRAIN TRADES: CHALLENGES AND OPPORTUNITIES

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Key words: grain, food security, trade, WTO, Korea.

ABSTRACT

World food supply and demand has been largely balanced over the last 40 years. Despite chronic hunger and malnutrition continuing to surface, overall grain prices have stabilized since the 1970s and the levels of energy intake have improved. But a number of challenges lie ahead: a steady decline in arable areas per capita, stagnant output growth, increasing food demands, declining grain stocks, population expansion, and monopolistic structure in grain trades. In the midst of deteriorating food self-sufficiency, Korea's food state appears to follow suit of the global trend. Adequate policies are also required to address these challenges. Existing market inefficiency must be remedied by reducing food wastes and enhancing physical resources in developing countries. Under the WTO system, it is also important to strengthen disciplines on export ban and restriction and allow flexible measures for grain stockholdings and stable grain supplies.

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I. Introduction

> *Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active healthy life* (FAO 1996).

The world food crisis in the 1970s gave us the wake up call to ensure food security. As a consequence, a World Food Summit (WFS) under the United Nation's Food and Agricultural Organization (FAO) was held to develop recommendations to enhance the global food supply. The situation however shifted to excess food supplies and falling prices in the 1980s. Since then, high commodity prices and historically low grain stocks in the mid-1990s rekindled a fundamental question of whether global agriculture has the capacity to produce enough food to feed a growing population.

During the course, more immediate concerns regarding hunger and malnutrition emerged. The FAO recently estimates that 842 million people worldwide were undernourished in 1999~2001(FAO 2003). The vast majority of the hungry (around 95%) are in developing countries. It is thus alerted that the WFS's goal of reducing the number of hungry people by half by 2015 must be accelerated.

In 2003, we are again facing a rising demand for food in the world. Global stocks of grain fell close to the level of the early 1970s and thus commodity prices have drastically increased. A concern is the sustained global food shortfalls since 2000. In spite of good harvests in 2004, continuing tight supplies will be extended.

Further to which, agriculture will have to feed an additional 2 billion people over the next 30 years. A real challenge is to produce extra food from an increasingly fragile natural resource base. To address such a challenge, the world agricultural sector must increase agricultural yields and reduce production costs,

while addressing consumer concerns for food safety and quality.

This paper aims to assess global and national food security situations. In doing so, common indicators are estimated over the long term period. It then identifies some of potential challenges that have to be addressed and discusses policy alternatives in the international regimes.

II. Present Global Food Situation

There is no standard measure for global food situations but it would be useful to estimate some numerical indicators and examine their trends over years. A yardstick used to measure will primarily be grain since grain accounts for about a half of the food energy in people's intake and unlike fruits and vegetables, it is a stable food source with good storability (Brown and Kane 1994). Here, grain refers to rice, wheat and coarse grains which in turn comprise corn, barley, sorghum, oats and rye.

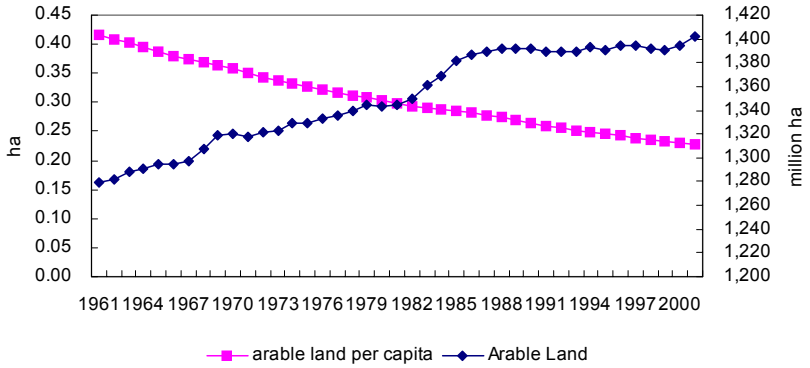
1. Arable Areas

A change in arable areas is a useful indicator that provides information regarding capacity of food production. Arable areas have generally increased in the last 40 years (Figure 1). But recent flattening out beginning from the late 1980s, sheds light on the fact that a capacity of future production will be largely constrained by the limited arable land. Arable areas per capita steadily declined from 0.42 hectare in 1961 to 0.23 hectare in 2001, a 45% reduction. While arable areas earned almost 10%, the population doubled in the same period. Another inference drawn by this indicator is that outpaced population could threat global food situations in the future (Lim 1999).

