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# RICE PRODUCTION AND MARKET:
# TRENDS AND OUTLOOK

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## "Rice Production and Market: Trends and Outlook"

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## ABSTRACT

*Rice, the dominant food staple for developing countries, is grown mostly in Asia and on small family farms. Asia has done well in increasing rice supplies to meet the growth in demand. But the concern of maintaining the demand-supply balance in future is growing with recent sluggish trends in rice production. Growth in demand has slackened in the middle- and high-income countries in Asia, but per capita rice consumption is increasing in other continents, particularly in Africa. The growth in production has been decelerating due to growing scarcity and increasing cost of land, water, and labor, and sustaining farmers' incentives in rice cultivation. Demand will continue to increase in West Asia and Sub-Saharan Africa from increases in per capita consumption and rapid population growth, and will outpace the growth in domestic production. The increase in import demand from these regions can be met by the exportable surplus from Thailand, India, Cambodia, and Myanmar, which have excess capacity for production. But, the downward trend in rice prices may reverse due to political compulsion to raise agricultural prices to address the growing rural-urban disparity in income in the fast growing giant Asian countries such as China and India.*

## INTRODUCTION

Rice is the dominant staple food crop for people in developing countries, particularly for the humid tropics across the globe. Almost 90% of rice is produced and consumed in Asia, and 96% in developing countries. Rice production has increased faster than population over the last three decades, despite being produced on small and marginal farms in countries with extreme population pressure on limited land resources. Most of the increase in production originated from technological progress in rice cultivation in the irrigated and the favorable rainfed ecosystems.

The growth in demand for rice has started declining because of rapid urbanization, and increases in per capita income leading to diversification of the diet, high levels of rice consumption already reached in many countries, and progress achieved in population control. But, the growth in rice supply has also slowed down because of the yield approaching economic optimum for the irrigated ecosystem, decline in relative profitability of rice cultivation, increasing concerns regarding environmental protection, and limited progress in developing improved technologies for the unfavorable ecosystems.

Two contrasting developments may substantially affect the rice economy in the future. First, the prosperous rice-growing countries may increasingly find it difficult to sustain producers' interest in rice farming. The move towards free trade in agricultural production, begun with the Uruguay Round of GATT, will affect the sustainability of rice farming in these countries.

There will be economic pressure for the movement of land, water and labor out of rice to other economic activities. Second, the potential for increased productivity for the irrigated ecosystem, created by the dramatic technological breakthrough in genetic enhancement of seeds in the 1960s has almost been exploited, while major technological breakthroughs for developing appropriate high-yielding varieties for the unfavorable ecosystems are still on the horizon.

## THE GLOBAL RICE MARKET

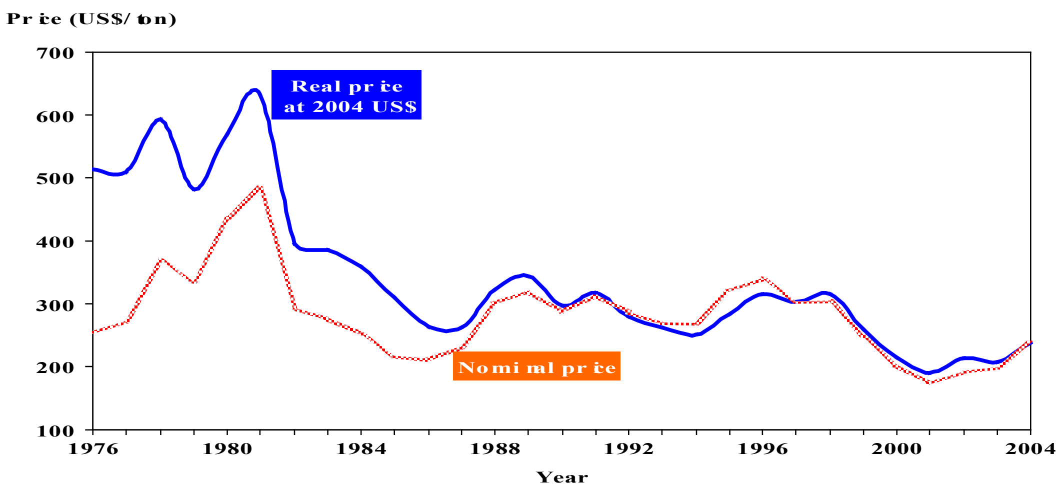
The international trade in rice has remained limited so far. About 6% of the world's rice production is currently traded internationally, in contrast to nearly 18% for wheat and 12% for coarse grains. The global rice market has expanded rapidly, however, over the last three decades. The average yearly import of rice increased from 8.0 million tons (4.0% of production) in 1968-70 to 27.0 million tons in 2002-04, an annual growth of 3.7%, in contrast to 2.2% annual growth in the rice production. The volume of trade was the highest in 1998-99 when Indonesia and the Philippines imported a large quantity after the drought from El Niño weather disturbances reduced domestic production drastically. The import from Indonesia has gone down significantly in recent years due to the government's reverting back to a policy of achieving self-sufficiency through domestic production. But imports from Africa have been growing faster with a doubling of imports within the last seven years. The total value of global rice trade is US$ 6.88 billion, of which about 71% is on account of developing countries.

Many countries import rice but on a very small scale. In South and Southeast Asia, the heartland of rice production, the major importers are Indonesia, Bangladesh, the Philippines, Malaysia, Japan, and Singapore. South and Southeast Asia's imports fluctuate largely from year to year depending on the effect of natural calamities (floods, droughts, and typhoons) on domestic production. Major rice importers whose imports have been growing steadily over time are in the Middle East (Iran, Iraq, Saudi Arabia, UAE, and Turkey), western and southern Africa (Nigeria, Côte d'Ivoire, Senegal, South Africa, Sierra Leone, Madagascar, Guinea, and Benin), and Latin America (Brazil, Mexico, Cuba, Haiti, and the Dominican Republic).

