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# Southeast Asia's Rice Surplus

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## Abstract

Southeast Asia is the leading source of world rice exports. Production growth in the region has slowed over the last decade. However, weaker consumption growth has allowed for export of a growing surplus. Rice markets favor varieties with relatively low yields but high consumer acceptance. Projections to 2021 foresee continued large exports from Southeast Asia, as regional exporters, including Thailand and Vietnam, are expected to produce enough rice to satisfy the import needs of Indonesia, the Philippines, and Malaysia, while continuing to serve large import markets outside the region.

**Keywords:** rice, rice surplus, Southeast Asia, Thailand, Vietnam, Indonesia, the Philippines, Burma, Cambodia, Malaysia, ASEAN

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## Contents

|   |    |
|---|----|
| Introduction .....  | 2  |
| Production .....  | 3  |
| Rice Consumption .....  | 11 |
| Rice Stocks .....   | 18 |
| The Future of Southeast<br>Asia's Rice Surplus .....                                    | 20 |
| Where the Region's Rice<br>Surplus Goes: Southeast Asia's<br>Trade with the World ..... | 24 |
| Conclusions .....   | 29 |
| References .....  | 30 |
| Appendix 1: Rice Types of<br>Southeast Asia .....                                       | 35 |
| Appendix 2: Rice Production in<br>Four Distinct Ecosystems. . . .                       | 36 |
| Appendix 3: Hybrid Rice in<br>Southeast Asia .....                                      | 37 |

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World Agricultural  
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# Introduction

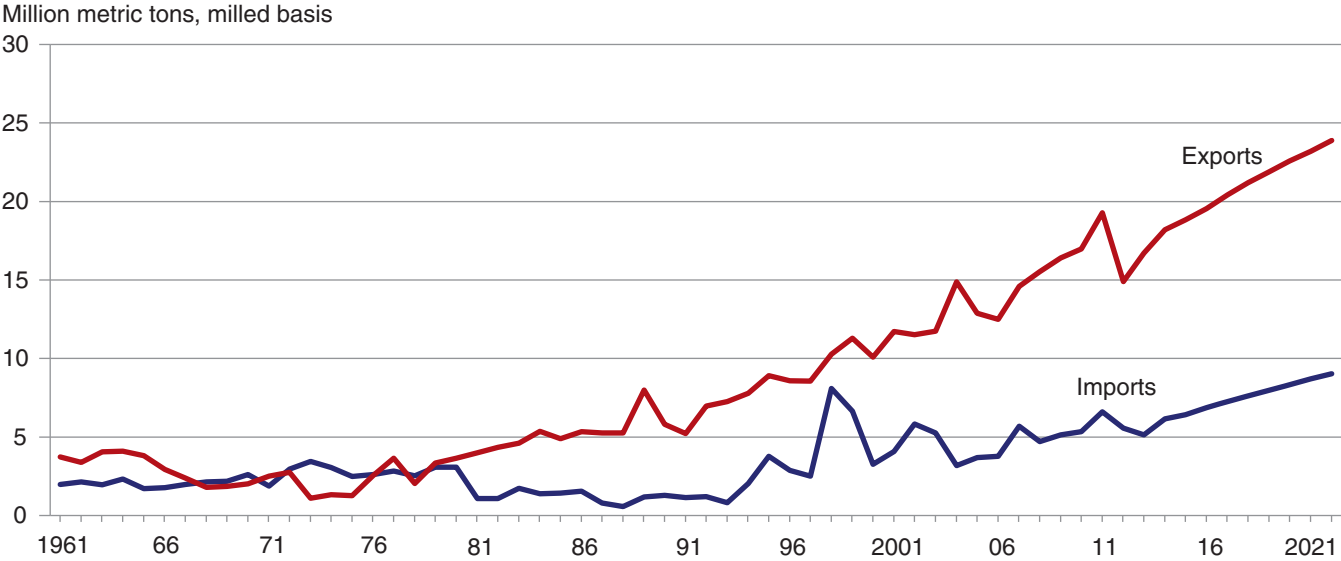
Southeast Asia’s rice surplus remains a bright spot amid concerns about global food availability. Net rice exports from Southeast Asia,<sup>1</sup> over 12 million tons in 2011, represent about half the import needs of the rest of the world. The rice surplus flowing out of the region has increased over the past 30 years, and U.S. Department of Agriculture (USDA) projections (2012) anticipate that this trend will continue over the next decade.<sup>2</sup> Southeast Asian rice exports help underpin the world rice market, and changes in the rice surplus would affect world and U.S. prices. This report examines why Southeast Asia’s rice surplus exists and why it likely will continue.

In USDA’s most recent projections, Southeast Asia’s rice production and consumption are projected to grow at a slower rate over the next decade than in the previous decade. The projected slowdown in the rate of production growth is raising food security concerns because of projected slower production growth of food grains globally (Parker, 2011). In the case of rice in Southeast Asia, however, it is necessary to look at production changes in the context of consumption. In Southeast Asia, slowing production growth does not appear to threaten regional food security because consumption growth is also slowing. Projected production growth in the region is sufficient to export a large rice surplus annually (10-12 million metric tons, or mmt) to the rest of the world (fig. 1), helping to meet global food needs.

<sup>1</sup>In this report, Southeast Asia refers to Brunei, Burma, Cambodia, Indonesia, Laos, Malaysia, the Philippines, Singapore, Thailand, and Vietnam.

<sup>2</sup>USDA *Agricultural Projections to 2021* provides a baseline projection. Henceforth, we refer to this as USDA’s baseline (2012).

Figure 1  
**Historical and baseline projections of Southeast Asia's rice exports and imports**



Sources: USDA, Economic Research Service calculations based on USDA's Foreign Agricultural Service Production, Supply and Distribution Database (PS&D) for 1961-2013 and USDA's baseline for 2014-21.

# Production

Southeast Asia produces about 25 percent of global rice output (fig. 2). The region’s rice production increased almost 18 percent between 2000 and 2010, or 1.6 percent per year.<sup>3</sup> Thus, USDA’s baseline projection of 1 percent per year during 2010-20 represents a significant slowing of growth. Expanded area and higher yields raised regional production in the past, but area growth is expected to slow in the future.

Indonesia, Vietnam, Thailand, Burma, and the Philippines dominate regional rice output (fig. 3). Small farms, typically between 0.5 and 2.0 hectares (ha) in size, produce most of Southeast Asia’s rice.<sup>4</sup> Most of the rice produced in Southeast Asia is indica rice, which is similar in appearance, texture, and taste to the long-grain rice grown in South Asia, southern China, most of South America, and the Southern United States. There are many varieties of indica rice; in Southeast Asia, the largest differentiated categories include several million tons of glutinous rice, produced mostly in Thailand and Laos, and several million tons of aromatic rice, produced mostly in Thailand (see, “Appendix 1: Rice Types of Southeast Asia”).

When discussing rice production, it is helpful to distinguish between peninsular Southeast Asia—Burma, Cambodia, Laos, Thailand, and Vietnam—and the island countries of Southeast Asia—Indonesia, the Philippines, Malaysia, Singapore, and Brunei (fig. 4).<sup>5</sup>

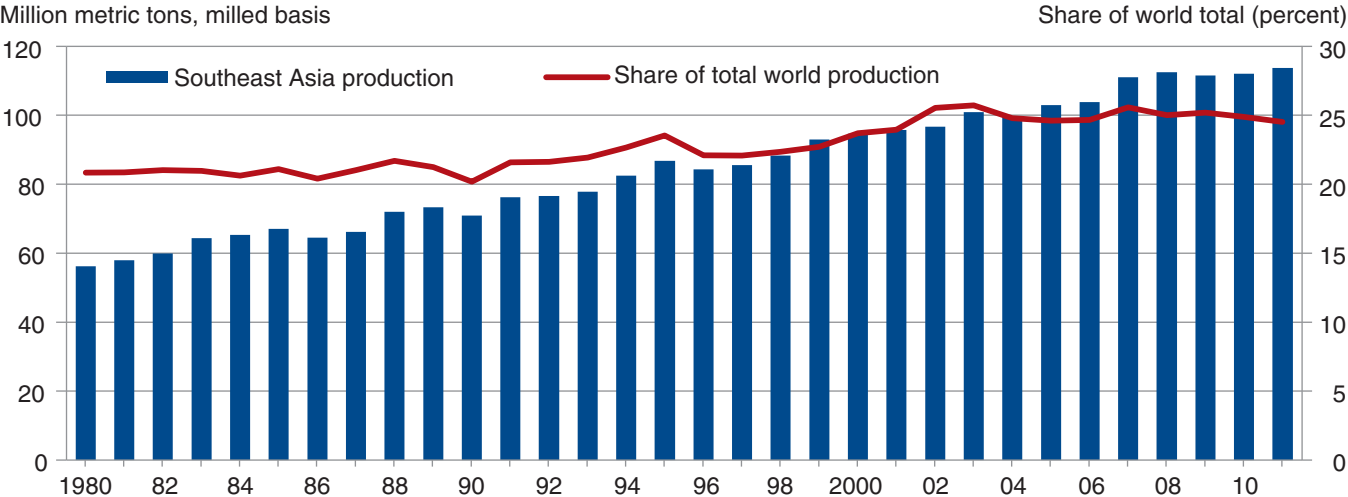
The peninsular countries have several major river systems that provide timely and adequate water for low-cost rainfed rice production. In contrast, the island countries lack large-scale river systems and use more irrigation (see, “Appendix 2: Rice Production in Four Distinct Ecosystems”). Peninsular Southeast Asia annually produces a large rice surplus, while island Southeast Asia has reported substantial deficits each year for more than two decades.

<sup>3</sup>Changes over time are calculated by comparing 3-year averages centered on the year cited in the text. Thus, production growth of 21 percent was between the average of 1999-2001 production and the average of 2009-11 production.

<sup>4</sup>One hectare equals 2.47 acres.

<sup>5</sup>Though part of Malaysia is attached to the mainland via the Malay Peninsula, we classify it as an island nation because of its production systems and similarities in weather patterns.

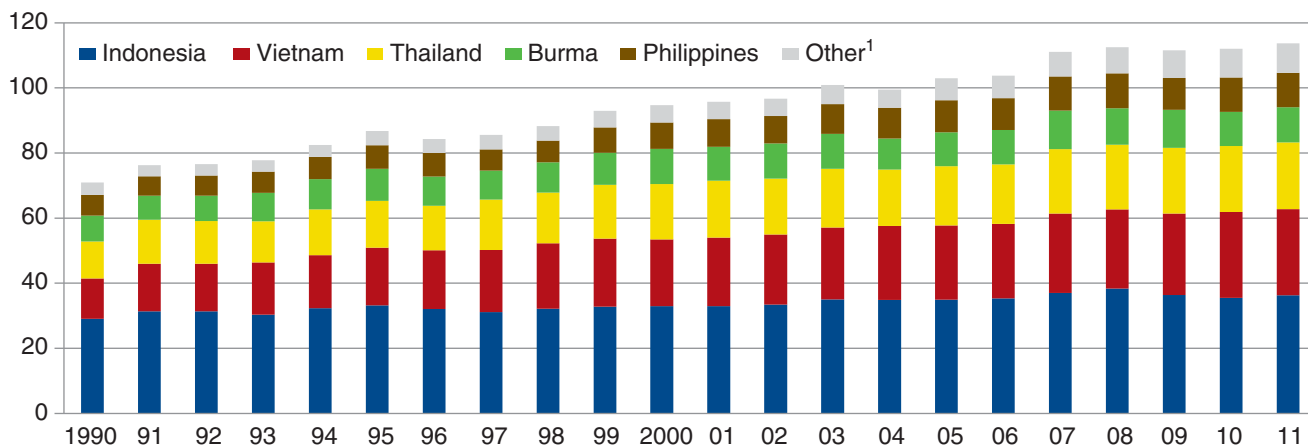
Figure 2  
**Southeast Asia's rice production**



Source: USDA, Economic Research Service calculations based on USDA’s Foreign Agricultural Service Production, Supply and Distribution Database (PS&D).