2. Production, Consumption and Trade

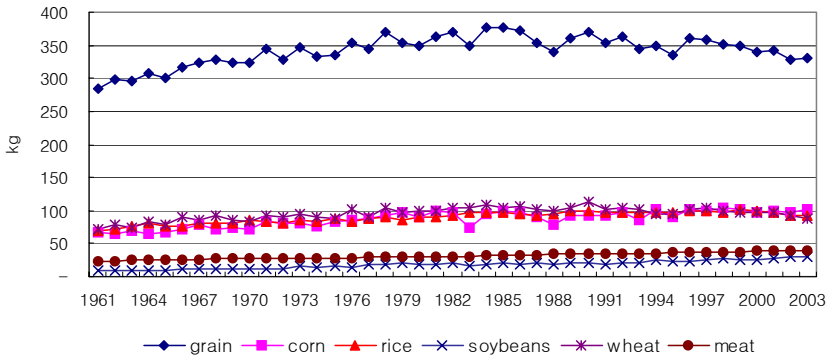
Food availability measured by grain production per capita improved up to the mid-1980s. But since then it has stagnated at around 350kg (Figure 2). On the other hand, meat production per capita continues to increase and reached 40kg in 2003. Soybeans

FIGURE 1. Global Arable Areas



Source: FAO (2004a).

FIGURE 2. Grain and Meat Production Per Capita

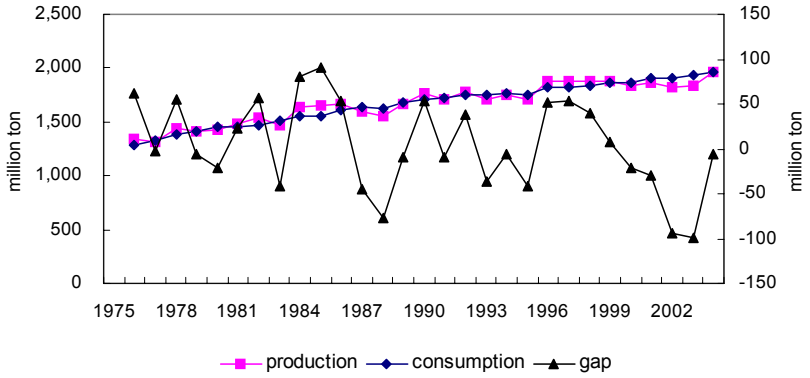


Source: FAO (2004a).

recorded the largest gain of 246% in total, followed by meat with a 72% rise. Overall, total grain production per capita increased by 16%.

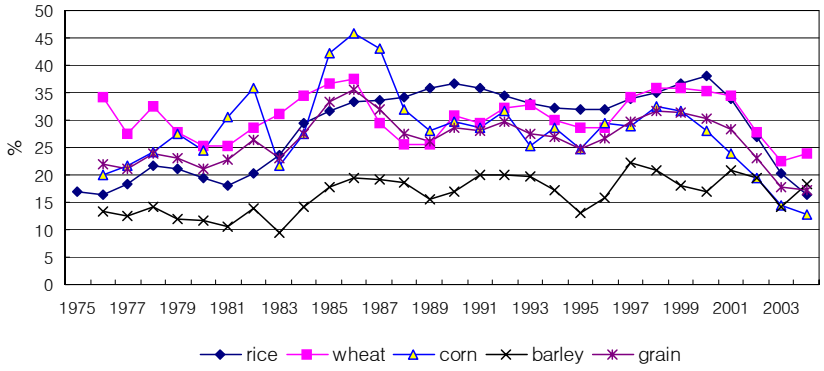
Figure 3 shows the gap between grain production and consumption that has fluctuated over time. Note that consumption has exceeded production for five consecutive years, which is mainly driven by the Chinese factor. For instance, Chinese ending

FIGURE 3. Grain Production and Consumption Gap



Source: USDA (http://www.usda.gov/oce/waob/index.htm)

FIGURE 4. Proportion of World Trade in Grain Production



Source: USDA (http://www.usda.gov/oce/waob/index.htm)

stocks of wheat and coarse grains dropped from 195 million tons in 2000 to 68 million tons in 2004 (USDA 2004). But, the grain gap is forecast to become narrower in 2004.

The proportion of trade in grain production remains around 13% over the period between 1976~2004 (Figure 4).[1]

[1] Values in 2004 are projected estimates.

But, a higher standard deviation in 1976~1994, 1.1 than that of the 1995~2004 period, 0.6, implies that trade has stabilized in recent years. Nevertheless, it is a bit premature to conclude that trade liberalization has a positive bearing on trade stabilization because the variations of rice and barley rose in the Uruguay Round implementation period.