Only a few countries participate in the export market. Major rice-exporting countries are Thailand, Vietnam, India, the United States, China, Pakistan, Australia, Italy, Uruguay, Argentina, Egypt, and Spain. There is a high concentration in the export market. The first five countries account for nearly three-fourths of the supply in the market. Thailand alone controls about 30% of the market. Myanmar and Cambodia were major exporters in the world market before the Green Revolution began in the1960s, but since then, have lost the market because of civil disturbances, slow growth in production, and deterioration in marketing infrastructure. These countries have unused capacity for expanding supply in the market. India, Argentina, Uruguay, and Guyana have increased rice exports substantially in recent years. The volume of exports from India fluctuates depending on the size of the stock, the opportunity for trade, and the government's policy towards rice export.

One notable feature of the world rice market is that it has traditionally been unstable where the availability of supplies is uncertain and prices are highly variable. The volatility of the market is a characteristic of most agricultural commodities because of frequent disruptions in supply from natural calamities but was much more pronounced for rice. Since the early 1990s however, the prices have been relatively stable despite rapid growth in imports (Dawe 2001, 2002).

Fig. 1: Trend in nominal and real prices (adjusted for inflation) of rice in the world market, 1976-2004.

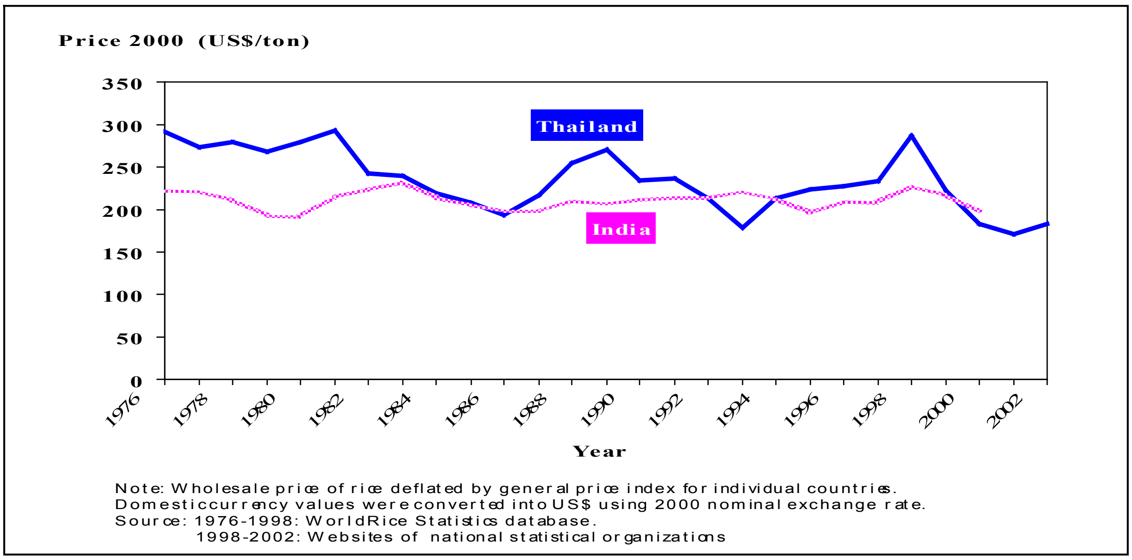


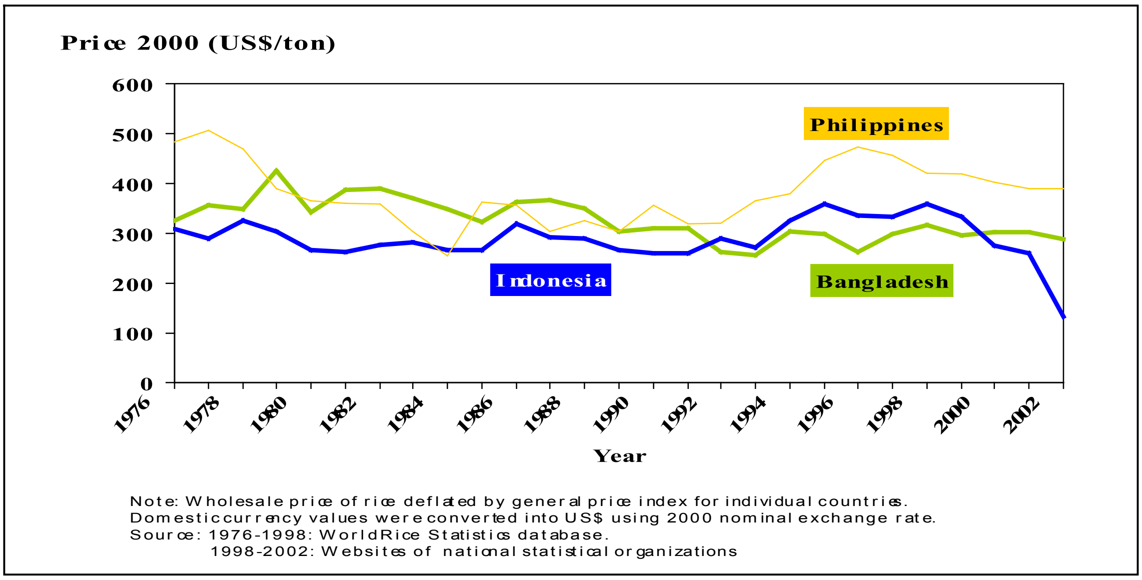

Source: Production: FAOSTAT Electronic Database, FAO.20Dec2004 udpate.
Rice Price: Relate to Thai rice 5%-broken deflated by G-5 MUV Index deflator (adjusted based on 2004 data update)
Source: www.,WorldBank.org

The other notable feature of the world rice market is the dramatic decline in the level of prices adjusted for inflation (real prices) (Fig 1). The nominal fob price of milled rice (5% broken) quoted in Bangkok changed from US$136 in 1965 to $196 in 2003, an increase of 44% over a period of 38 years. During that period the wholesale price index in G-5 countries has increased by 5.2 times. After adjusting for inflation, the real price of rice in the world market in 2003 was about 30% lower compared to the level in 1985. The long-term decline in the real price of rice has contributed to the achievement of food security particularly in low-income food deficit countries, as it provides them access to affordable supplies of staple food from the world market. As landless rural households, the poorest of the poor who constitute one-third to one-half of the rural population in most countries in South and Southeast Asia, spend over half of their income to purchase rice. The continuous decline in the real price of rice was a major contributory factor to the reduction of poverty in Asia.