Figure 3  
**Southeast Asia's rice production, by country**

Million metric tons, milled basis



¹“Other” includes Cambodia, Laos, Malaysia, and Brunei.

Source: USDA, Economic Research Service calculations based on USDA's Foreign Agricultural Service Production, Supply and Distribution Database (PS&D).

## Area

Rice production is defined as area multiplied by yield. Rice area is less variable than area for many other crops or farm activities because it requires a large investment of labor and capital to construct paddy fields suitable for contained flooding. Most Southeast Asian rice grows in paddies, where the field is under water for significant periods. Typically, the paddy is planted to rice year after year, sometimes more than once a year.<sup>6</sup> Flooding the fields helps protect against pests and disease and improve fertility, compared with dryland farming. Much of the rice, particularly in peninsular Southeast Asia, is grown in river deltas that flood naturally on a seasonal basis. Farmers construct bunds (or embankments) around fields to create paddies that channel and retain water. Other paddies, especially in island Southeast Asia, are linked to constructed reservoirs and water-delivery systems that allow greater control over water supply. In dry seasons, paddy irrigation is essential and, in wet seasons, it typically provides greater yields. In this report, the second system is referred to as “irrigation” (see, “Appendix 2: Rice Production in Four Distinct Ecosystems”).

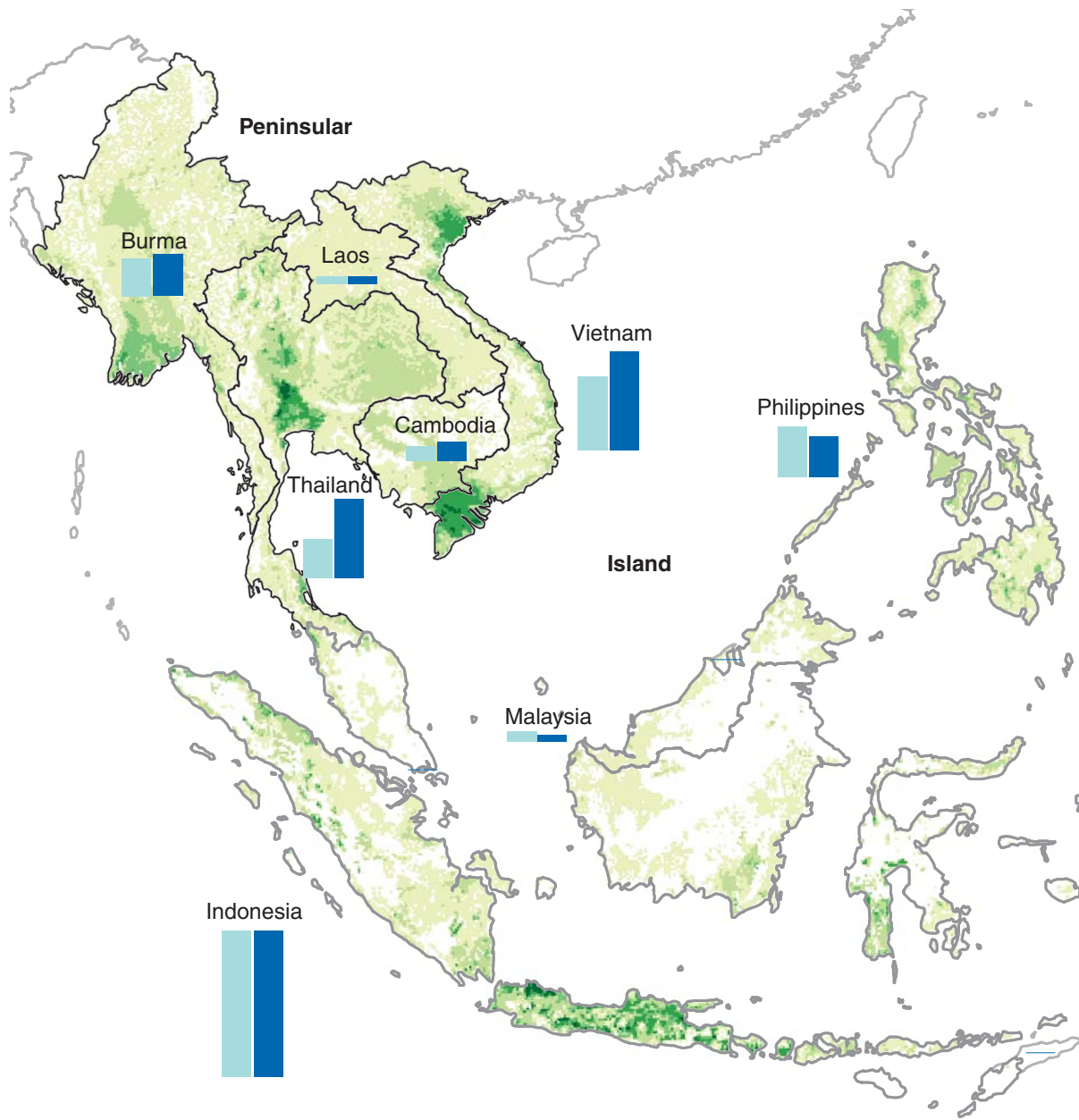
Nevertheless, area can expand or contract over time. Southeast Asia currently has about 46 million ha of land planted to rice, up from 28 million ha in 1960, a 64-percent increase over the last 50 years. Rice area expanded quickly during 1985-2000, increasing slightly faster in peninsular than in island Southeast Asia. In the last decade, however, rice area in Southeast Asia expanded by less than 1 percent per year (table 1). USDA's baseline for the coming decade projects that growth in Southeast Asia's peninsular and island areas will slow even further, or by less than 500,000 ha from 2011 to 2021, compared with the 3.4-million ha increase in the previous decade.

Projections for slower area growth reflect the reality that Southeast Asia already makes full use of land best suited for rice, leaving little scope for

<sup>6</sup>In the case of double or triple cropping, area statistics then count the same land two or three times. Rice area expansion or contraction actually is adding or scaling back multiple cropping of the same land, rather than farming additional land or switching out of rice.

Figure 4

### Rice production in peninsular and island Southeast Asia



Consumption\*    Production\*    Tons produced\*\*

19 mmt    19 mmt    100 k

0

\*Average 2008 - 2010 National totals

\*\*per 5 minute pixel, 2000

mnt=million metric tons.

Source: USDA, Economic Research Service calculations based on You et al., Spatial Production Allocation Model 3.1.

Table 1

**Southeast Asia's rice area**

| Country               | 1999-2001          | 2009-11 | 2019-21              | Growth                       | Growth                                  |
|-----------------------|--------------------|---------|----------------------|------------------------------|---|
|                       | average            | average | average <sup>1</sup> | rate, 2009-11 from 1999-2001 | rate, 2019-21 from 2009-11 <sup>1</sup> |
|                       | -----1,000 ha----- |         |                      | Percent                      |   |
| Peninsular countries: | 26,318             | 28,842  | 28,823               | 0.9                          | 0.3                                     |
| Burma                 | 6,067              | 6,833   | 7,145                | 1.2                          | 0.4                                     |
| Cambodia              | 1,987              | 2,740   | 2,968                | 3.3                          | 0.8                                     |
| Laos                  | 728                | 859     | NA                   | 1.7                          | NA                                      |
| Thailand              | 9,995              | 10,869  | 11,251               | 0.8                          | 0.3                                     |
| Vietnam               | 7,541              | 7,541   | 7,459                | 0.0                          | -0.1                                    |
| Island countries:     | 16,357             | 17,264  | 17,698               | 0.5                          | 0.2                                     |
| Indonesia             | 11,663             | 12,092  | 12,344               | 0.4                          | 0.2                                     |
| Malaysia              | 656                | 672     | 649                  | 0.2                          | -0.4                                    |
| Philippines           | 4,035              | 4,499   | 4,705                | 1.1                          | 0.4                                     |
| Southeast Asia total  | 42,676             | 46,105  | 46,521               | 0.78                         | 0.28                                    |

ha= hectares.

NA = not available.

Note: Total may not sum due to rounding.

<sup>1</sup>Average for 2019-21 and growth for peninsular countries and for Southeast Asia is calculated without Laos because a country projection was not available.

Source: USDA, Economic Research Service calculations based on USDA's Foreign Agricultural Service Production, Supply and Distribution Database (PS&D); Economic Research Service international baseline data.

expansion. Instead of opening new land to paddy field production, rice area expansion often comes at the expense of other crops or from increased double cropping of rice (Maclean et al., 2002). This is especially true in Vietnam's northern delta (around Hanoi) and on the Indonesian island of Java. Both areas are thickly populated and intensively cultivated, leaving few areas for expanded agriculture. Attempts to expand rice area on Indonesian islands other than Java typically have failed because the soil is not favorable for rice production (Eelaart, 2003). Increased multiple cropping in Thailand and the Philippines depends on expensive irrigation construction, which is less likely to be funded than in the past given budgetary limits and market prices that favor lower yield rice varieties. The longer growing period of lower yielding traditional rice varieties makes multiple cropping more challenging.

Vietnam harvests several rice crops a year, reflecting a variety of regional crop patterns and widespread multiple cropping. From 1988/89—when market-oriented government reforms began—to 1999/00, rice area increased 28 percent, mostly as a result of multiple cropping (Young et al., 2002). From 2000/01 through 2008/09, however, Vietnam's rice area declined. The Vietnamese Government encouraged farmers to shift to alternative crops, especially in place of the summer-fall rice crop that is particularly vulnerable to typhoon damage. The government also discouraged rice area expansion as a way to mitigate environmental damage and increased crop disease risk caused by growing multiple rice crops each year on the same land (UNEP,



2005). Since 2010/11, rice area in Vietnam has increased, with plantings now at the 1999/00 level.

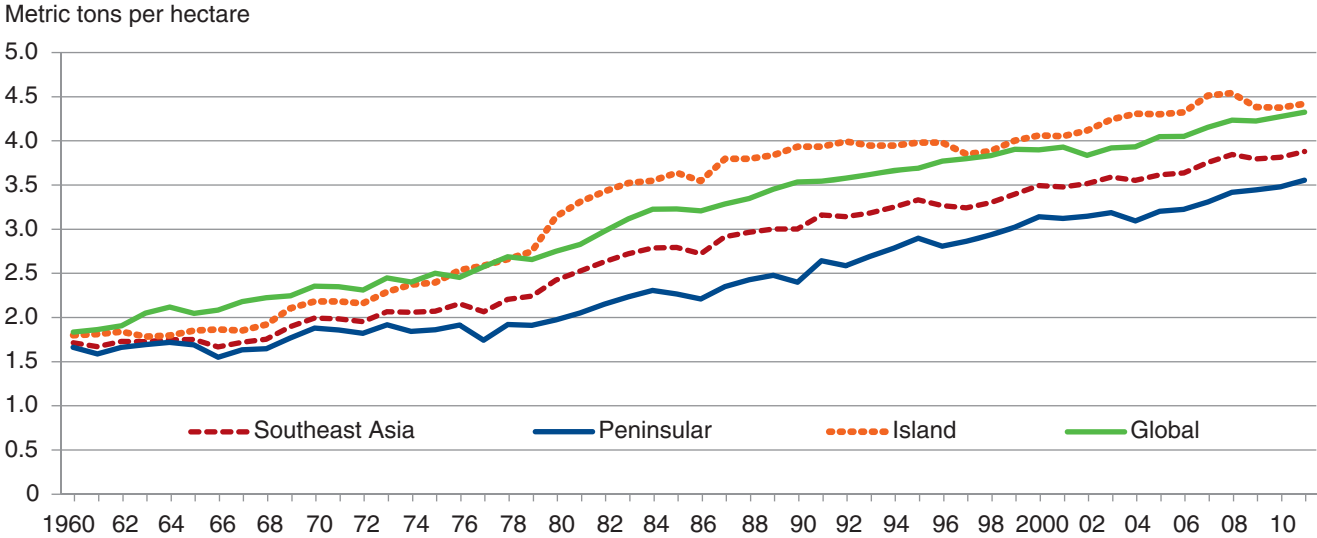
Compared with Thailand, Vietnam, and island Southeast Asia, rice area gains in the past decade for Burma and Cambodia were large and are expected to continue. Burma and Cambodia added 1.5 million ha of rice area between 2000 and 2010 and are projected to add an additional 540,000 ha by 2021. These two countries still have land that can be converted to rice production, as well as the potential for increased multiple cropping through irrigation investment. Slower projected growth in rice area in the coming decade reflects prices that may not be high enough to maintain expansion at historic rates and budgets that cannot support new irrigation systems.