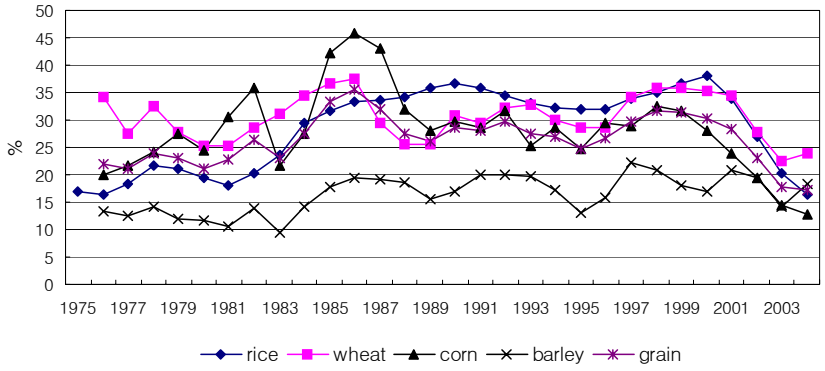
The lowest trade share for rice confirms that the world market is 'thin' where most rice is domestically produced and consumed. The share is no greater than half of other grains. Differently put, rice accounts for 30% in world grain production but its trade marks only 11%.

In short, these indicators illustrate that global consumption continues to outpace production and trade is stabilizing as a whole.

3. Stocks-to-Use Ratios

A stocks-to-use ratio is an important reference indicator revealing a food security situation. In fact, the FAO considers the 17~18% range as the minimum necessary to safeguard world food security. The ratio for grain ranged from 17% to 36% in 1976~2004 (Figure 5). Despite that the lowest ratio of 17.1% is forecast in 2004, it still meets the minimum requirement. A low ratio of 13% for corn causes a concern, though.

FIGURE 5. The Stocks-to-Use Ratio



Source: USDA (http://www.usda.gov/oce/waob/index.htm)

4. Daily Calories and Proteins

Daily calories and proteins per capita are another indicator revealing food availability. Table 1 shows that calories intake increased by 17% in 1960~1999. The 28% increase in developing countries outpaced that of developed countries by 9%. Daily proteins per capita also show a similar improvement. Developing countries gained a 29% increase and a 10% increase in developed countries.

But, other indicators for malnutrition and poverty reveal a gloomy picture. For example, the proportion of undernourished people to total population in developing countries was 17% in 1999~2001 (UNDP 2004). The number of chronically hungry people in developing countries was reduced by only 19 million between the periods of 1990~1992 and 1999~2001 (FAO 2003). To reduce the number of undernourished people by half by 2015 as declared by the World Food Summit, the annual reduction rate must be more than 12 times the current pace or 26 million per year.

The rise in world energy supplies per capita is encouraging. But a hasty solution must be prepared for the immense problem of hunger and malnutrition.

TABLE 1. Calories and Proteins Per Capita per Day

	1960s		1970s		1980s		1990s	
	Calories	Proteins	Calories	Proteins	Calories	Proteins	Calories	Proteins
World	2,347	64	2,453	65	2,636	70	2,750	73
Developed Countries	2,956	90	3,079	94	3,201	99	3,337	103
Developing Countries	2,036	51	2,173	53	2,424	59	2,607	66

Source: Diaz-Bonilla et al. (2003)

5. Prices and Variation

Price volatility measured by coefficient of variation (CV) and annual price changes in absolute terms (PCC) turns out quite different across grains and time periods (Table 2).[2] While Thai rice prices have shown volatile movements with a 41% CV, volatility of corn and barley prices appears to be modest.

As expected, price volatility was quite large in the 1970s due to the world food crisis. Unfavorable weather conditions in major food producing areas in 1972 and again in 1974 resulted in a sharp depletion of stocks and thus pushed prices up. A supply shortfall in rice was manifested by the skyrocketed PCC value in those years. For rice, wheat and corn price volatility appears to

TABLE 2. Volatility of World Grain Prices

Year	Wheat		Corn		Soybeans		Rice		Barley	
	CV	PCC	CV	PCC	CV	PCC	CV	PCC	CV	PCC
Total	37.9	15.4	34.1	11.0	36.4	22.7	40.8	40.0	21.1	9.8
1950s	6.6	3.8	6.3	3.6	3.3	3.0	8.9	10.7	-	-
1960s	5.5	3.1	6.9	2.8	8.6	8.2	20.3	17.3	-	-
1970s	36.9	26.2	29.5	14.3	31.8	35.6	44.5	90.2	13.4	7.5
1980s	15.0	13.3	17.8	16.2	13.5	28.8	31.9	54.0	16.4	10.1
1990s	18.5	23.6	18.0	14.6	11.7	21.8	11.2	30.4	18.2	10.6
2000s	12.3	9.7	8.5	4.8	13.5	24.1	7.1	25.8	14.7	9.3

Note: Prices are based upon FOB US dollars per ton. Wheat and corn prices are on the basis of US Gulf Ports and soybeans are US (Rotterdam) prices. Rice is Thailand (Bangkok) and barley is from Canada (Winnipeg).

Source: Calculated from IMF, International Financial Statistics. (http://ifs.apdi.net/imf/)

[2] Due to differences in units, PCC values can not be directly compared to one another. But, PCC within the same grain is quite useful in understanding price volatility over different periods.

have been reduced in recent years. Such price stability can be explained by a progressive increase in prices.