A decline in the price of rice in the world market in real US dollar does not necessarily translate into a decline in the real prices in the domestic market. To the extent that the domestic currency undergoes depreciation against the US dollar, this will erode the decline in the rice price when translated into domestic currency. During the last three decades, most Asian currencies have depreciated against the US dollar. The trend in the real rice prices in the domestic market, after adjusting for the wholesale price index for selected Asian countries, can be reviewed from Fig.2. The figure shows a declining trend in the rice prices in Thailand and India, the major rice exporters, but the decline is much less pronounced. For the importing countries, the price has had upward trend in recent years.

Fig 2: Real price of rice, selected countries in Asia, 1966-2003




## FACTORS AFFECTING CONSUMPTION

Growth in demand for a staple grain depends on (a) the level of per capita income, (b) the rate of growth of population, and (c) the change in prices relative to those of substitute crops. At low levels of income, when meeting energy needs is a serious concern, rice is considered a luxury commodity.

With increases in incomes, people tend to substitute low-cost sources of energy such as coarse grains, cassava, and sweet potato for rice. But, at high levels of income, rice becomes an inferior good (Ito et al., 1989). As incomes rise further, consumers go for a diversified diet and replace rice with high-cost quality foods that provide more protein and vitamins, such as vegetables, bread, fish, and meat. Growing urbanization, which accompanies economic growth and industrialization, further dampens the demand for rice with higher claims of non-food basic needs on the consumer budget.

The trend in per capita consumption of rice in selected Asian countries can be seen in Table 1. Rice consumption has been declining from a high level in the middle- and high-income countries in Asia such as Japan, South Korea, China, Thailand, and Malaysia. Except for Malaysia, population growth in these countries has also reached low levels - around 1% per year. Over the next three decades, their population may grow at only 0.5% per year. So, these countries may not experience any further upward pressure on demand for rice.

Table 1: Changes in rice consumption, selected Asian countries

| Country | Rice consumption milled rice (MT) | Per capita consumption (kg/person/yr) | | | Change in population 2000-30 (%) | |
|---|---|---|---|---|---|---|
| | 2000-02 | 1970-72 | 1989-91 | 2000-02 | 1970-2000 | 2000-2030 |
| China | 110.73 | 79 | 94 | 86 | 54 | 17 |
| India | 79.88 | 69 | 79 | 77 | 82 | 40 |
| Indonesia | 31.90 | 105 | 147 | 149 | 77 | 33 |
| Bangladesh | 22.31 | 150 | 153 | 158 | 94 | 43 |
| Vietnam | 13.38 | 157 | 154 | 169 | 82 | 41 |
| Myanmar | 9.91 | 160 | 209 | 206 | 78 | 31 |
| Philippines | 7.93 | 86 | 96 | 103 | 107 | 49 |
| Japan | 7.45 | 89 | 65 | 59 | 22 | -5 |
| Thailand | 6.41 | 151 | 111 | 104 | 74 | 27 |
| Korea, South | 4.03 | 119 | 104 | 85 | 46 | 12 |
| Nepal | 2.45 | 80 | 103 | 102 | 94 | 81 |
| Pakistan | 2.40 | 12 | 15 | 16 | 128 | 93 |
| Iran | 2.07 | 25 | 32 | 31 | 144 | 49 |
| Cambodia | 2.06 | 163 | 157 | 153 | 89 | 82 |
| Malaysia | 1.93 | 123 | 81 | 82 | 105 | 48 |
| Sri Lanka | 1.74 | 95 | 94 | 93 | 54 | 21 |
| Korea, North | 1.55 | 82 | 73 | 69 | 55 | 19 |
| Laos | 0.91 | 188 | 171 | 169 | 95 | 76 |
| Saudi Arabia | 0.83 | 23 | 25 | 36 | 254 | 120 |

*Source of basic data: FAOSTAT database, FAO 2005.*

For low-income Asian countries such as Indonesia, the Philippines, India, Bangladesh, Vietnam and Myanmar, per capita consumption has reached a high level and may not grow further because of very low income elasticity of demand and rapid urbanization (Sombilla et al. 2002).

An increase in consumption by low-income households expected with the reduction in poverty may be compensated by a decline in consumption for the middle- and upper-income groups. Since the unit cost of producing rice is much higher than for maize, rice will unlikely be used as livestock feed. With an annual population growth from 1% to 1.5% per year, these countries may face a demand growth of only 10 to 15% over the next decade.

The per capita consumption of rice has been growing from low levels in most countries outside Asia (Table 2), and may continue to increase with the replacement of rice by other food items. But the demand pressure on the rice market may not be high because of slower population growth and very low levels of consumption.

Table 2: Changes in rice consumption, selected countries in Africa and Latin America and the Caribbean.