**Yield**

Average rice yields for Southeast Asia (3.8 tons per ha on a rough or unhusked and unmilled basis) are lower than the global average of almost 4.4 tons per ha in 2011/12 (fig. 5). However, this yield reflects a natural advantage of peninsular Southeast Asia’s rainfed production; although rainfed production has lower yields, it reduces irrigated production costs. Rice yields for island Southeast Asia exceed the global average, and are typical of global irrigated rice agriculture.

Throughout Southeast Asia, farmers and governments face a production choice. They can plant rice varieties that achieve high yields and often can be harvested in less time but rely on irrigation water, greater fertilizer application, and greater use of pesticides. The shorter growth cycle of these varieties enables farmers to grow other crops (rice or other plants) after the rice crop is harvested. Alternatively, farmers can plant traditional rice varieties that

Figure 5  
**Southeast Asia’s rough rice yield per hectare**



Note: Rough rice is unhusked, unmilled rice.  
 Source: USDA, Economic Research Service calculations based on USDA’s Foreign Agricultural Service Production, Supply and Distribution Database (PS&D).

tend to have lower yields and longer crop cycles but which require less water and fertilizer and use less expensive seeds. Traditional rice varieties usually receive a higher price from consumers.<sup>7</sup> Farmers' net returns from rice depend on input costs (labor, land, seeds, fertilizers, and other chemicals), yields, and market sales values for the crop. As a region's consumers grow more affluent, demand for traditional rice varieties has been strong, boosting crop prices. Because of higher input costs and lower market values for high-yield varieties, farmers often opt to plant traditional rice varieties instead.

Government programs intended to increase rice yields through the use of hybrid and other rice varieties developed for high yields can be expensive to implement because they often involve free seed distribution and subsidies to cover added inputs (see, "Appendix 3: Hybrid Rice in Southeast Asia"). If markets discount the prices of higher yield rice varieties, the subsidies required to persuade farmers to increase yields can be high. To date, the development of most hybrid varieties has emphasized higher yields, but efforts to match the quality characteristics demanded by consumers could improve future acceptance.<sup>8</sup>

Average rice yields increased more than 9 percent from 2000 to 2010 in Southeast Asia, or about 0.90 percent per year (table 2). Yield growth (rough basis) through 2021 is projected at almost the same rate, or 0.88 percent per year.

In Thailand, rice yields are projected to rise by over 1 percent annually through 2021, faster than the 2000-10 rate. Thai Government policies are expected to provide strong incentives for yield growth—the government promises to buy farmers' rice at a price well above historical market prices (Prasertsri, 2011). Over much of 2000-10, Thai farm prices have been high, rising above prices in island Southeast Asia countries and supporting farmers' ability to increase production (fig. 6).

Yield growth in Cambodia during 2000-10 benefited from the adoption of international technologies and modern rice varieties. Because improved seeds were for short growth cycle varieties, they allowed for double cropping. More farmland has been developed for irrigation as well.<sup>9</sup> Future yield growth is likely to be more difficult than that seen in the early 2000s, as Cambodia's farmers are hampered by availability of good seed and access to credit to buy seed and fertilizers. Thus, yield growth is expected to slow (Shean, 2010).

In the rest of Southeast Asia, projected yield increases over 2011-21 are modest (less than 1 percent per year). Irrigation enables farmers to use high-yield varieties. The scope for building large dams and reservoirs, however, tends to narrow over time because water and suitable downstream land are in limited supply and the easiest dam sites have already been exploited. Southeast Asia's Governments must weigh subsidies for inputs, such as fertilizer and seeds, against budget constraints.

<sup>7</sup>In 2011, retail prices for the highest priced rice varieties were 50-75 percent higher than those for the lowest-priced varieties in Burma, Thailand, and the Philippines (Aye, 2009; Prasertsri, 2011; Philippine Department of Agriculture, Bureau of Agricultural Statistics, 2011). Pingali et al. (1997) wrote that, "Most of the modern varieties are considered low quality by Asian consumers."

<sup>8</sup>Unnevehr et al. (1992) presented multi-country research on rice quality characteristics. Pandey and Bhandari (2009) wrote that hybrid rice quality is a critical factor that is being addressed in breeding programs.

<sup>9</sup>Cambodian Ministry of Agriculture data indicated that almost 40 percent of Cambodia's rice farmland was at least partially irrigated in 2007, or more than double the share reported by the International Rice Research Institute (IRRI) in the mid-1990s. Because government statistics include flood-prone rice production areas and land with now-defunct irrigation facilities, the amount of irrigated rice farmland in Cambodia is slightly overstated. For more information, see Shean (2010).



Table 2

**Southeast Asia's rice yields**

| Country               | 1999-2001       | 2009-11 | 2019-21              | Growth                              | Growth   |
|-----------------------|-----------------|---------|----------------------|-------------------------------------|--|
|                       | average         | average | average <sup>1</sup> | rate, 2009-<br>11 from<br>1999-2001 | rate, 2019-<br>21 from<br>2009-11 <sup>1</sup> |
|                       | -----mt/ha----- |         |                      | Percent                             |  |
| Peninsular countries: | 3.08            | 3.41    | 3.76                 | 1.0                                 | 1.0  |
| Burma                 | 2.94            | 2.52    | 2.58                 | -1.6                                | 0.3  |
| Cambodia              | 2.04            | 2.62    | 3.21                 | 2.5                                 | 2.0  |
| Laos                  | 2.68            | 2.91    | NA                   | 0.8                                 | NA   |
| Thailand              | 2.58            | 2.83    | 3.17                 | 0.9                                 | 1.1  |
| Vietnam               | 4.18            | 5.50    | 6.00                 | 2.8                                 | 0.9  |
| Island countries:     | 4.04            | 4.39    | 4.71                 | 0.8                                 | 0.7  |
| Indonesia             | 4.42            | 4.71    | 5.06                 | 0.6                                 | 0.7  |
| Malaysia              | 3.17            | 3.77    | 3.85                 | 1.8                                 | 0.2  |
| Philippines           | 3.09            | 3.64    | 3.90                 | 1.6                                 | 0.7  |
| Southeast Asia total  | 3.45            | 3.78    | 4.12                 | 0.90                                | 0.88   |

mt/ha = metric tons per hectare.

NA = not available.

Notes: Rice measured on a rough, or paddy, basis—unhusked and unmilled. Note that the regional growth rate on a milled basis for the projection period (2009-11 to 2019-21) is lower (.78) because countries with lower milling rates raise yields more.

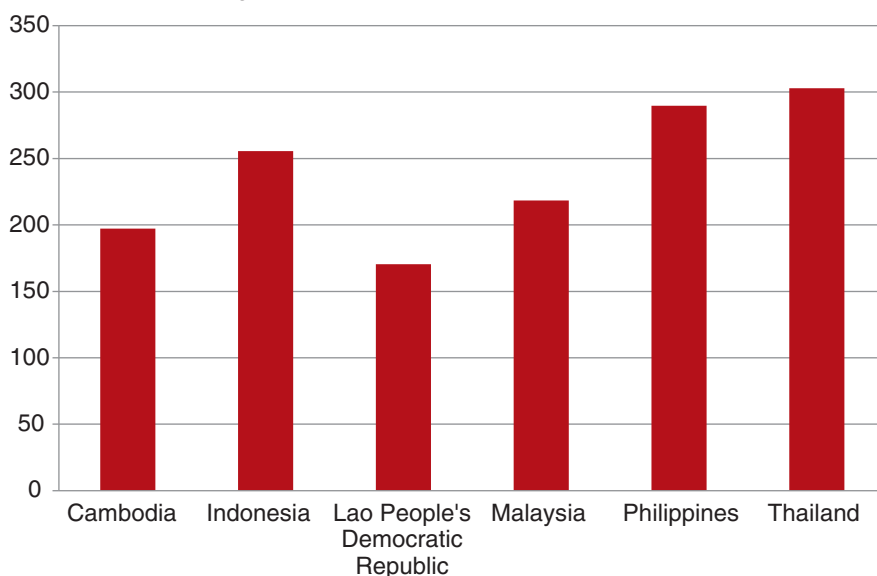
<sup>1</sup>Average for 2019-21 and growth for peninsular countries and for Southeast Asia was calculated without Laos because a country projection was not available.

Source: USDA, Economic Research Service calculations based on USDA's Foreign Agricultural Service Production, Supply and Distribution Database (PS&D); and Economic Research Service's international baseline data.

Figure 6

**Southeast Asian rice producer prices, average 2007-09**

U.S. \$/metric ton, rough basis



Source: USDA, Economic Research Service calculations based on Food and Agriculture Organization of the United Nations FAOSTAT data.

## Projecting Rice Production (Rice Area Times Yield)

USDA's baseline projects lower growth in rice area during 2011-21 than was seen in 2000-10 and continued slow growth in rice yields. Taken together, area and yield projections imply that regional rice production will grow more slowly than in the past. Regional rice production is projected to rise by about 11.3 million tons (milled basis) from 2011 to 2021, compared with an increase of 16.6 million tons over 2000-10 (table 3). Both rice area and yield projections are based on expectations that rice prices will not support greater investment in higher yielding seeds, chemical inputs, and irrigation infrastructure than over the past decade. Rice prices are expected to continue to reward the farming of low-yield, high-quality rice varieties that consumers prefer, rather than varieties that maximize yield. Southeast Asia's Governments could intervene to subsidize seeds and inputs and build more irrigation infrastructure. They also could buy up high-yield rice varieties above market price levels to encourage production. Partly because of budgetary constraints, however, such costly government interventions are not projected to expand over the next decade. World Trade Organization (WTO) commitments on subsidies also limit such interventions.

Table 3

### Southeast Asia's rice production (milled basis)

| Country               | 1999-2001          | 2009-11 | 2019-21              | Growth                       | Growth                                  |
|-----------------------|--------------------|---------|----------------------|------------------------------|---|
|                       | average            | average | average <sup>1</sup> | rate, 2009-11 from 1999-2001 | rate, 2019-21 from 2009-11 <sup>1</sup> |
|                       | -----1,000 mt----- |         |                      | Percent                      |   |
| Peninsular countries: | 51,912             | 62,843  | 69,402               | 1.9                          | 1.0                                     |
| Burma                 | 10,357             | 10,995  | 11,805               | 0.6                          | 0.7                                     |
| Cambodia              | 2,555              | 4,186   | 6,089                | 5.1                          | 3.8                                     |
| Laos                  | 1,170              | 1,395   | NA                   | 1.8                          | NA                                      |
| Thailand              | 17,019             | 20,327  | 23,545               | 1.8                          | 1.5                                     |
| Vietnam               | 20,812             | 25,940  | 27,964               | 2.2                          | 0.8                                     |
| Island countries:     | 42,380             | 48,023  | 52,755               | 1.3                          | 0.9                                     |
| Indonesia             | 32,907             | 36,057  | 39,560               | 0.9                          | 0.9                                     |
| Malaysia              | 1,350              | 1,649   | 1,626                | 2.0                          | -0.1                                    |
| Philippines           | 8,119              | 10,317  | 11,574               | 2.4                          | 1.2                                     |
| Southeast Asia total  | 94,292             | 110,867 | 122,161              | 1.6                          | 1.0                                     |

mt=metric tons.

NA=not available.

<sup>1</sup>Average for 2019-21 and growth for peninsular countries and for Southeast Asia was calculated without Laos because a country projection was not available.