III. Food Situations in Korea

As an agricultural importing country, Korea has endeavored to secure enough food. In particular, rice is given priority because it is a staple grain and backbone of the economy and culture. The Korean War in the early 1950s and a chronic food shortage up to the 1970s nourished the country to increase rice production even at the expense of other grains. Owing to a concerted effort to boost production, Korea was able to reach rice self-sufficiency by the mid-1980s.

However, agricultural trade liberalization under the Uruguay Round began to disband the highly protected farm sectors and acted as a stimulus to structural reforms. On top of higher import penetration, a decline in rice consumption per capita is pushing most small-scaled farmers into a limit.

1. Arable Areas

After reaching a peak of 2.3 million hectares in 1977, arable areas in Korea progressively declined to 2.0 million hectares in 2002 (Figure 6). Like the global trend, arable areas and paddy fields per capita are moving down the same path. It is however noted that the annual reduction rate in Korea is over two times higher than that of the world.

Total grain production reached the highest point at 10.5 million tons in 1978; thereafter it has steadily decreased (Figure 7). Grain and rice production per capita also follows suit. In the 1961~2003 period, grain and rice production per capita fell by 48% and 30%, respectively. It was thus inevitable for Korea to increase grain imports. The import bill for grain rose from 135 million in 1961 to 1.8 billion dollars in 2002. This is a 1,248% increase in real terms.[3]

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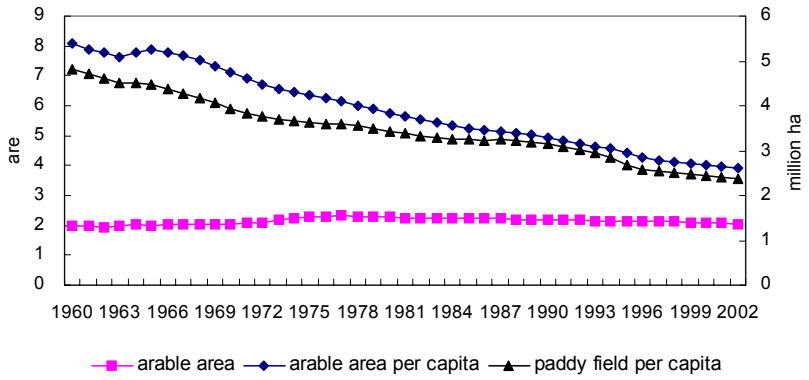
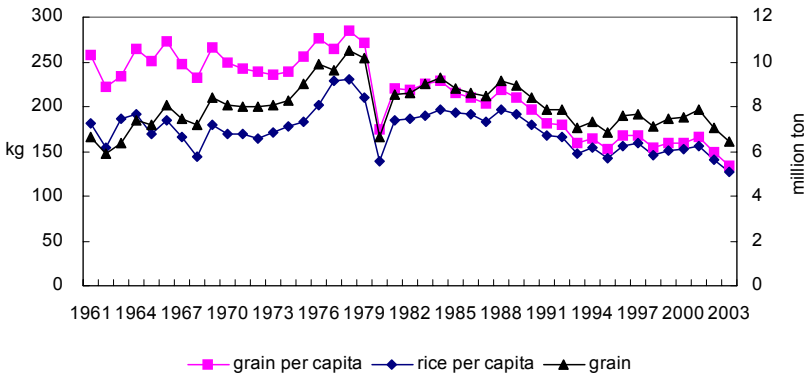
[3] Real values were calculated by using the US Producer Price Index (2000=100).

FIGURE 6. Arable Areas in Korea



Source: Ministry of Agriculture and Forestry (http://www.maf.go.kr)

FIGURE 7. Grain and Rice Production Per Capita in Korea

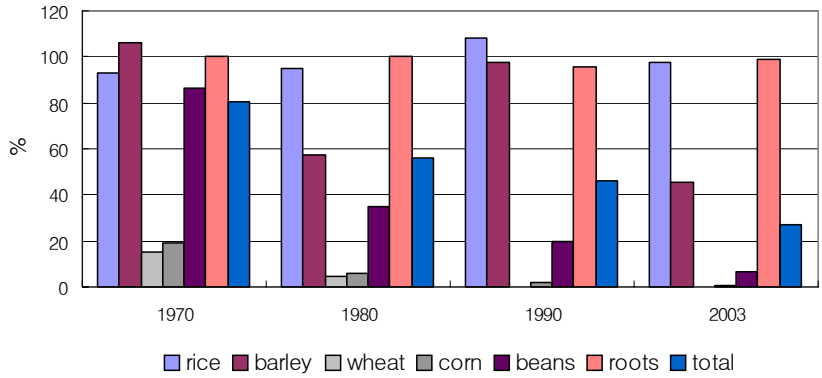


Source: FAO (2004a); MAF (http://www.maf.go.kr)