| Country | Rice consumption milled rice (MT) | Per capita consumption (kg/person/yr) | | | Change in population 2000-30 (%) | |
|---|---|---|---|---|---|---|
| | 2000-02 | 1970-72 | 1989-91 | 2000-02 | 1970-2000 | 2000-2030 |
| AFRICA | | | | | | |
| Nigeria | 2.97 | 5 | 24 | 25 | 139 | 80 |
| Egypt | 2.64 | 28 | 31 | 38 | 92 | 61 |
| Madagascar | 1.59 | 125 | 98 | 97 | 130 | 110 |
| Côte d'Ivoire | 1.05 | 45 | 54 | 65 | 187 | 47 |
| Senegal | 0.71 | 48 | 65 | 74 | 126 | 80 |
| Guinea | 0.64 | 50 | 64 | 77 | 108 | 84 |
| Tanzania | 0.58 | 7 | 17 | 16 | 153 | 63 |
| South Africa | 0.56 | 4 | 8 | 13 | 91 | 1 |
| Mali | 0.53 | 17 | 25 | 43 | 112 | 148 |
| Ghana | 0.43 | 8 | 12 | 22 | 127 | 67 |
| Sierra Leone | 0.38 | 105 | 97 | 84 | 66 | 86 |
| Liberia | 0.17 | 114 | 107 | 56 | 112 | 132 |
| Guinea-Bissau | 0.12 | 66 | 104 | 88 | 134 | 131 |
| Mauritania | 0.10 | 13 | 48 | 35 | 110 | 107 |
| Mauritius | 0.07 | 70 | 67 | 62 | 44 | 22 |
| Togo | 0.09 | 6 | 12 | 20 | 127 | 78 |
| Libya | 0.09 | 10 | 14 | 17 | 164 | 55 |
| LATIN AMERICA | | | | | | |
| Brazil | 6.37 | 38 | 41 | 37 | 78 | 33 |
| Colombia | 1.29 | 24 | 32 | 30 | 87 | 47 |
| Peru | 1.28 | 24 | 37 | 48 | 95 | 45 |
| Cuba | 0.71 | 50 | 49 | 63 | 31 | 4 |
| Ecuador | 0.62 | 23 | 43 | 49 | 112 | 47 |
| Mexico | 0.55 | 5 | 4 | 5 | 95 | 36 |
| Dominican Rep | 0.36 | 30 | 48 | 43 | 89 | 34 |
| Haiti | 0.33 | 11 | 22 | 41 | 80 | 49 |
| Costa Rica | 0.23 | 36 | 41 | 58 | 133 | 55 |

*Source of basic data: FAOSTAT database, FAO 2004.*

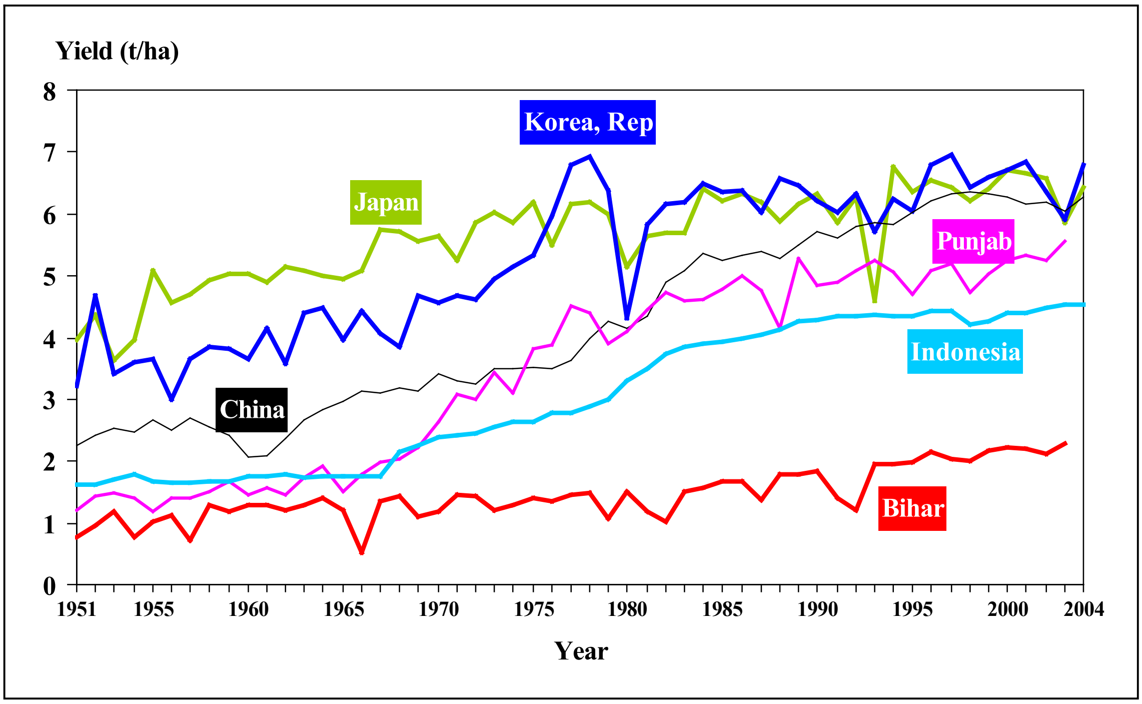
The major boost in demand will come from countries in West Asia and Sub-Saharan Africa, and South America (Table 2). In many countries in these regions, per capita consumption has been increasing rapidly with rural-urban migration of the population that leads to a change in food habit from Maize or root crops-based diets to rice-based diets. With women's growing participation in the labor market the preference for rice as a staple food has been growing because it is convenient to cook. Also the population continues to grow at a high rate particularly in Africa. The population may double in many countries within the next three decades. Therefore the demand for rice may increase at 3% to 4% per year in these regions. However, the pressure on the increase in global consumption of rice from these regions may not be large. But the increase in rice demand in Africa will substantially affect the global trade, as Africa now accounts for a third of the global import trade.

## FACTORS AFFECTING PRODUCTION

Economic prosperity and industrial progress are leading to rapid urbanization and the concentration of people in large cities. An important implication of growing urbanization is that some fertile rice lands have to be diverted to meet the demand for housing, factories, and roads. Also with urbanization and associated food habits, the markets for vegetables, fruits, and livestock products will grow stronger. Thus, there will be economic pressure to reduce the area under rice cultivation to accommodate agricultural diversification in favor of high-value crops.

Some countries have potential for expanding rice area if rice cultivation continues to be profitable compared to other economic opportunities. In Asia, the area under rice production can be further increased in Thailand, Myanmar, Cambodia, and several states in eastern India. It is estimated that there are 20 million ha of inland river valleys in southern and western Africa, of which only 15% are currently cultivated (Alexandratos, 1995). The major constraint to the expansion to rice area is underdeveloped infrastructure and marketing facilities, limited expansion of irrigation facilities, and the risk to human health from water-borne diseases associated with irrigated rice cultivation. Brazil, Argentina, Uruguay, and Guyana (South America) can increase rice area substantially if rice cultivation provides adequate returns to factors of production comparable with those of other economic activities. But the cost of rice cultivation is substantially higher in Africa and Latin America than in Asia. If the trend in rice prices continues to move downward, additional land will unlikely be brought under rice cultivation, particularly in exporting countries.