Source: USDA, Economic Research Service calculations based on USDA's Foreign Agricultural Service Production, Supply and Distribution Database (PS&D); Economic Research Service's international baseline data.

## Rice Consumption

Southeast Asia's consumers eat large quantities of rice—9 out of 10 countries with the largest rice consumption per person are in the region. According to 2007 data from the Food and Agriculture Organization (FAO) of the United Nations, annual average regional consumption of all cereals (rice, wheat, etc.) for direct food use, or about 167 kilograms (kg) per person, is higher than the world average of about 147 kg.<sup>10</sup> Since the region's food grain consumption is already high, it is not likely to grow. Instead, dietary diversification in the region will likely lead to increased consumption of animal products and vegetable oils in the future.

USDA's PS&D database provides more recent estimates than FAO, but does not disaggregate rice disappearance into food, other uses, and waste. During 2000-10, per person rice consumption (for all purposes) was stable in Southeast Asia at about 162 kg per year, according to the PS&D. The FAO database indicates that Southeast Asian grain consumption for direct food use is high by global standards, and the PS&D database reveals that rice consumption per person currently appears to be changing very little year to year for the region as a whole. Since population growth is slowing in the region, constant consumption per person implies that total consumption growth in the region also will slow in coming years.

In Southeast Asia, most rice is consumed as fully milled white rice (or table rice) that is steamed or cooked in water and served in a bowl at a meal in the home or away from home at a restaurant or cafeteria. Such rice is the most important food throughout the region; however, there are other uses for rice, such as for seed, animal feed, and food manufacturing purposes, as well as waste and loss. FAOSTAT provides rice consumption estimates net of these other categories, creating an estimate of direct food use. For 2000-07, FAO reported fairly stable per person consumption of rice for direct food use (131 kg per year) for the whole region (table 4).

<sup>10</sup>Data for 2009 are the latest available in the FAOSTAT database, but they diverge so much from USDA's PS&D database that they are not used here. Cereals are on a milled basis.

Table 4

### Southeast Asia's food use of rice, 1998-2007

| Country        | 1998   | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|----------------|--|------|------|------|------|------|------|------|------|------|
|                | <i>kg per person per year, milled equivalent</i> |      |      |      |      |      |      |      |      |      |
| Vietnam        | 168  | 169  | 168  | 167  | 165  | 168  | 168  | 167  | 165  | 166  |
| Laos           | 161  | 160  | 160  | 159  | 159  | 160  | 161  | 161  | 162  | 163  |
| Burma          | 157  | 157  | 157  | 156  | 157  | 158  | 157  | 157  | 159  | 157  |
| Cambodia       | 156  | 156  | 167  | 154  | 156  | 150  | 146  | 151  | 152  | 152  |
| Philippines    | 92   | 100  | 104  | 104  | 109  | 108  | 117  | 121  | 121  | 129  |
| Indonesia      | 137  | 139  | 132  | 130  | 130  | 129  | 129  | 128  | 128  | 125  |
| Thailand       | 117  | 114  | 117  | 113  | 110  | 112  | 108  | 108  | 104  | 103  |
| Malaysia       | 88   | 87   | 85   | 81   | 75   | 76   | 72   | 77   | 76   | 77   |
| Southeast Asia | 133  | 135  | 133  | 131  | 130  | 131  | 131  | 132  | 131  | 131  |

kg = kilogram.

Notes: The FAOSTAT database 2012 revision indicates high food consumption levels for Thailand and Burma. Because of the great difference between USDA's PS&D data and revised FAOSTAT data, data for 2008-09 were not used.

Source: Food and Agriculture Organization of the United Nations, FAOSTAT database (rice supply available for food use).

FAOSTAT data estimate nontable use (i.e., not for direct food use) and waste of rice in the region at 55 kg per person per year. Another estimate—31 kg per person per year—can be formed by subtracting FAO’s direct food-use estimates from USDA’s total rice disappearance. Differing rice production estimates account for the disparity between the two estimates. Both estimates, however, suggest that a large amount of rice is used for purposes other than direct table food consumption in Southeast Asia.

**Rice for Table or Food Use**

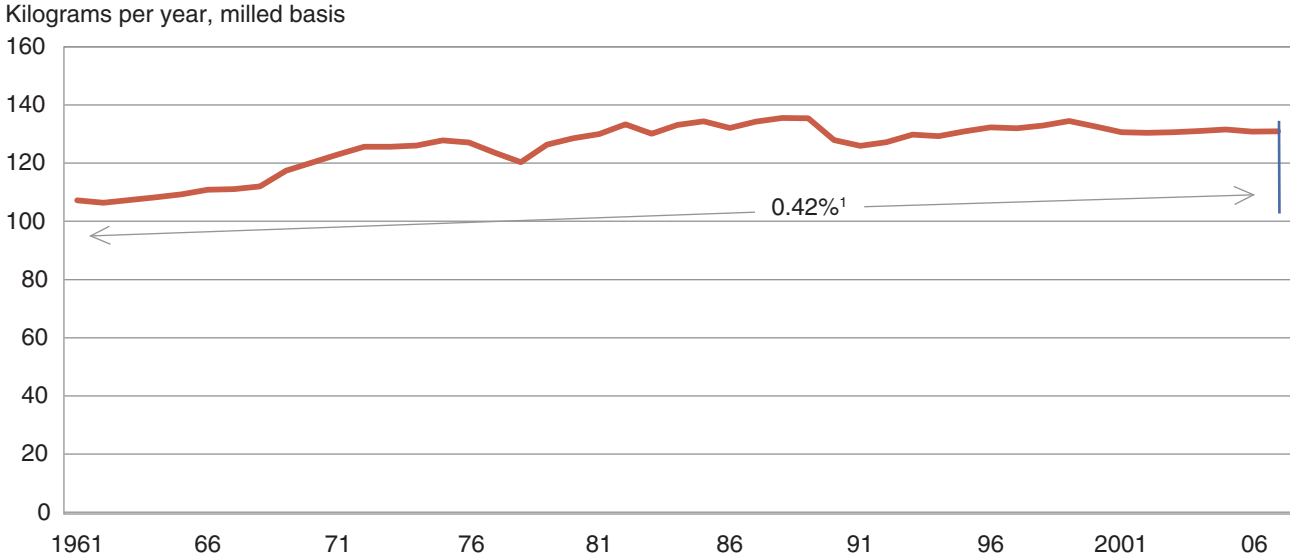
FAO estimates for 2007 of table rice consumption per person across Southeast Asia ranged from a low of 77 kg per year in Malaysia to a high of 166 kg in Vietnam. Consumption levels were stable or falling over 1998-2007 in almost all Southeast Asian countries. Only the Philippines experienced significant increases in consumption per person.

Rice consumption levels for food are inversely correlated with economic development, with the lowest income countries in the region (Cambodia, Burma, Laos, and Vietnam) consuming more rice per person than the wealthier countries (Malaysia and Thailand).<sup>11</sup>

Since 2000, table use of rice per person has been nearly flat in Southeast Asia as a whole. In fact, food consumption per person has changed little since 1982 (fig. 7), even as incomes grew significantly throughout the region. Factors other than income may explain the stagnation and decline in rice consumption per person. For example, more of the population is moving from rural areas to cities (urbanization), potentially lowering demand for rice, even when accounting for differences in income (Huang and David, 1993).

<sup>11</sup>Timmer et al. (2010) examined considerable evidence that rice consumption per person declines with increases in income once a threshold level of income is achieved. They concluded (p. 160) for Indonesia that, “Per capita rice consumption will decline sharply in the future in Indonesia, provided income continues to grow, as evidenced by the declines that have already taken place.” Vietnam’s Government estimated food rice consumption per person at 132 kg in 2010 (Quan, 2012), substantially below the FAO estimates seen in table 4.

Figure 7  
**Southeast Asia’s food rice supply per person, 1961-2007**



NS = not significantly different from zero.  
<sup>1</sup>  $\ln(\text{Consumption}) = a + b(\text{Time})$ .  
 Source: USDA, Economic Research Service calculations based on data from Food and Agriculture Organization of the United Nations, FAOSTAT database.

Consumers may also be increasing their spending on rice, but buying higher quality rice rather than greater quantities.

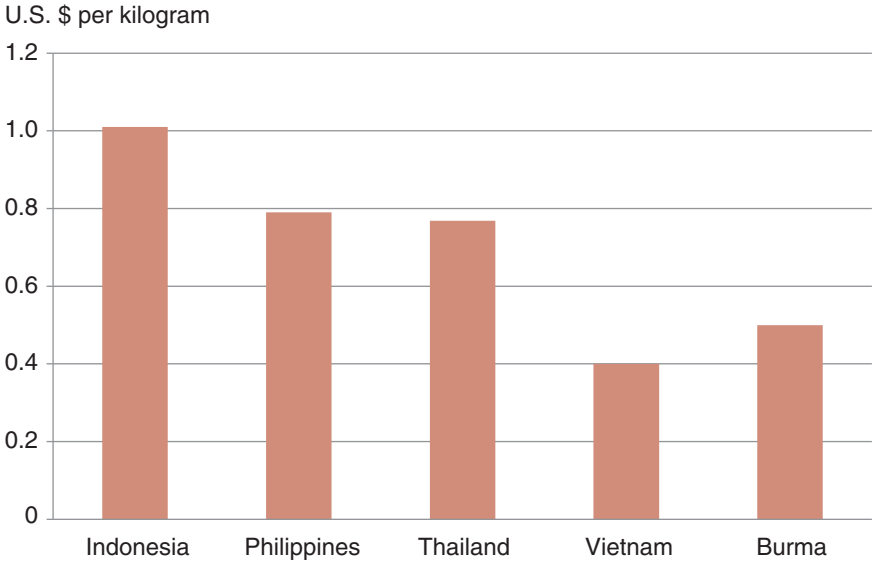
Changes in table rice consumption per person are gradual; a sudden downward shift is unlikely in any year. Rice is a staple throughout Southeast Asia and, even if rice prices rise steeply, consumers are likely to buy roughly the same amount of rice as before the price increase. Rice demand, in general, is relatively unresponsive to price changes. If supplies drop sharply, prices will be bid up quickly. Consumers will buy rice at any price rather than drop out of the market and purchase substitute goods while rice prices are high. Price spikes for a staple commodity like rice can lead to noticeable upward shifts in the consumer price index and can destabilize the economy as a whole and a nation's political situation. In recent years, the island countries of Southeast Asia have allowed retail prices to stabilize at levels higher than those in the peninsular countries (fig. 8). High consumer prices help pay for strong producer prices that prevail in the island countries as they try to achieve self-sufficiency in rice.

Despite unchanging levels of per-person rice consumption, Southeast Asia's population growth has led to increased total consumption for table use. For the region as a whole, consumption rose from 68.1 million tons in 2000 to 73.9 million tons in 2007, or 828,000 tons per year, on average (Food and Agriculture Organization, 2010).

Population growth in Southeast Asia has been slowing. Estimates of annual growth rates for 2010 are below 2 percent for all but one country in the region (table 5).<sup>12</sup> Projected growth rates for 2015, 2020, and 2025 are progressively lower at 1.1 percent, 1.0 percent, and 0.9 percent, respectively.

<sup>12</sup>Singapore's growth rate (2.1 percent in 2010) was high because of immigration.

Figure 8  
**Southeast Asia's retail rice prices, March 2011**



Source: USDA, Economic Research Service calculations based on data from Food and Agriculture Organization's Global Information and Early Warning System and Thailand's Department of Internal Trade.