2. Grain Self-Sufficiency

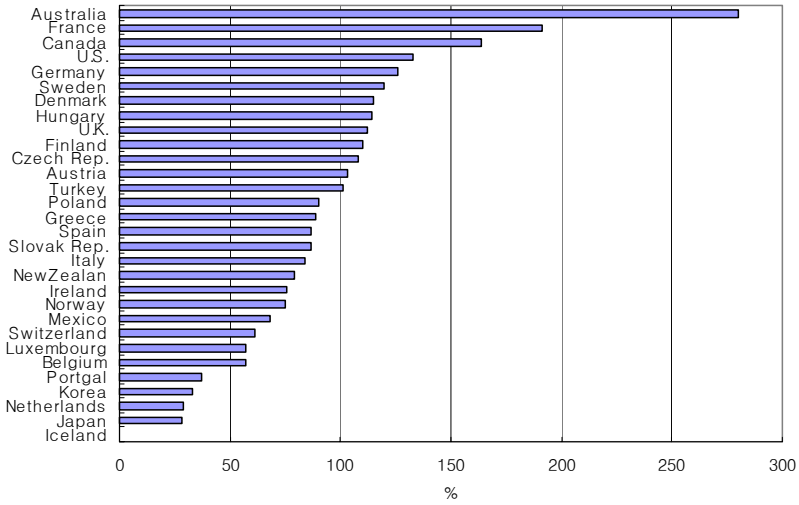
In tandem with a dwindling production capacity, grain self-sufficiency is deteriorating. As a whole, the grain self-sufficiency rate is no more than 27% as of 2003 (Figure 8). Except rice, a self-sufficient crop, most grains are heavily dependent on imports. Both wheat and corn's self-sufficiency is even lower than 1%. When feed grains are excluded, the self-sufficiency becomes 51%.

FIGURE 8. Grain Self-Sufficiency Rates of Korea



Source: MAF (2004).

FIGURE 9. Grain Self-Sufficiency Rates of OECD Countries



Source: FAO (http://www.fao.org).

Compared with other countries, Korea's grain self-sufficiency is one of the lowest. As of 2000, Korea ranked 119th out of 174 countries. When demographic and economic sizes are

taken into account, it is a quite low level. Among 30 OECD countries, Korea ranked 27th in 2000 (Figure 9). With a 27% rate in 2003, Korea might fall behind Japan.[4]

3. Stocks-to-Use Ratios

As seen in Figure 10, Korea has not met the minimum level of the stocks-to-use ratio for grain in the last 10 years. For the first time in history, the grain stock ratio fell below a 10% level in 1996. In spite of its improvement, it is still behind the reference level. On the other hand, rice stocks appear to show bigger peaks and troughs in its cycle. This is because rice accounts for most of the grain production. In 1996, rice stocks fell to their lowest point at a 5% ratio and then rose to over the 30% level in 2003. Such rapid accumulation of rice stocks is attributable to an accelerated reduction in rice consumption per capita and continuation of price support measures.

IV. Agriculture's Challenges and Prospects

The prospect of ensuring global food security is debatable. But the most recent prediction by the International Food Policy Research Institute (IFPRI) indicates global grain production would cope with continually increasing demand (Rosegrant et. al 2001). According to the study, grain demand is projected to increase by 1.3% annually while output growth will be 1.26% per year between 1997 and 2020. This difference is caused by a higher level of production in the 1997 base year. As a consequence, world grain prices in real terms are forecast to drop by 29% for rice, 28% for wheat and 30% for corn, compared with 1997's levels.

At the other extreme, the Worldwatch Institute predicted annual production increases of less than half the level predicted by the IFPRI (Brown 1994). The study pointed out a number of output limiting factors including the depletion of land and water

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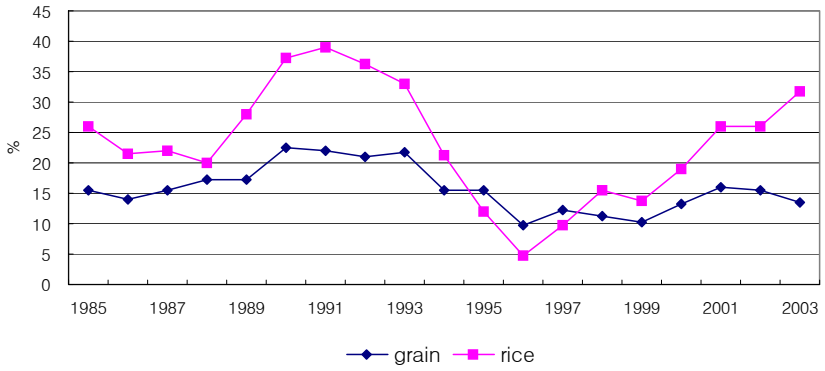
[4] Japan maintained a self-sufficiency rate of 28% in 2002 (http://www.maff.go.jp).