Fig. 3: Long term trend in yield, selected countries, 1951-2004




In the irrigated rice ecosystem, which accounts for almost three-fourths of total rice supplies, most farmers have already planted high-yielding modern varieties and the best farmers' yields are approaching the potential that scientists are able to attain with today's knowledge in that particular environment. The attainable yields are about 8 t/ha in the temperate zone and 6 t/ha in the tropics, which are about to be reached in many countries (Hossain, 1997). It is possible to increase yield by at most 1 t/ha with the adoption of improved crop management practices for reducing the existing yield gap (FAO, 2001), but dissemination of these knowledge-intensive technologies to millions of small and marginal farmers may not be easy. As the yield plateau is reached, rice yield will remain stagnant in irrigated areas, as has already been demonstrated by Japan, and South Korea (Fig 3) Farmers in high-yield countries now look for mechanical technologies that save labor, and enhance labor productivity and farm profits. New technologies that merely increase land productivity may not have much appeal to farmers in middle and high-income countries experiencing surging wage rates and opportunity cost of family labor.

Water, which is usually regarded as an abundant resource in humid Asia, is also becoming a scarce commodity. With the diversion of water from agriculture to other needs, degradation of irrigation infrastructure may follow, which may put downward pressure on both rice area and yield in the irrigated ecosystem.

The scope for further conversion of the rain fed ecosystem into the irrigated ecosystem is also becoming limited. Irrigation cost has increased substantially as easy options for irrigation development have already been exploited. Also, environmental concerns have been growing regarding adverse effects of irrigation and flood control projects on water logging, salinity, fish production, and the quality of groundwater for drinking purposes. Already, there has been a drastic decline in investment for the development and maintenance of large-scale irrigation projects (Rosegrant and Svendsen, 1992). In some regions with favorable groundwater levels (e.g. Bangladesh, Eastern India and the Philippines), the fall in private-sector investment in irrigation is being compensated by expanding private sector investment in shallow tube wells. This, however, raises environmental concerns of depleting ground water beyond the level of recharge, and arsenic contamination of drinking water.

The growing economic prosperity in Asia had an adverse effect on sustaining farmers' interest in rice cultivation (Pingali et al, 1997; Park, 1993). The expansion of the non-farm sector and the rapidly rising labor productivity push up non-farm wage rates, which promotes rural-urban migration of labor and contributes to the tightness of the agricultural labor market with continuous upward trend in the wage rate. Since traditional rice farming is a highly labor-intensive activity, the increase in the wage rate raises the cost of rice production and reduces profits and farmers' incomes.

In Japan, Taiwan (China), and South Korea, the constant outflow of the agricultural labor force has caused a continuous decline in the farming population. Aging of workers and depopulation in remote areas have continued, making it difficult to sustain the existing rural communities in some areas. The competitiveness of rice farming was maintained initially through (1) improved farm management practices that increased efficiency in the use of non-land inputs, and (2) increased use of capital to replace labor through mechanization of farming operations. But these measures were not adequate for raising the incomes of farmers at par with those of urban workers. The government had to come forward to protect the domestic rice market so that the price mechanism could be used to transfer income from the relatively well-off urban rice consumers to the relatively poor rice farmers. The government had to raise rice prices and farm subsidies to maintain the balance between rural and urban household incomes. Protection of the domestic rice industry has led to the high-cost domestic production of rice. The cost of producing rice in Japan and Korea is many times higher than the rice exporters. Thus, having an exportable surplus of rice from the middle- and high-income countries of Asia is highly improbable. Rather, would they be exposed to international competition following the growing pressure from the World Trade Organization (WTO) to liberalize international trade in rice, the area under rice cultivation may decline. The recent development in the rice economy in China following rapid economic growth demonstrates the validity of this hypothesis.

Some emerging technologies such as hybrid rice and new plant type may raise yield and input-use efficiency in the irrigated ecosystem, and thereby contribute to further increasing rice production from this favorable ecosystem.

The most important of these are the new plant type (NPT) or "super rice," which is expected to shift the yield frontier by another 25%, hybrid rice technology for the tropics that promises to increase yield by 15%, and incorporation of host-plant resistance against major pests using biotechnology tools that may reduce crop losses by 5% to 10% (Khush, 1995; Virmani 2002). The International Rice Research Institute (IRRI) has started distributing NPT lines to NARS for adaptation under their conditions. Poor grain quality and high seed costs were identified as major constraints to the adoption of hybrid rice (Janaiah et al, 2003). Researchers are now attempting to solve the problems by using parents and restorer lines of improved quality, and by technological improvements in hybrid rice seed production. However, the underdeveloped infrastructure for the production and distribution of seeds, the fear of dependence on multinationals, and the negative perceptions by civil society regarding genetically modified rice may constrain the fast diffusion of these technologies, to have a substantial effect on an increase in rice yield (Huang et al, 2002).

The potential for increasing yield in the rain fed ecosystem is still vast, as yield is now only at 1.5 to 2.5 t/ha. Indeed, this ecosystem is the dominant one in the low-income countries of South and Southeast Asia, West Africa, and Central America (IRRI, 1995). The rainfed ecosystem is subject to the vagaries of nature such as droughts, floods, submergence from heavy rains, typhoons, and climate changes. Traditional rice varieties have developed traits through centuries of evolution to let them withstand climatic and soil-related stresses, but they have very low yields. Rice scientists have so far had limited success in identifying these traits and incorporating them in high-yielding modern cultivars (Zeigler and Puckridge, 1995). Where rainfall is unreliable and drainage is poor, farmers still grow traditional varieties and use fertilizers in sub-optimal amounts because of the uncertainty of obtaining adequate returns from investments in purchased inputs. This is the main reason behind the low yield and large yield gaps in countries with a predominantly rainfed ecosystem.