Table 5

**Estimated and projected population growth rates in Southeast Asia**

| Country        | Population,     | 2000 | 2005 | 2010 | 2015           | 2020 | 2025 |
|----------------|-----------------|------|------|------|----------------|------|------|
|                | 2010            |      |      |      |                |      |      |
|                | <i>Millions</i> |      |      |      |                |      |      |
|                |                 |      |      |      | <i>Percent</i> |      |      |
| Indonesia      | 243             | 1.5  | 1.3  | 1.1  | 1              | 0.9  | 0.8  |
| Philippines    | 100             | 2.2  | 2    | 1.9  | 1.8            | 1.6  | 1.5  |
| Vietnam        | 90              | 1.3  | 1.3  | 1.1  | 1              | 0.8  | 0.7  |
| Thailand       | 66              | 0.8  | 0.7  | 0.6  | 0.5            | 0.4  | 0.3  |
| Burma          | 53              | 1.4  | 1.2  | 1.1  | 1              | 0.9  | 0.8  |
| Malaysia       | 28              | 2.6  | 1.9  | 1.6  | 1.5            | 1.3  | 1.2  |
| Cambodia       | 14              | 1.6  | 1.4  | 1.7  | 1.6            | 1.4  | 1.2  |
| Laos           | 6               | 2.1  | 1.6  | 1.8  | 1.6            | 1.4  | 1.3  |
| Singapore      | 5               | 2.5  | 2.4  | 2.1  | 1.9            | 1.7  | 1.5  |
| Southeast Asia | 608             | 1.5  | 1.4  | 1.3  | 1.1            | 1.0  | 0.9  |

Source: U.S. Department of Commerce, U.S. Census Bureau's International Data Base (IDB).

Between 1980 and 1985, Southeast Asia's population increased by 40 million people. Between 2005 and 2010, the region added approximately 38 million people. From 2010 to 2015, about 37 million more are expected and, from 2015 to 2020, about 35 million more (U.S. Census Bureau). Population growth continues to slow as households choose to have fewer children; families with 1-2 children are increasingly the norm. Urbanization, proceeding steadily throughout the region, also is associated with fewer children per household. While immigration is important in some countries, most migration is intraregional. Malaysia, Thailand, and Singapore host workers from other countries, mostly from Burma, Cambodia, and Indonesia, and people move in both directions across the Vietnamese-Cambodian border.

If food consumption of rice is defined as table use of rice per person multiplied by the number of people, data suggest that one part of the formula—consumption per person—has stopped growing and the number of people is growing more slowly. Population in four of the five largest Southeast Asian countries will grow by 1 percent or less per year over the next 10 years. Despite signs of increased consumption per person in the region's second-largest country—the Philippines—annual growth in the region's table use of rice may remain at or near 1 percent over the next decade—slower than in the past.

### ***Other Uses of Rice and Waste***

In recent years, "other" uses of rice (e.g., feed, processing, and seed) and waste have grown faster than table use of rice, according to FAO data. Overall, nontable use of rice rose by 7.7 million tons between 1998-2000 and 2005-07 (table 6). Table use grew by less than 5.6 million tons. Among all uses for rice, feed use had the strongest growth over this period at an estimated 62 percent. Waste and other uses grew by 27 and 35 percent, respectively.



Table 6

**Uses of rice in Southeast Asia (milled basis)**

| Category                       | 1998-2000<br>average | 2005-07<br>average | Quantity<br>change | Percent<br>change |
|--------------------------------|----------------------|--------------------|--------------------|-------------------|
| -----1,000 metric tons-----    |                      |                    |                    |                   |
| Feed                           | 5,055                | 8,204              | 3,149              | 62                |
| Seed                           | 2,153                | 2,500              | 347                | 16                |
| Waste                          | 7,482                | 9,469              | 1,987              | 27                |
| Processing                     | 456                  | 436                | -20                | -4                |
| Other utilization              | 6,500                | 8,744              | 2,244              | 35                |
| Total nonfood<br>disappearance | 21,647               | 29,353             | 7,706              | 36                |
| Food (table) use               | 67,463               | 73,029             | 5,566              | 8                 |
| Total rice<br>disappearance    | 89,109               | 102,382            | 13,272             | 15                |

Note: Totals may not sum due to rounding.

Source: Food and Agriculture Organization of the United Nations, FAOSTAT data.

***Feed Use***

Consumption of animal products is growing throughout Southeast Asia, and much of the additional demand is met by animal production based on intensive grain feeding. Quantitative data are sparse but suggest that rice is a significant source of animal feed in parts of Southeast Asia. FAO estimated Southeast Asia's feed use of rice at almost 6 percent of the region's rice production in 2005-07, or about 30 percent of the grains fed in recent years.<sup>13</sup> Broken and other milled rice substitutes for corn, feed wheat, and cassava in rations for swine and poultry. Locally grown rice also has a lower transportation cost than corn and feed wheat, which are often imported from overseas. As a result, broken rice sometimes has become more affordable for farmers and feed mills despite the high price of food-quality milled rice relative to corn.<sup>14</sup> In general, the outlook for feed use of rice in the region depends on relative prices for rice and other grains, especially corn.

***Seed Use***

FAO estimates seed use at about 2 percent of Southeast Asia's production (2007), and country estimates range from less than 1 percent of production in Indonesia and Malaysia to 3.4 percent of production in Burma and 6 percent in Laos. Future seed use likely will be proportional to future rice area.

***Food Processing Use***

Processed rice foods, such as rice noodles and rice-based alcoholic beverages, have a long history in the region.<sup>15</sup> Most rice used in food and beverage processing comes from broken or other low-quality rice. Food processing and alcohol consumption usually increases as income levels and urban populations increase (Regmi et al., 2001). Even if consumption increases, however, the share of rice going to food and beverage processing likely is less than 10 percent of total rice use. FAO estimated use for processing at only 350,000-500,000 tons in 2005, less than half of a percent of Southeast Asia's rice

<sup>13</sup>Prasertsri (2011) estimated that broken rice used in feed represented 10 percent of total Thai rice consumption. Quan and Vigil (2011) reported that, "rice is one of the main sources of homemade feed for swine, fish, and poultry" in Vietnam, especially in the Mekong River Delta. Quan (2012) cites Vietnamese Government data that the category "seeds, feed, post-harvest loss" represented 18 percent of Vietnam's rice output in 2010.

<sup>14</sup>Rice farmers often feed the crop to their own animals to avoid the need for cash or credit purchases of feed.

<sup>15</sup>Quan (2012) cites Vietnamese Government data that estimate "industry rice use and loss" at 973,000 tons in 2010, rising at a faster rate than any other component of Vietnamese rice distribution.

production. However, it may be that some food or beverage processing uses are also assigned to “other” use by the FAO.

### ***Other Use and Waste***

FAO estimated that over 19 million tons of rice were categorized as “waste” and “other utilization” in Southeast Asia in 2005-07, or 15 percent of total regional production. Other utilization includes rice for processing nonfood goods, rice consumed by tourists, and rice used in pet food. Little is known about the size and growth of these markets.

Loss and waste of rice appears to be a significant problem in Southeast Asia. Some rice loss occurs in the fields during harvest. Other loss occurs post-harvest when the rice is not dried properly or during processing. Pests also are a constant post-harvest threat. Stored rice deteriorates over time, where the rate depends on storage conditions.<sup>16</sup> FAO estimated that, between 1998-2000 and 2005-07, waste grew faster than consumption as a whole in Southeast Asia. If current and new initiatives to reduce loss and waste succeed, future growth in this category will be slower.

### ***Rice Disappearance: Historical and Projected***

According to population projections used in USDA’s baseline, fewer people will be added to the region’s population in the coming decade than in the past one. Rice consumption (aggregated across all uses) per person is projected to decline throughout most of the region, resulting in a slowdown in total consumption growth. Still, total annual rice consumption in Southeast Asia, currently slightly more than 100 million tons, is projected to increase nearly 8 million tons by 2021, with annual demand growth of about 0.8 percent. Demand increased by about 12.5 million tons in the previous decade (table 7). The projection depends heavily on the assumption that current consumption levels of table rice (per person) are so high that further growth is unlikely, and that some decline is likely as consumers gradually turn to other foods.<sup>17</sup>

Nontable rice consumption is expected to continue to grow faster than consumption of table rice. Greater use of rice in processing is likely, and feed use could increase as animal production in the region continues to grow. Some governments, however, especially in the Philippines, are concerned about the relatively large share of rice that is wasted or lost each year. Steps to reduce waste and loss may be more effective in the future, and this large category of disappearance may grow more slowly than in the past or even shrink.

<sup>16</sup>Corpuz (2008) estimated rice losses in the Philippines, at 20 percent or more of production. FAOSTAT estimates are much lower, under 2 percent. Some rice that is termed a loss because of spoilage is subsequently used for processing or feed, potentially explaining some of the discrepancy between the Corpuz and FAOSTAT estimates.

<sup>17</sup>Mohanty et al. (2010) projected declines in rice consumption per person in all Southeast Asian countries except Burma and the Philippines, where a “modest increase” was projected from 2008-09 to 2018-19 (p. 180).

Table 7

**Southeast Asia's rice consumption (milled basis)**

| Country               | 1999-2001          | 2009-11 | 2019-21              | Growth rate,           | Growth rate,                      |
|-----------------------|--------------------|---------|----------------------|------------------------|-----------------------------------|
|                       | average            | average | average <sup>1</sup> | 2009-11 from 1999-2001 | 2019-21 from 2009-11 <sup>1</sup> |
|                       | -----1,000 mt----- |         |                      | Percent                |                                   |
| Peninsular countries: | 40,176             | 44,893  | 47,165               | 1.1                    | 0.5                               |
| Burma                 | 9,700              | 10,377  | 10,895               | 0.7                    | 0.5                               |
| Cambodia              | 2,594              | 3,363   | 4,759                | 2.6                    | 3.5                               |
| Laos                  | 1,165              | 1,420   | NA                   | 2.0                    | NA                                |
| Thailand              | 9,233              | 10,300  | 10,584               | 1.1                    | 0.3                               |
| Vietnam               | 17,483             | 19,433  | 20,927               | 1.1                    | 0.7                               |
| Island countries:     | 47,007             | 54,817  | 60,390               | 1.5                    | 1.0                               |
| Indonesia             | 35,886             | 38,850  | 42,567               | 0.8                    | 0.9                               |
| Malaysia              | 1,971              | 2,648   | 3,114                | 3.0                    | 1.6                               |
| Philippines           | 8,730              | 12,942  | 14,709               | 4.0                    | 1.3                               |
| Southeast Asia total  | 87,183             | 99,713  | 107,555              | 1.4                    | 0.8                               |

mt = metric tons.

NA = not available.

Note: Totals may not sum due to rounding.

<sup>1</sup>Average for 2019-21 and growth for peninsular countries and for Southeast Asia was calculated without Laos because a country projection was not available.

Source: USDA, Economic Research Service calculations based on USDA's Foreign Agricultural Service Production, Supply and Distribution Database (PS&D); Economic Research Service's international baseline data.