FIGURE 10. Stocks-to-Use Ratios for Korea



Source: MAF (2004).

resources and a fragile environment. Brown (2004) further argues that as China becomes a massive importer of rice, wheat and corn with a range of 30~50 million tons, world grain prices will have to escalate.

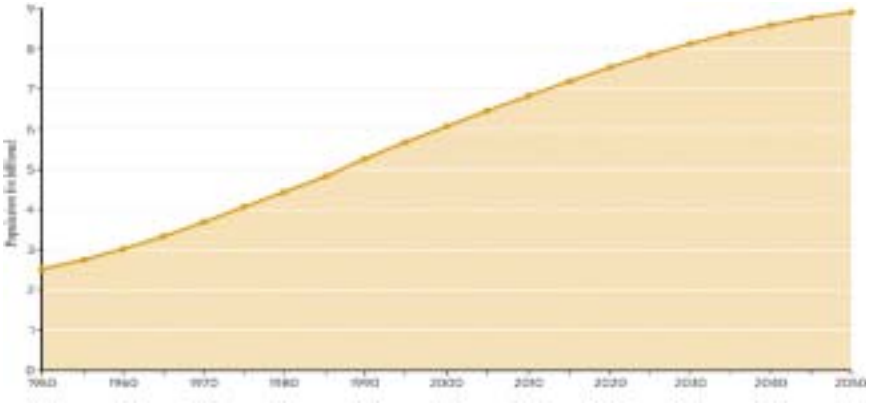
It is needless to say that the capacity of food production relies on physical resources such as land, water and other inputs. It also depends on R&D, education and policies. So, it remains to see whose projections are correct. But we can at least identify emerging challenges to policy implications.

1. Population Projection

According to the United Nations, global population now 6.4 billion will add some 2.5 billion people by 2050 (Figure 11). It is currently growing at76 million people per year. The growth rate peaked in the mid-1990s at about 82 million annually. Average family sizes have declined from six children per woman in 1960 to around three today.

Concern continues to mount on the projection that about 96% of the projected population growth will be in developing countries whose food insecurity is greater. Further to which the 50 least developed countries (LDC) are expected to grow by 228%, to 1.7 billion by 2050. It is thus important to get ready

Figure 11. Projected World Population



Source: UNFPA (2004).

for the growing food demands from developing countries. The populations of Europe and Japan are declining and its reduction rate will be doubled by 2010 to 2015. Mostly because of immigration, North America continues to grow at about 1% per year.

Korea's population growth is projected to be slow over the next decades. Besides, a continued decline in rice consumption is likely to require even less paddy fields. On the contrary, rising food demands for meats will have to be met by additional imports.

2. Agricultural Input Constraints

To meet increasing food demands, it is vital to increase agricultural land and productivity. Agricultural land is finite and thus scarce. The rapid development of urbanization has depleted water supplies and diverted some highly productive agricultural land. For instance, China's reduction in grain production from 392 million tons in 1998 to 322 million tons in 2003 can be explained by the shrinking grain harvested area, mainly caused by depletion of aquifers and irrigation wells, losing irrigation water to cities and industry, urban expansion and construction, and migration of farm labor to cities (Brown 2004). Another example is that about 4

million hectares of potential farmland in northern China which may not be placed into production because of limited water supplies and the areas being lost to heavy agricultural, industrial, and household use (Ko 1996; Gale 2002).

By 2025, the arable land scarcity index, ha per capita for East Asia is forecast to drop below the benchmark. A critical threshold level of the index is estimated to be 0.07ha per capita. The estimates for China, Japan and Korea by 2025 are 0.06, 0.04 and 0.04 respectively (Kaosa-ard and Rerkasem 2000).

The FAO indicates that 18 key Asian countries farm 90% of their arable land. But, the IFPRI estimates 2.5 billion hectares of land in developing countries to support agriculture of which 760 million hectares are already in production (IPC 1996). Sub-Saharan Africa and Latin America account for most of this additional land. For instance, provided the arable land area expands by 20% by 2050, additional grain output at a 1990 yield level would amount to 400 million tons. Nevertheless, questions remain if the potential land will be viable for cultivation in terms of economic and environmental feasibility.

Another relevant factor is a slower growth of irrigated agricultural land, which has a direct bearing on productivity. As seen in Table 3, the growth rate of irrigated agricultural land per year dropped by half over the last 40 years. A drastic decline especially in developed countries may reflect growing concern about the effects of irrigation on environment. Declining water tables and desalinization problems continue to pose a threat. About 65% of the total water use is devoted to agriculture but high

TABLE 3. The Annual Growth Rate of Irrigated Agricultural Land

	World	Developed Countries	Developing Countries
1960s	2.2%	2.1%	2.3%
1970s	2.6%	3.6%	2.3%
1980s	1.5%	1.2%	1.6%
1990s~2001	1.0%	0.2%	1.3%

Source: Calculated from FAO (2004a)

water demands outside agriculture and increased water stress are increasingly eroding the share of agricultural water use (Pinstrup-Anderson et al. 1997).