Recent advances in molecular biology have increased the probability of research success in developing appropriate technologies for the rainfed ecosystem (Hossain et al 2000, Khush and Brar 2002). Structural and functional genomics provide knowledge, tools, and techniques to identify important genes and their association with agronomic traits. Rice breeders have begun to use marker-assisted selection techniques to expedite breeding cycles, and to incorporate traits of drought, submergence, and salinity tolerance into high-yielding varieties. Genetic engineering has already demonstrated great potential for introducing genes from other species into rice for herbicide tolerance and pest resistance and higher micronutrient contents. It may, however, take some time for this research to bear fruits. Countries will have to enact bio-safety regulations to facilitate adaptation trials and may have to overcome hurdles regarding the enforcement of intellectual property rights, even when the technologies are developed by the private sector. Considering the above, the possibility for a substantial increase in yield from the rainfed ecosystem in the short to medium run is not that great (Huang et al, 2002).

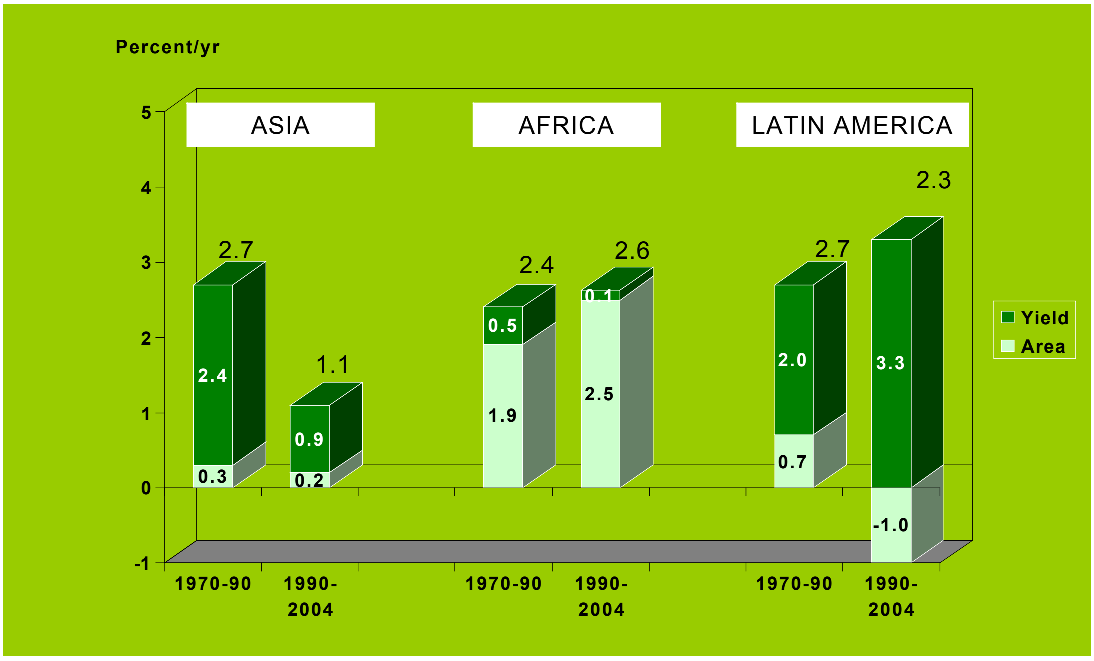
The West Africa Rice Development Association (WARDA) has made a breakthrough in developing “New Rice for Africa” (NERICA) based on crosses between African and Asian rice. NERICA varieties have better tolerance for most African stresses, including weeds and drought, shorter growing cycles, and high yield potential. They also perform better under both high- and low-input management systems (Defoer et al, 2002). This technological development provides an opportunity for farmers to stabilize the yield and intensify low-input upland systems. Development partners of Africa are enthusiastic about this development. Efforts are under way to fast-track adoption of NERICA in West Africa through the farmer participatory variety selection (PVS) approach. Faster adoption of these varieties may contribute to a substantial increase in production in sub-Saharan Africa, where upland and rainfed lowland ecosystems are predominant. The impact of this development on the global rice market will however be insignificant, as the region accounts for only six percent of global rice area.

Table 3: Growth (%/yr) in rice production and its sources by region, 1970-90 and 1990-04.

| | Production | | Area | | Yield | |
|---|---|---|---|---|---|---|
| Region/country | 1970-90 | 1990-04 | 1970-90 | 1990-04 | 1970-90 | 1990-04 |
| China | 2.7 | -0.3 | -0.5 | -1.2 | 3.2 | 0.7 |
| India | 2.9 | 0.9 | 0.5 | 0.1 | 2.4 | 0.8 |
| Indonesia | 4.7 | 1.0 | 1.2 | 0.7 | 3.4 | 0.3 |
| Bangladesh | 2.5 | 3.6 | 0.4 | 0.8 | 2.1 | 2.8 |
| East Asia and Pacific excluding China & Japan | 3.2 | 2.4 | 0.8 | 1.2 | 1.9 | 1.1 |
| South Asia excluding India | 2.5 | 3.0 | 0.7 | 0.5 | 1.8 | 2.5 |
| West Asia | 2.7 | 2.7 | 1.3 | 0.3 | 3.3 | 1.2 |
| Africa | 2.3 | 2.6 | 1.9 | 2.5 | 0.5 | 0.1 |
| Latin America and the Caribbean | 2.7 | 2.3 | 0.7 | -1.0 | 2.0 | 3.3 |
| Developed countries | 0.4 | 0.0 | -0.1 | -1.3 | 0.5 | 1.3 |
| World | 2.7 | 1.2 | 0.4 | 0.3 | 2.2 | 0.9 |

*Source of basic data: FAOSTAT database, FAO 2005.*
*Note: The growth is estimated by fitting the trend lines to the time series data for 1970 to 2002 period :* $LnY=a+bT+cD+dDT$.