## Rice Stocks

Regionally, ending stocks have risen relative to consumption since 1998, and Southeast Asia's stocks-to-use ratio peaked in 2008/09 when stocks reached 19.9 million tons (milled basis) and represented over 20 percent of annual consumption levels, or sufficient supplies to feed the region for more than 70 days (fig. 9).<sup>18</sup>

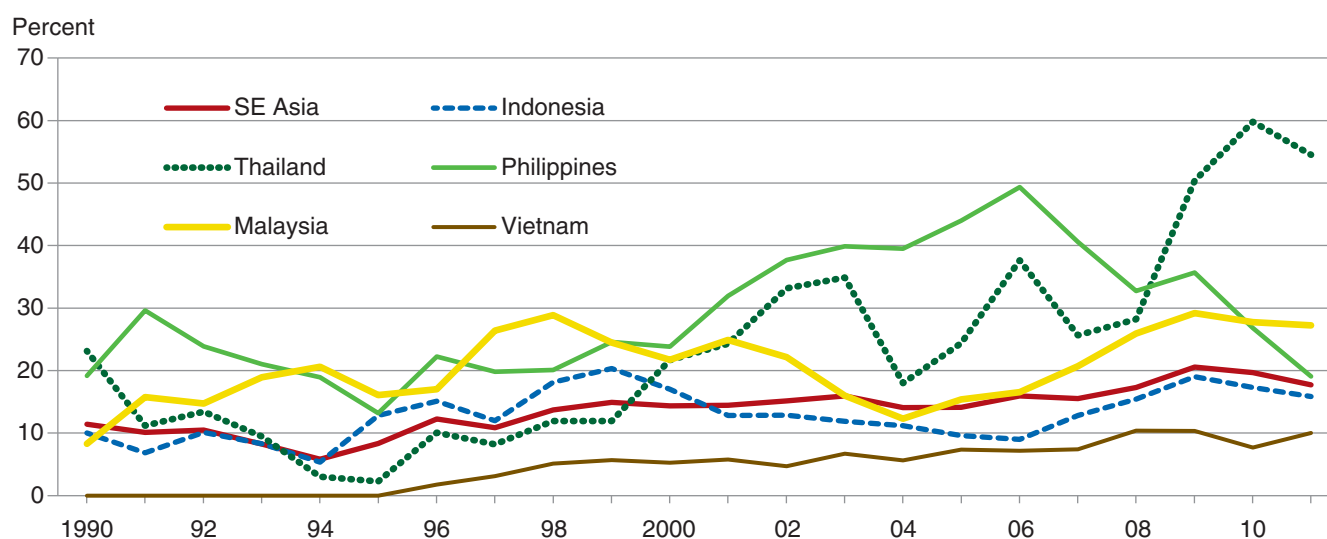
The full extent of rice stocks in Southeast Asia is not known. Actual stock-holdings are likely to be higher than the estimates in USDA's PS&D database—one of the few sources for stock estimates. The stock estimates generally do not include household stocks but try to account for publicly held and commercial stocks. Government estimates of publicly held stocks are not always accurate, and estimates of privately held stocks are difficult to obtain. The stock situation in Vietnam, Cambodia, and Burma is particularly hard to gauge. Estimates of stocks in Vietnam and Cambodia have only been available since 1996 and 2006, respectively.

Governments hold stocks for several reasons. Stocks may be held for emergencies, such as when natural disasters strike and nearby rice stocks must be quickly moved to the affected populations. They are also held in case market conditions (e.g., limited national or global supplies) threaten to raise prices sharply. Market conditions appear to be a likely motive for the large government stockholdings of importing countries, such as the Philippines and Indonesia, and these stocks are often purchased from foreign sources.

In other cases, stocks accumulate because governments buy rice from farmers to increase the prices that farmers receive. At various times, this has led to large government purchases in Thailand, the Philippines, and Indonesia.

<sup>18</sup>Represents aggregate of ending stocks for each country. Countries' marketing years are not all the same. Thus, aggregate stock estimates may not reflect actual stocks at any specific time.

Figure 9  
**Stocks-to-use ratios in Southeast Asia**



Source: USDA, Economic Research Service calculations based on USDA's Foreign Agricultural Service Production, Supply and Distribution Database (PS&D).

Governments announce that these stocks are temporary and will be sold when market prices are higher. In practice, governments sometimes hold the stocks for long periods, perhaps fearing that release at any time would depress prices and hurt farmers.

### ***Stock Changes: Historical and Projected***

In the next 10 years, the USDA baseline projects a decrease in Southeast Asia's stocks of about 300,000 tons (or 0.1 percent), compared with the increase in stocks of over 6 million tons seen between 1999-2001 and 2009-11 (table 8). The rise in stocks during 2000-10 was caused primarily by efforts to increase farm prices through government purchases in Thailand and, less significantly, in Indonesia and the Philippines. A secondary factor increasing stocks came as a result of Indonesia and the Philippines stock-piling imports to hedge against possibly higher world prices. Current high government stock positions are costly and (especially in Thailand) may not be related to food security. Thus, regional governments may be loath to add substantially to stocks in the coming decade.

Table 8  
**Southeast Asia's rice ending stocks (milled basis)**

| Country               | 1999-2001 average  | 2009-11 average | 2019-21 average <sup>1,2</sup> | Growth rate, 2009-11 from 1999-2001 | Growth rate, 2019-21 from 2009-11 <sup>2</sup> |
|-----------------------|--------------------|-----------------|--------------------------------|-------------------------------------|--|
|                       | -----1,000 mt----- |                 |                                | Percent                             |  |
| Peninsular countries: | 4,485              | 9,729           | 9,449                          | 8.1                                 | -0.3   |
| Burma                 | 1,100              | 647             | 647                            | -5.2                                | 0.0  |
| Cambodia              | NA                 | 163             | 163                            | NA                                  | 0.0  |
| Laos                  | 28                 | 70              | NA                             | 9.7                                 | NA   |
| Thailand              | 2,441              | 7,030           | 7,256                          | 11.2                                | 0.3  |
| Vietnam               | 915                | 1,819           | 1,418                          | 7.1                                 | -2.5   |
| Island countries:     | 8,290              | 9,213           | 9,217                          | 1.1                                 | 0.0  |
| Indonesia             | 5,103              | 5,876           | 5,863                          | 1.4                                 | 0.0  |
| Malaysia              | 452                | 745             | 665                            | 5.1                                 | -1.1   |
| Philippines           | 2,735              | 2,592           | 2,689                          | -0.5                                | 0.4  |
| Southeast Asia total  | 12,775             | 18,942          | 18,667                         | 4.0                                 | -0.1   |

mt = metric tons.

NA = not available.

Note: Totals may not sum due to rounding.

<sup>1</sup>Stock series for Burma and Cambodia were significantly changed in the PS&D database after the completion of the USDA baseline exercise. Averages for 2019-21 have been adjusted to reflect the historical data and the assumption made in the baseline of no change in stock levels for the two countries.

<sup>2</sup>Average for 2019-21 and growth for peninsular countries and for Southeast Asia was calculated without Laos because a country projection was not available.

Source: USDA, Economic Research Service calculations based on USDA's Foreign Agricultural Service Production, Supply and Distribution Database (PS&D); Economic Research Service's international baseline data.

## The Future of Southeast Asia's Rice Surplus

Southeast Asia's rice surplus reflects the rice quantity remaining after regional consumption has been satisfied and stock changes made. The USDA baseline projects that the region's annual rice production will grow by about 11 million tons, while consumption will grow by nearly 8 million tons, over the next decade. Both estimates point to slower growth than in 2000-10, when production rose by 16.6 million tons and consumption by 12.5 million tons. Stocks are expected to decrease slightly, after growing by 6 million tons in the previous decade. The region's average annual surplus will increase by about 3.3 million tons, or almost 30 percent between 2009-11 and 2019-21 (table 9).

USDA baseline projections assumed normal weather and no changes in trade policies or national policies in Southeast Asia that could impact supply or demand. The future, however, is unlikely to be free from major weather events or policy changes. Southeast Asia's future rice surplus estimates might deviate from the USDA baseline projections. For example, the El Niño events of 1997-98 and 2010 provide contrasting examples of the effects of severe weather events on markets (see box, "El Niño Weather Patterns Can Cut Southeast Asia's Rice Surplus"). In 1997-98, the region's net exports shrank to almost nothing. The 2010 El Niño, which affected production almost as much as the 1997-98 El Niño, had a smaller effect on trade because stocks

Table 9  
**Southeast Asia's rice surplus**

|                                  | 1999-2001<br>average | 2009-11<br>average | 2019-21<br>average <sup>1</sup> | Growth<br>rate, 2009-<br>11 from<br>1999-200 <sup>1</sup> | Growth<br>rate, 2019-<br>21 from<br>2009-11 <sup>2</sup> |
|----------------------------------|----------------------|--------------------|---------------------------------|---|--|
|                                  | -----1,000 mt-----   |                    |                                 | Percent   |  |
| Beginning stocks                 | 12,383               | 19,009             | 18,599                          | 4.4   | -0.2   |
| Production                       | 94,292               | 110,867            | 122,161                         | 1.6   | 1.0  |
| Consumption                      | 87,183               | 99,713             | 107,555                         | 1.4   | 0.8  |
| Ending stocks                    | 12,775               | 18,942             | 18,667                          | 4.0   | -0.1   |
| Surplus (net exports)            | 6,716                | 11,221             | 14,539                          | 5.3   | 2.6  |
| Selected countries' net exports: |                      |                    |                                 |   |  |
| Burma                            | 291                  | 758                | 907                             |   |  |
| Cambodia                         | -36                  | 805                | 1,329                           |   |  |
| Thailand                         | 6,916                | 9,105              | 13,012                          |   |  |
| Vietnam                          | 3,771                | 6,094              | 7,033                           |   |  |
| Indonesia                        | -2,243               | -1,197             | -3,009                          |   |  |
| Malaysia                         | -614                 | -1,010             | -1,495                          |   |  |
| Philippines                      | -1,267               | -2,100             | -3,242                          |   |  |

mt = metric tons.

<sup>1</sup>The average for 2019-21 is calculated without Laos because a country projection was not available.

Source: USDA, Economic Research Service.



## El Niño Weather Events Affect Southeast Asia's Rice Surplus

El Niño events in Southeast Asia are 1- or 2-year weather patterns that can sharply constrict the region's rice surplus, with major implications for global prices and trade levels (Hansen et al., 1998). El Niño droughts are not a new phenomenon, and the island countries of Southeast Asia usually suffer more from them than other parts of the region. In 1996/97 and 1997/98, El Niño-related drought affected rice harvests in Indonesia and the Philippines. The absence of normal rainfall damaged Indonesia's summer crop and delayed planting of the main 1997/98 crop, causing a production shortfall of nearly 1 million tons. The Philippines also experienced a severe drought, with production there declining by 11 percent (box fig. 1). These crop shortfalls led Indonesia to increase its imports in 1998 to a record 5.8 million tons—the largest quantity of rice ever imported by a single nation—and the Philippines imported another 2.2 million tons. Total 1998 Southeast Asian rice imports were almost 9 million tons—more than three times the 1997 level.

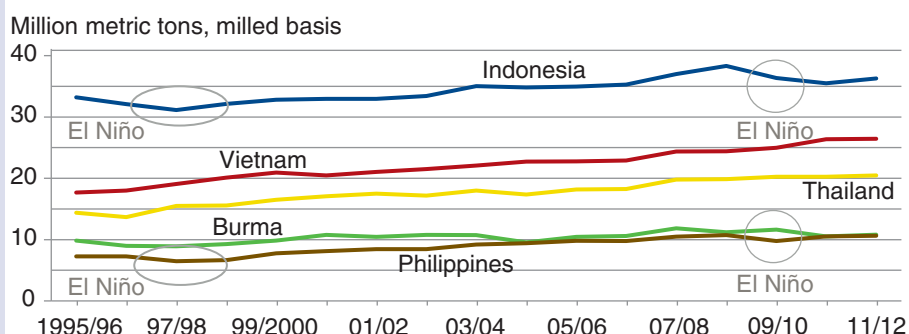
These imports affected the global rice market. Global rice trade soared more than 50 percent in 1998 to a record 26.7 million tons, with Southeast Asia accounting for 34 percent of global imports. Thailand and Vietnam accommodated most of the additional regional import demand; however, India, China, and the United States also shipped rice to the region. Although increased import demand occurred during the 1997-98 Asian financial crisis—a time when the depreciated Thai baht made its exports cheaper in U.S.

dollar terms—global rice prices still increased nearly 30 percent from November 1997 to late June 1998. With regional import demand soaring, Southeast Asia's net exports fell nearly 80 percent in 1998. East Asia (principally China), South Asia (principally Pakistan and India), and the United States all overtook Southeast Asia as larger net exporters in that year. Indonesia and the Philippines also made large imports in 1999 (box fig. 2). By 2000, however, regional and global trade had returned to previous volumes and patterns. The El Niño weather event was a short-term shock, not a long-term change in market structure or behavior.

The El Niño phenomenon recurs, but with varying severity and market impacts. The 2010 El Niño event decreased production in Indonesia by almost 2 million tons and in the Philippines by almost 1 million tons. Prior to the 2010 event, both the Philippines and Indonesian stock levels were higher than before the 1997-98 El Niño, and imports did not rise as much as in the earlier episode. El Niño-related drought could strike Southeast Asia in the future. Although Southeast Asia's rice trade balance would likely be restored within 2 years, a future occurrence of such a phenomenon could put short-term pressure on global rice supplies and likely cause an increase in rice prices.