Table 4 shows a reduction in grain productivity measured by yields. Rice yield increased by 3.2% per year during the 1976~1990 period but it has slowed down to 0.8% in the last 15 years. A slower pace of grain productivity can be explained by a sluggish increase in fertilizer uses and irrigated agricultural land. Brown and Kane (1994) pointed out that such a stagnant use of fertilizers resulted from saturated marginal efficiency and a subsidy reduction in India, China and the former Soviet Union. A number of other issues are also relevant. Climate changes and weather variations will damage agricultural production (Thompson 1975; World Bank 1990).

In Korea, an average annual reduction of arable land has amounted to only 0.4% since 1961. Agricultural land diverted to non-agricultural use is around 12,000 hectaresper year. Such a low reduction in arable land and a stable rate of land diversion appear to have a limited bearing on domestic production.

Use of chemical fertilizers has decreased from a peak of 458 kg per hectare in 1990 to 350 kg per hectare in 2003. Policy drives for sustainable farming and economic incentives generated by the market toward environment-friendly products appear to have effects on an adequate use of fertilizers. Irrigated areas account for 77% of the total paddy fields and they have gradually increased over years.

Rice yield hit it's highest point at 5.2 tons on a milled basis in 1997 and thereafter decreased to 4.4 tons per hectare in

TABLE 4. Annual Growth Rates of Grain Yields

Period	Rice	Wheat	Corn	Barley
1976~1990	3.2%	3.1%	2.1%	1.5%
1991~2004	0.8%	1.1%	2.0%	1.0%

Source: Calculated from USDA (http://www.usda.gov/oce/waob/index.htm).

2003, a 15% reduction in 6 years. A trade-off between rice quality and quantity and unfavorable weather seem to be major causes for the decline. Good harvest prospects in 2004 will cancel out the trend though.

Generally speaking, agricultural input constraints are not a severe barrier for food security in the country. Despite the fact that agricultural land is scarce with respect to demographic conditions, current inputs are likely suitable to maintain agricultural production. With an accelerated reduction in rice consumption per capita and secured stocks, recent yield loss would not risk the country's food security.

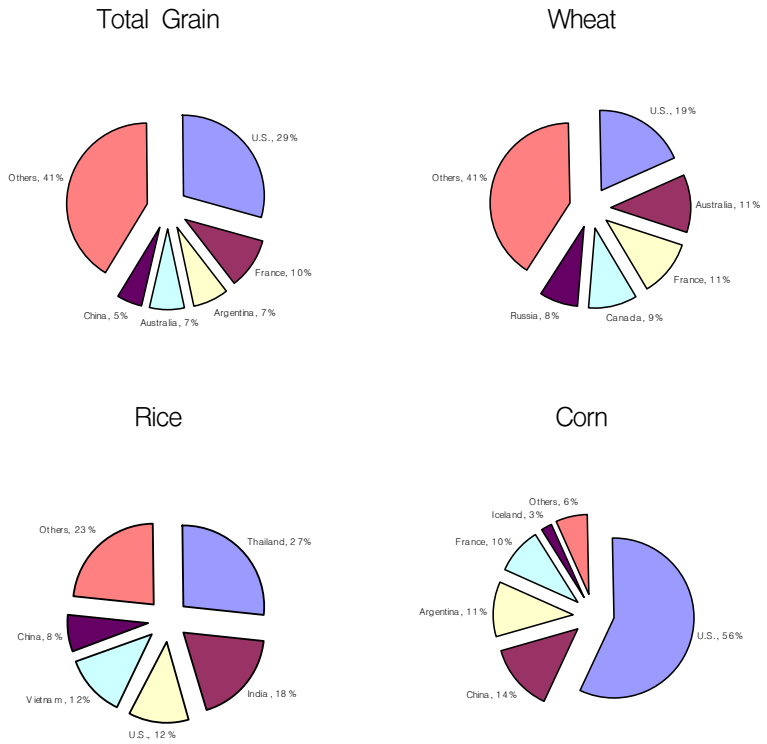
3. Trade Aspects

Stable food supplies rely on trade. But trade can not guarantee complete food security. A typical economic theory proposes that trade liberalization help ensure food security by inducing economic growth, income, employment and efficient allocation of global resources (Anderson 1998; Roe and Gopinath 1996). However, the linkage between trade and growth is not automatic since trade is only one of many factors explaining economic growth (Ohga 1998).

Empirical evidence for the nexus is mixed. After going through a cross-section of the evidence, Madeley (2001) found the following points. First, regulation of transnational corporations (TNCs) is needed to curtail excessive corporate power. Second, trade liberalization in developing countries should slow down since the WTO round would not be helpful for food insecure people. Third, since the benefits of trade liberalization will be very limited to low-income agricultural producers, policy emphasis should shift from trade liberalization to production, which can be beneficial to the food insecure. Finally, a fair and market oriented world trade system should be established.