Fig. 4: Changes in the *sources of growth in rice production.*




*Source: FAO, 2005.*
*Note: The growth is estimated by fitting the trend lines to the time series data for 1970 to 2002 period using the May 2004 update on rice production data.*

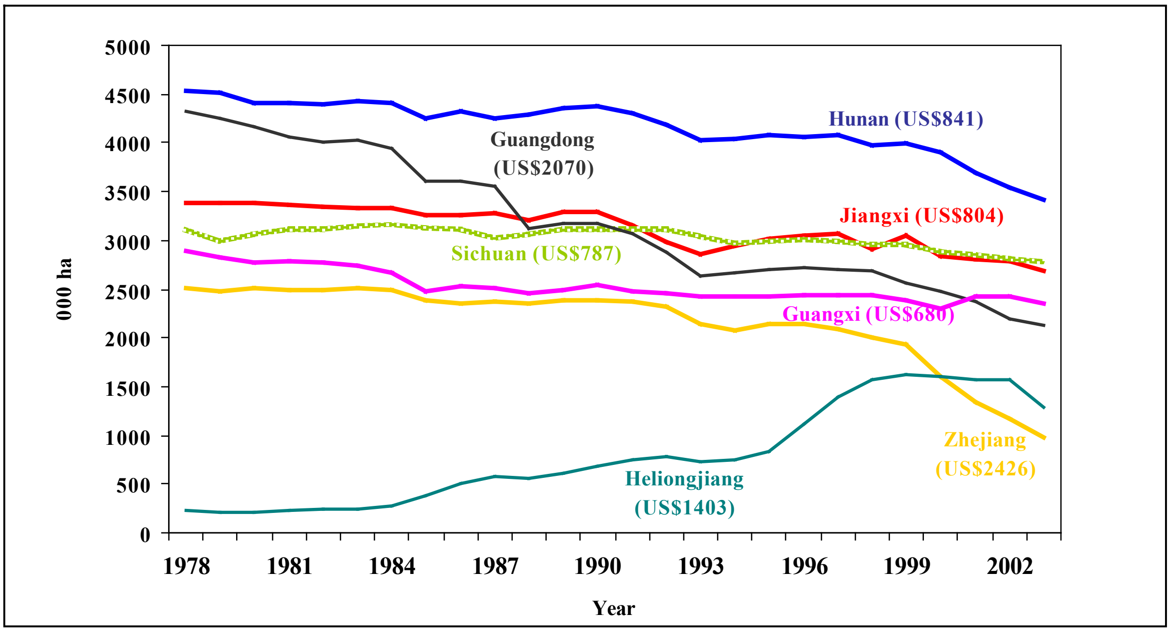
A deceleration in the growth of global rice production has already set in. The annual growth in global rice production was only 1.2% per year from 1990 to 2004 compared with 2.7% from 1970 to 1990. Growth in rice yield has declined even faster, from 2.2% to 0.9% per year (Table 3 and Fig 4). The recent growth (1990-2004) in rice production has failed to outpace population growth in several countries in Asia, where rice is grown predominantly under the irrigated ecosystem. The countries that have maintained or increased growth in rice production at par with population are those that have a large proportion of area under the rain fed ecosystem and had a sluggish growth in rice production earlier.

## FUTURE OUTLOOK

The world trade in rice is generally dictated by the demand for imports. The supply responds to it by drawing down stocks. As reported earlier, imports have had a consistent upward trend because of increasing demand from countries in West Asia, Sub-Saharan Africa and the Central and South America. This upward trend in rice trade is likely to continue. The pace of expansion of the world trade in rice in the future may depend on production and domestic policies for the major rice-producing and -consuming countries.

China's rice consumption may even fall in absolute terms in the near future because of continued decline in per capita consumption and the slow and declining population growth. But China's entry into the WTO may have an adverse effect on the domestic production of rice, unless it is compensated by incentives through removing prevailing distortions caused by overvaluation of the exchange rate and under-investment in agricultural research and extension (Huang, personal communication). The rice area in China is on a downward trend, and the decline has been faster in provinces of high economic growth (Fig. 5). Chinese farmers are reducing the area under rice, allocation just enough land to rice cultivation to meet the household food need, and free land and other resources for growing high value non-rice crops to increase farm incomes. In villages where employment opportunities are created in fast growing rural factories and non-farm occupations, farmers pay inadequate attention to intensive crop management practices putting a downward pressure on the yield. The government is already concerned by continuous decline in rice production since 1998 and its effect on domestic availability of rice, and the growing rural urban disparity in incomes. The government has recently introduced some measures to increase the profitability of rice cultural cultivation and agricultural incomes. But, these one-shot measures would not be enough to sustain the incentives to continue rice farming under the pressure fast growing productivity and labor incomes in the non-rice agricultural activities and in the manufacturing and services sectors of the economy. In order to feed itself, China would need to protect the domestic rice economy in order to continuously raise rice price prices and agricultural subsidies, a policy followed by Japan and Korea in the past. Pursuing this policy may not be possible under the present WTO regime promoting liberalization of agricultural trade. Under this scenario China may become a net importer of rice from the world market, which would have an important bearing on rice price prices in the world market because China's present consumption is almost five times the global rice market.

Fig. 5: Trend in rice area, major rice-growing provinces, China 1978-2003



India continues to expand rice production through technological progress in the irrigated ecosystem, the provision of input subsidies for irrigation and chemical fertilizers (this makes India a low-cost rice producer in the world), and providing price support to commercial farmers in Punjab through compulsory procurement of surplus rice at pre-determined prices. The growth of production has started slackening, however, in the northern and southern states where the irrigated ecosystem predominates. Consumption will continue to grow, however, because of fairly high population growth rates in the rice consuming states in Eastern India. Recently, the government has started providing incentives to the private sector for exporting rice. With domestic production growing in the traditional rice-deficit states of eastern India, and with continued policy support for maintaining low-cost domestic production in the irrigated environment in the North and the South, India may remain a major exporter of rice in the world market.