Box figure 1

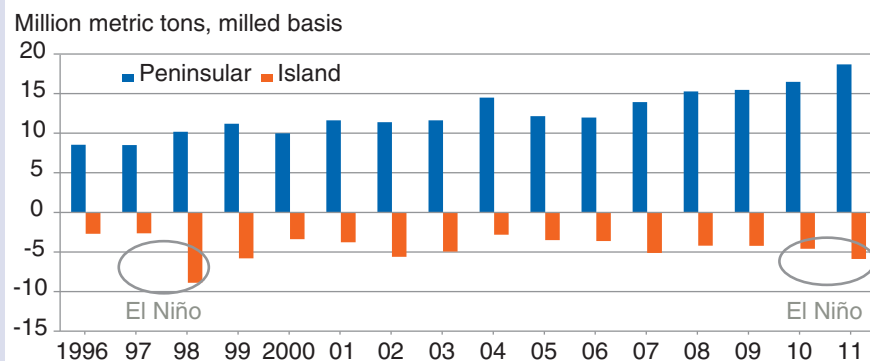
### El Niños and Southeast Asia's rice production



Source: USDA, Economic Research Service calculations based on USDA's Foreign Agricultural Service Production, Supply and Distribution Database (PS&D).

Box figure 2

### El Niños and trade: Net rice exports



Source: USDA, Economic Research Service calculations based on USDA's Foreign Agricultural Service Production, Supply and Distribution Database (PS&D).

were higher when the event unfolded. El Niños and other weather events will recur in Southeast Asia, but their effects will be limited in duration and their market impacts will vary depending on the effects on production, stock levels, and policy reactions.

Policy changes can have longer lasting effects than weather events. The rice price spike of 2008 (see box, “Rice Price Spike of 2008”) caused the governments of the three island countries—Indonesia, the Philippines, and Malaysia—to intensify efforts to become more self-sufficient in rice (i.e., import less rice).<sup>19</sup> USDA’s baseline projections do not envision fulfillment of these goals before 2021. However, the USDA baseline projections model was adapted to project full self-sufficiency in rice for both Indonesia and the Philippines by 2020. Specifically, this scenario assumed higher yield growth for Indonesia and the Philippines, and a decline in Philippine rice consumption per person (table 10). Southeast Asian rice imports in this scenario were 7.8 million tons less in 2020 than in the baseline. In the scenario, rice from peninsular Southeast Asian countries was no longer sent to the island countries and was instead diverted to the rest of the world. World rice prices were projected to drop by 10 percent from baseline levels as the extra rice increased supplies in world trade (fig. 10).

Many other events likely will shape Southeast Asia’s rice trade over the next decade. Nevertheless, USDA’s baseline projections, using low estimates of future production growth, still indicate that the continuation of a large surplus of rice in the region, to the benefit of consumers in the rest of the world, is a plausible outcome.

### **Rice Price Spike of 2008**

Prices of rice traded between countries spiked in 2008. However, prices within important consuming countries did not always spike to high levels. The increase in world market rice prices also did not seem to reflect key market variables, such as supply and demand, since production and consumption in key countries, including Southeast Asian countries, were at normal levels in 2008 and stocks were high.

Several countries banned or limited rice exports in 2007 and 2008, including major exporters like India and Vietnam. Vietnam imposed a ban for part of 2008 to keep domestic consumer rice prices from rising at a time when the country feared inflation. However, Thailand—the world’s largest rice exporter—did not constrain private trade, although the government continued to hold very large stocks. In mid-2008, the Philippine state trading agency—the National Food Authority—contracted with a Vietnamese State-controlled firm—Vinafood II—to buy rice at a very high price. Afterward, prices dropped rapidly as panic-induced buying subsided.

The rice price spike followed sharp price increases in other agricultural and nonagricultural commodities. Research continues to try to explain why the rice price spike occurred.<sup>1</sup>

<sup>1</sup>See, among others, Dawe, ed., 2010; Dawe and Slayton, 2010; Timmer, 2010; Slayton, 2009; Childs and Kiawu, 2009; Heady and Fan, 2010.

<sup>19</sup>Indonesia and the Philippines are actively working toward self-sufficiency in rice (Barichello and Patunru, 2009; Corpuz, 2007), and Indonesian agricultural officials have predicted rice exports in the near future. Malaysia’s leaders have set a goal of 70 percent self-sufficiency in rice (Hoh, 2010).

Table 10

**Self-sufficiency scenario for Indonesia and the Philippines**

| Baseline rates of change | Area | Yield | Production | Consumption/person      | Population | Consumption |
|--------------------------|------|-------|------------|-------------------------|------------|-------------|
| Importers:               |      |       |            | <i>Percent per year</i> |            |             |
| Philippines              | 1.0  | 1.1   | 2.1        | 0.0                     | 1.8        | 1.7         |
| Indonesia                | 0.0  | 0.4   | 0.4        | -0.3                    | 1.0        | 0.7         |
| Scenario rates of change | Area | Yield | Production | Consumption/person      | Population | Consumption |
| Importers:               |      |       |            | <i>Percent per year</i> |            |             |
| Philippines              | 1.0  | 2.1   | 3.1        | -1.6                    | 1.8        | 0.1         |
| Indonesia                | 0.0  | 0.6   | 0.6        | -0.3                    | 1.0        | 0.7         |

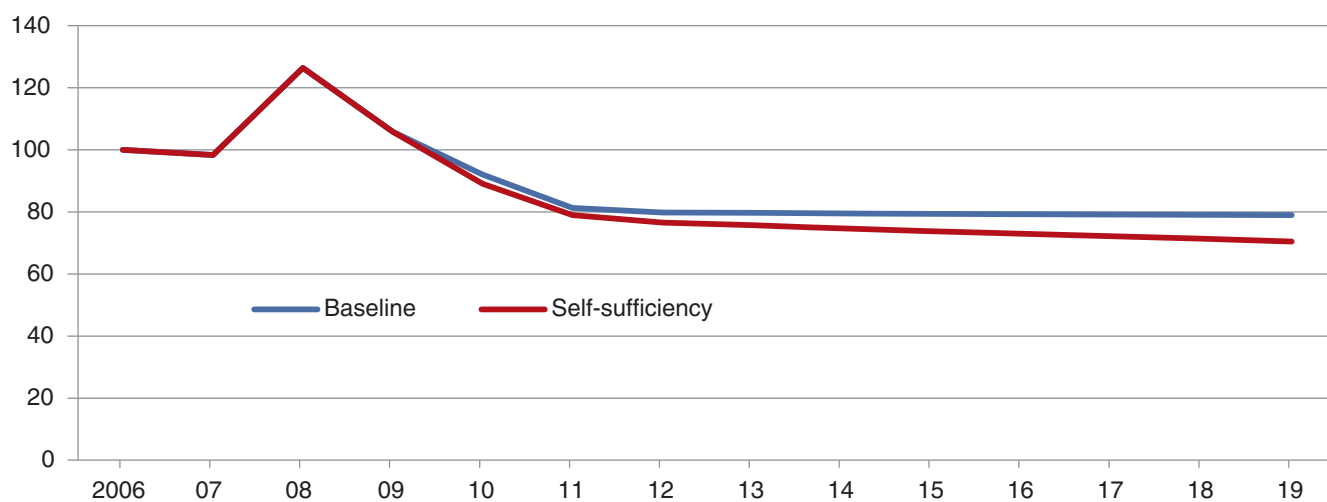
Notes: Scenario analysis was based on the USDA projections model of 2009/10. Shaded cells indicate where model parameters were changed.

Source: USDA, Economic Research Service.

Figure 10

**World reference prices for rice**

Index, 2006=100



Sources: USDA baseline model for 2009/10 and scenario model.

## Where the Region's Rice Surplus Goes: Southeast Asia's Trade with the World

At current and historical prices, Southeast Asia produces more rice than the quantity demanded in the region, and stock levels for most countries in the region are adequate or high. Over the past two decades, the region's net exports have more than doubled (fig. 11). The island countries of the region, however, have not been able to efficiently produce enough rice to feed their large populations; thus, Southeast Asia is both the world's largest exporting region and the second-largest importing region.

### Exports

Southeast Asian countries ship rice to a diverse set of markets (fig. 12). A significant share of exports from the region (approximately 33 percent in 2011) was sent to other markets within the region, chiefly from peninsular to island countries. The primary destination for rice exports outside the region is Sub-Saharan Africa, with smaller quantities widely distributed to the rest of the world. Southeast Asian rice exports are particularly important to Sub-Saharan Africa, where they account for over 90 percent of the region's rice imports and almost 40 percent of its rice consumption. While there is a definite regional export focus on Sub-Saharan Africa and intra-Southeast Asia trade, the region's exporting countries differ both in target destinations and the type of rice exported.

**Thailand**—In most years, Thailand is the world's largest rice exporter, accounting for about 30 percent of global trade in 2009-11. Thailand's rice export industry is distinguished by the diversity of its markets, both in types

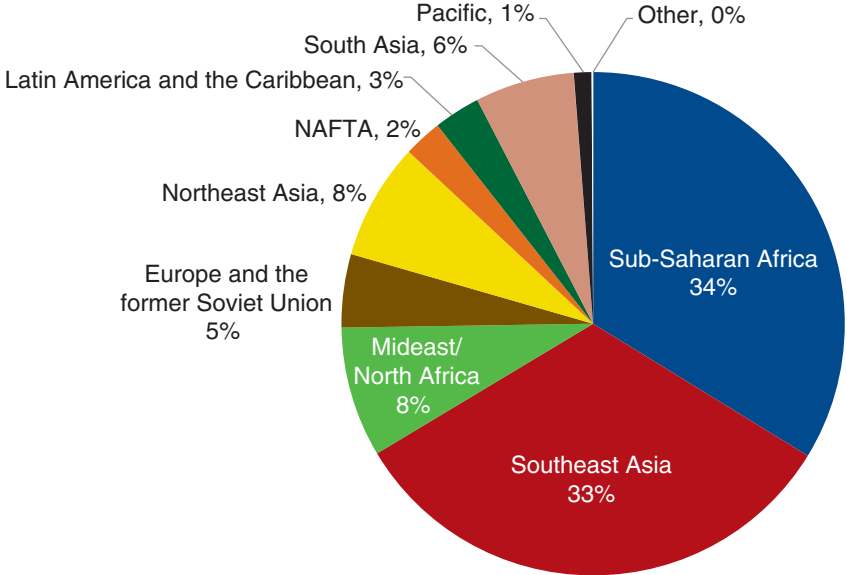
Figure 11  
Southeast Asia's net rice exports, 1990-2011



Source: USDA's Foreign Agricultural Service Production, Supply and Distribution Database (PS&D).

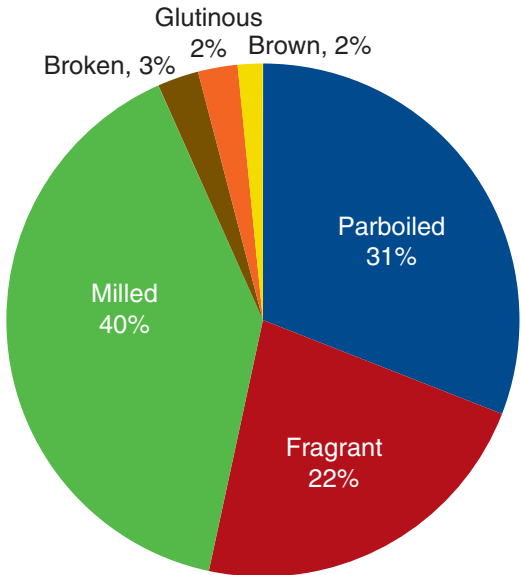
of rice it exports and in national destinations. Thailand ships regular-milled white rice, broken rice, parboiled rice, glutinous rice, and fragrant rice, and thus is able to satisfy the import needs of most countries worldwide (fig. 13).