Some express their concerns about the preponderate structure of grain trades (Kim and Huh 2004). For example, five countries such as the U.S. France, Argentina, Australia and China accounted for 59% of world grain exports in 2002 (Figure 12).

FIGURE 12. The Structure for Grain Trades: 2002



Source: FAO (2004b).

As for wheat, rice, and corn, the top five exporting countries commanded 59%, 77%, and 94% of world trades, respectively. In fact, viewing global grain markets as monopolistic where a few dominant exporters can influence the market, Hellwinckel and Ugarte (2003) exhibit thatthe U.S. is a price leader in the rice and corn markets.

In addition to price leadership, the monopolistic market structure is vulnerable to a regional crisis such as disease outbreaks and weather-related disasters. Such a crisis would pose a tremendous threat to the countries which depend heavily on world markets for the importation of grains. If four firms control

more than 40% of the market, the industry can be said as having a monopolistic market structure. Table 5 clearly indicates that the US market structure is monopolistic since the concentration ratios of the top three (CR3) or four (CR4) are greater than the threshold.[5]

V. Policy Implications

To meet the agricultural challenges, a number of policy prescriptions would be possible. Nevertheless, an immediate task we will have to take is to correct existing inefficiency in the markets. The majority of the hungry and malnourishment problems are not due to food availability but to inadequate food access. In addition to boosting economic growth, food distributional channels and infrastructure must be established and developed. Food aid or support must be provided to strengthen the beneficiary economies, not to destroy. Wars and civil conflicts that disrupt food availability and access must be controlled and stopped. International communities could contribute to stabilization of those vulnerable economies.

TABLE 5. Monopolistic Market Structure in the US

	Terminal Grain Handling Facilities	Corn Exports	Soybean Exports
Concentration Ratio	CR4=60%	CR3=81%	CR3=65%
Firms	1. Cargill 2. Cenex Harvest States 3. ADM 4. General Mills	1. Cargill-Continental Grain 2. ADM 3. Zen Noh	1. Cargill-Continental Grain 2. ADM 3. Zen Noh

Source: Hendrickson and Heffernan (2002).

[5] The US is the home to six of the top ten agri-corporations of the world (Thorat 2003).

Another existing inefficiency lies in food wastes. According to Oerke et. al (1994), global crop loss is around 42% and post-harvest loss marks at 20%. Global losses of rice due to pests, pathogens and weeds are estimated to 51%. Another study reports 37% rice yield losses (Savary et. al 2000). Reductions in food wastes require improvements in the use of protection chemicals and biological controls as well as investments in physical structures such as drying and storage facilities.

From a Korean perspective, the country is much in need of national food production policies, including stockholdings. In addition to abnormal situations such as wars and unfavorable weather-related hazards, risks can arise even in ordinary circumstances from plant and animal disease outbreaks, nuclear disasters, prolonged climate changes, and drastic changes in global supply and demand. This is why Korea pays much attention to legal developments in the WTO system which regulates domestic agricultural policies.

In this regards, the WTO must allow green box-type support to maintain production capacity for a food security purpose. Given land irreversibility, it will be very costly to resume domestic production in a crisis case. Strict disciplines on export ban and restrictions must be established lest historical experience of the embargoes on soybeans export by the United States in 1973 and again in 1975 should repeat.

Regulation on domestic stock policies by the WTO's Agreement on Agriculture can be further improved. Public intervention up to the minimum level of grain stocks must be exempted from reduction commitments. This will be a legitimate way to acknowledge the role of stocks in ensuring food security under the WTO system.

Korea needs solid policy reforms in order to embrace emerging challenges as well. Abolition of the price support scheme for rice will be a substantial move toward market orientation, but it will require accurate compensatory measures to stable food supplies. One such reform would be a public commitment to maintain targeted food self-sufficiency from domestic production.

Measured in terms of calories, Japan sets out at a 45% level and Norway calls for a minimum level of 50% or 57% if including fish products.

Once a target is established, the government must orchestrate a proper mechanism to build a safety net for food security. To fulfill the target, quality agricultural land should be preserved and sizable enterprise farmers have to be fostered. A necessary element for economic management of national stocks is to find optimal levels of buffer stocks associated with targeted self-sufficiency. It may further need private sector contributions including farmers and farmers' organizations.

Finally, agriculture is multifunctional. Food security is one of the most important agricultural multifunctionalities-especially to importing countries like Korea. Not regarding other non-commodity services generated by domestic production, food security alone deserves undivided attention. The United Nations even categorizes it as a human right. It is thus vital to design and implement adequate policy instruments to ensure food security. The WTO regime should incorporate such a legitimate concern and facilitate universal food security.

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