Vietnamese farmers have responded favorably to the economic liberalization introduced in recent years (Pingali and Xuan, 1992), and Vietnam has become the second most important exporter of rice in the world market because of rapid growth in production since the mid-1980s. Vietnam has almost exhausted its capacity for increasing rice production and has started adopting a policy of agricultural diversification to boost farmers' incomes. Rice production will grow at a much slower rate than in the past while domestic consumption will continue to increase with the addition of about 1.2 million people every year. Thus, Vietnam may gradually reduce its rice exports, but will remain a major rice-exporting country in the near future.

Thailand, Myanmar, and Cambodia have considerable excess capacity for increasing rice production. The rice yield remains at a low level and additional land could be brought under cultivation, particularly through increasing area under the second rice crop in the dry season. Thailand has continued to increase exports even when rice prices remained low in the world market. Farmers have maintained a low cost of production despite increasing wage rates through consolidation of farm holdings and mechanization of agricultural operations. If rice prices go up, farmers will be encouraged to increase production by investing in irrigation and increasing area under the dry season rice, and reducing the yield gap for the wet season. Myanmar and Cambodia has favorable endowments of land, and are likely to increase their exports substantially in the future if the government supports investment in irrigation, milling facilities and marketing infrastructure.

Outside Asia, there is a large potential for increasing rice production and exports from Argentina, Uruguay, and Guyana. The exploitation of this potential will depend, however, on the rate of increase in the world price of rice; the valuation of their currencies vis-à-vis the U.S. dollar and the currencies in Thailand, India, and Vietnam, and the change in policy in the United States on income support to rice farmers. The U.S. is their major competitor for exports in the markets for Central and South America. The U.S. farm bill that provides substantial income support to rice farmers already had a negative effect on the export potential of these countries.

Indonesia, the Philippines, Malaysia, and Singapore are the major rice importers in Southeast Asia. In Indonesia and the Philippines, rice production has remained almost stagnant in the 1990s, while consumption has been growing on account of the increase in population as well as the increase in per capita rice intake in the Philippines due to shift from corn-based to rice-based diets in upland areas. The stagnancy of production may continue in Indonesia because of the highly intensified production system already reached in Java, the rice bowls of Indonesia. In the Philippines domestic production may get a boost from favorable government policies for the adoption of hybrid rice and subsidies given to the production of quality seeds. Malaysia and Singapore have been following a policy of self-reliance by importing rice from low-cost sources rather than sustaining high-cost domestic production. These countries may follow market liberalizing policies, particularly free trade within the ASEAN region. In that case Singapore and Malaysia, Indonesia may increase their rice imports in the future, while the Philippines may maintain imports at a lower level.

Bangladesh has substantially reduced the yield gap in the irrigated ecosystem over the last decade that resulted in a downward trend in imports. The production growth may slow down in the future because of the plateau in yield for the dry season rice crop (boro) and slow technological progress in the large flood-prone and salinity-prone coastal areas. Rice consumption will continue to grow, however, mainly because of the increase in population of about two million people every year. Bangladesh is likely to remain a marginal rice importer. Nepal has the capacity to achieve self-sufficiency in rice production, but Sri Lanka may remain a minor importer because of high production costs from labor scarcity and higher wage rates.

Many major rice-importing countries are located in West Asia and North Africa. Only Egypt is a rice exporter. The region does not have a comparative advantage in growing rice but the demand has been growing because of the increase in per capita consumption and rapid population growth. Iran and Iraq, Saudi Arabia, Yemen, and Turkey now import from 0.5 to 1.0 million tons per year. The region will increase its share of the global market for rice, particularly for the aromatic Basmati-type produced in India and Pakistan.

In Sub-Saharan Africa the growth in domestic production may accelerate in the future from the increase in rice area in the inland river valleys and gradual adoption of the NERICA varieties for the uplands. But consumption may grow faster because of high population growth and changes in food consumption patterns away from coarse grains and root crops to rice and wheat, particularly in urban areas. There will be further boosts in imports if the price of rice remains low in the world market. The countries with sizable markets and an upward trend in imports are Nigeria, Senegal, Côte d'Ivoire, South Africa, Namibia, Madagascar, Guinea, and Benin.

In South and Central America, Brazil, Mexico, Cuba, and Haiti may remain important rice importers. In South America per capita rice consumption has been growing because rice is found to be a healthy and convenient (require less time for preparation compared to other food staple) food, but the growth of population is slowing down. Colombia, Peru, Ecuador, and Costa Rica have been able to keep imports at a low level despite the increase in per capita rice consumption, because of respectable growth in domestic production.

Brazil's rice production remained stagnant in the 1990s despite the increase in yield for the irrigated rice, due to reduction in area under upland rice. The upland rice production became less competitive with the government following a policy of trade liberalization. The imports of rice from South America may decline in the future with several countries adopting policies for the protection of the domestic rice producers.

## CONCLUSIONS

The growth in demand for rice will slow down substantially with economic growth and success in population control, particularly in the middle- and high-income countries in Asia and Latin America. But, the growth in production may also slow down because of the growing scarcity of land, labor, and water. Demand may increase substantially from West Asia and Sub-Saharan Africa because of high growth of population and the increase in per capita consumption. The domestic production of rice may increase in Sub-Saharan Africa due to recent technological breakthrough, but it is unlikely to offset the increase in demand. These regions will remain the major market for rice, along with Indonesia, the Philippines, Malaysia, and Singapore in Southeast Asia. The U.S., Italy, Spain, Argentina, Uruguay, and Guyana will continue to serve the limited market in Central and South America and Europe.

The world rice market will continue to remain segmented because of the overwhelming importance of rice as a staple food and its political and cultural significance. Large rice-consuming countries will continue to protect rice producers' and consumers' welfare through inward-looking policies. Any upward pressure on the price of rice will provide incentives to exploit the excess capacity for rice production in Thailand, India, Myanmar, and Cambodia, and some countries in South America. The domestic rice price may recover to the level of the mid-1990s, but a reverse upward trend is unlikely to happen, unless China decides to follow trade liberalization and access the world market to feed its growing urban population. China can afford to import rice from the world market due the favorable trend in exports of manufactured goods and a comfortable foreign exchange balance. But if China imports even 10% of its rice needs, it will swamp the world market for rice and cause substantial increase in prices.

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