Figure 12  
**Southeast Asia’s rice exports, by destination, 2011**



NAFTA = North American Free Trade Agreement.  
 Note: Export origins shown include Burma, Cambodia, Indonesia, Malaysia, Thailand, and Vietnam. Singapore’s exports are entirely re-exports originating from other locations.  
 Source: USDA, Foreign Agriculture Service and Economic Research Service calculations based on Global Trade Information Services.

Figure 13  
**Thailand's rice exports, by type, 2011**



Source: USDA, Economic Research Service calculations based on data from USDA’s Foreign Agricultural Service.

**Vietnam**—Typically, Vietnam is the world’s number two rice exporter, supplying roughly 20 percent of total global rice trade. Compared with the diverse array of rice types exported by Thailand, most of Vietnam’s exports are lower quality, higher broken-content rice of the IR-66 variety.<sup>20</sup> Fragrant rice production has increased recently, boosting Vietnamese exports in this category. All exports must be approved by the Vietnam Food Agency (VFA), which can ban or restrict exports to control domestic rice prices (Quan and Vigil, 2011). Vietnam’s rice export sector also differs from Thailand’s in that most exports are contracted through two government parastatal<sup>21</sup> corporations—the Northern Food Corporation (Vinafood I) and the Southern Food Corporation (Vinafood II). Government sales to Iraq, Iran, and Cuba are handled by Vinafood I, while Vinafood II handles sales to the Philippines, Malaysia, and Indonesia. Partly because of its Philippine trade, Vinafood II is Vietnam’s largest rice exporter.

**Burma**—Re-emerging as an important global rice exporter, in 2009, Burma exported almost 1.1 million tons of rice—its highest export level since 1966. Before World War II, Burma was the world’s largest rice-exporting country and remained a major exporter during most of the 1950s and early 1960s. The sharp decline in exports thereafter was due largely to government policies. Although the private sector technically manages exports, numerous government controls apply. Exporters pay an export tax (reduced from 20 percent to 5 percent in 2011), and all exporters must obtain a permit after the government verifies that enough rice is available for sale. Furthermore, export permits are only granted if the government determines that domestic prices are stable enough to allow exports. In 2010, exports fell to 445,000 tons due to concerns over rising domestic prices and then rose in 2011 to over 778,000 tons (Aye, 2009; USDA/FAS, 2012).

**Cambodia**—The country re-emerged in 2004 as a net rice exporter for the first time in 40 years. However, it still lacks the export infrastructure and advanced marketing chain required to be a major player in the global export market, though the farm-gate cost of production makes Cambodian rice one of the lowest-priced options in the world. The country’s milling sector, however, is inefficient and more costly than the milling sectors in Thailand or Vietnam (Shean, 2010). Because milling and exporting rice is expensive, most of Cambodia’s surplus rice is smuggled out of the country as rough rice to avoid both formal and informal export fees, as well as import duties and value-added tax in Vietnam. Sources estimate that 95 percent of the smuggled rice goes to Vietnam and 5 percent to Thailand (Development Alternatives, Inc. et al., 2008). The Cambodian Government is making efforts to increase legal milled rice exports. In 2011, it exported over 120,000 tons to Europe under the European Union’s Everything But Arms (EBA) program.<sup>22</sup> With further rice production improvements possible, Cambodian rice exports may continue to increase because domestic consumption growth is slow. Efforts to improve milling, sometimes with Thai or Vietnamese investment, may help expand Cambodia’s formal rice exports in the future.

Sub-Saharan Africa is the largest rice export destination for Thailand, Vietnam, and Burma. Thailand exports 200,000 tons or more annually to each of several African nations, including Nigeria, South Africa, Côte D’Ivoire, and Senegal. Nigeria and South Africa primarily import parboiled rice, while most exports to Côte D’Ivoire and Senegal are fragrant rice vari-

<sup>20</sup>IR-66 is a rice variety developed by the International Rice Research Institute that has indica characteristics and matures quickly (Khush and Virk, 2005).

<sup>21</sup>A company or agency owned or controlled wholly or partly by the government.

<sup>22</sup>Cambodia, Laos, and Timor-Leste qualify for import tariff exemption under the EBA. For more information, refer to <http://ec.europa.eu/trade/wider-agenda/development/generalised-system-of-preferences/everything-but-arms>.



eties (Senegal also imports Thai broken rice). Regular-milled white rice with a high broken content also is exported to certain markets in Sub-Saharan Africa. In recent years, however, Thailand's nonfragrant milled rice has lost markets to Vietnam, which has comparable grades of rice, often priced less than Thai rice.<sup>23</sup> In turn, Vietnam's share of these markets is sometimes challenged by Burma and Pakistan, countries whose milled rice prices are typically lower than Vietnam's.

Exports to Southeast Asia are the second main market for the four exporting countries. Although Thai rice is often undercut on price by Vietnam, Thai exports to the rest of Southeast Asia remain substantial—over 1.6 million tons in 2011. Exports of high-quality Thai aromatics also find a growing market within Southeast Asia, where consumers are becoming more affluent. Alongside growing exports, Vietnam also has seen increased imports in the past 5 years. Large volumes of rough rice (estimated at 500,000 tons or more on a milled-equivalent basis) have been flowing into Vietnam from neighboring Cambodia. The rough rice is then milled and used for local consumption.

### **Imports**

Indonesia, Malaysia, and the Philippines are Southeast Asia's principal rice importing countries. In 2011, the region imported 6.6 million tons, accounting for 20 percent of total world trade. Thailand and Vietnam supply most of the region's rice imports. U.S. shipments to the region have been small and sporadic since 2000.

**Philippines**—During 2005-10, the Philippines imported at least 1.8 million tons of rice per year and was the world's top importer 5 out of 6 years.<sup>24</sup> Over the past decade, rice usage in the Philippines has grown at an average annual rate of 4 percent. Production, however, has grown by an average of 2.9 percent per year. This production gap has made imports increasingly important to the Philippine rice balance sheet. In 2010, imports accounted for nearly 20 percent of total rice usage, one of the highest shares in the region. The National Food Authority (NFA) imports and resells large volumes of low-quality white rice (typically with 25 percent broken rice) to poor Filipinos. Most imports come from Vietnam, but varying amounts of Thai rice are also imported.

**Indonesia**—The rice imports of this country are volatile but can be even larger than those of the Philippines, with 2007 imports near 2 million tons and about 3.1 million tons in 2011. Indonesia achieved self-sufficiency in rice in the mid-1980s but was unable to maintain it, mostly due to increasing consumption and difficulty expanding crop area (Simatupang, 2008).<sup>25</sup> Though Indonesia is the world's third-largest rice producer, following China and India, its location on the equator in the Western Pacific makes it vulnerable to droughts—typically during an El Niño—that can reduce rice production by 3-4 percent, or over 1 million tons. The government typically imports rice, even in nondrought years, to keep a robust buffer in case of future bad harvests (Slette and Meylinah, 2011). As in the Philippines, a government-run enterprise manages rice imports, storage, and distribution.<sup>26</sup>

**Malaysia**—The most import-dependent among Southeast Asia's rice-producing countries, Malaysia usually imports over 40 percent of its

<sup>23</sup>Vietnam's largest African markets are Cote d'Ivoire, Ghana, Senegal, Mozambique, and Angola.

<sup>24</sup>The Philippines was self-sufficient in rice for periods in the 1960s and 1970s, and as recently as 1995 went without imports for a year (USDA/FAS, PS&D database).

<sup>25</sup>Indonesia was last self-sufficient in rice in 1993 (USDA/FAS, PS&D database).

<sup>26</sup>In addition to officially reported trade data, a substantial amount of illegal or smuggled rice trade takes place in Indonesia. Reports have indicated that smuggled rice imports have been as high as 500,000 tons in some years. Consistent annual estimates of smuggled rice are not available (e.g., Katial-Zemany and Alam, 2003).

consumption. A lack of suitable rice-growing area has hampered government efforts to expand production. As more migrant workers settled in Malaysia, rice consumption increased by over 20 percent from 2005 to 2010; consequently, imports increased.<sup>27</sup> As in Indonesia and the Philippines, a government agency controls Malaysia's rice imports (Hoh, 2008). Malaysian rice imports fluctuate less than those of Indonesia and the Philippines because domestic production is more stable.

### *Implications of Southeast Asia's Trade for the United States*

The U.S. rice sector interacts with Southeast Asia's rice sector both as a customer and as a competitor. In 2011, about 67 percent of U.S. rice imports came from Southeast Asia (primarily Thailand). Most of this imported rice is of the fragrant jasmine variety. Although the United States produces some fragrant rice varieties, many consumers and ethnic restaurants purchase Thai jasmine rice because of its unique flavor profile. Southeast Asia is not a significant destination for U.S. rice exports, largely because U.S. prices are not competitive. In 2011, the United States exported 32,000 tons of rice to the region, or less than 1 percent of total U.S. rice exports. In some years, U.S. rice has been shipped to the Philippines under Public Law 480, Title I.<sup>28</sup>

While the United States sells little rice to Southeast Asia, it competes with Southeast Asian exporters in other markets. For example, both the United States and Thailand produce high-quality long-grain rice, and both countries export large quantities of rice to the Middle East, with substantial competition in the Saudi Arabian market. Most recently, both have tried to win Iraqi export contracts, with Vietnam also contending for this business. In Sub-Saharan Africa, the United States and Thailand compete for sales to Ghana—the largest U.S. commercial market in the region. In other markets, such as Japan, the United States and Thailand offer different rice types, creating little scope for competition.

Thailand's lower quality rice faces competition from Vietnam, India, Burma, Pakistan, and sometimes China. In response, Thailand has moved into higher-quality markets where it competes directly with the United States. As markets perceive smaller quality differences between them, prices for leading varieties of Thai and U.S. rice have moved closer in recent years. In the future, Vietnam likely will upgrade the quality of its rice exports, putting more competitive pressure on Thailand and the United States.

The Southeast Asian rice surplus has a major effect on world rice prices, especially prices of long-grain rice grown in the Southern United States, half of which is exported. Increases (decreases) in the Southeast Asian surplus lead to more (less) exports, reducing (increasing) world prices. USDA's baseline projects that long-grain U.S. rough-rice farm prices will average \$13.00 per hundredweight for 2010-21, almost 50 percent higher than for 2000-10.<sup>29</sup> If Southeast Asia's two largest importing countries—Indonesia and the Philippines—successfully reduce their import levels by increasing production, world prices likely would fall below projected levels. Alternatively, weather-related reductions in Southeast Asia's rice production could increase prices in some years. In either direction, U.S. rice export prices would be affected directly, leading to higher or lower farm prices for long-grain rice.

<sup>27</sup>Malaysia has two differentiated import segments. The country imports a substantial amount of low-quality, high broken content rice from Vietnam to feed the low-income migrant-worker population. For the native population, Malaysia imports either high-grade milled rice or fragrant rice from Thailand (Hoh, 2008).

<sup>28</sup>Title I (Trade and Development Assistance) provides for government-to-government sales of U.S. agricultural commodities to developing countries on credit or grant terms under the Food for Peace Act. For more information, refer to <http://www.fas.usda.gov/excredits/FoodAid/pl480/pl480.asp>.

<sup>29</sup>Prices are farm prices, rough basis. Refer to ERS *Rice Yearbook, 2011* for the historic prices (table 15) and *USDA Long-Term Agricultural Projections* (2012), table 24b, for projected prices.

## Conclusions

Southeast Asia likely will maintain its rice surplus in the coming decade. Yield growth is expected to remain modest, as high-yield varieties continue to face high input costs and low consumer prices. Growth in rice area is expected to continue to slow, as the risk of crop diseases discourages multiple cropping and new investments in irrigation infrastructure do not expand beyond earlier levels. Slowing supply growth, however, is still expected to meet the region's demand. Southeast Asians are unlikely to increase rice consumption per person beyond current levels, and population growth will be less than in the past. Use of rice in feed could continue to grow if prices of corn and other feeds remain high but, overall, consumption growth is expected to continue to slow. As production continues to outpace consumption, the regional rice surplus is expected to grow.

A large surplus of rice in Southeast Asia is a boon for consumers elsewhere. Southeast Asia's rice millers and traders are experienced at sending various types of rice everywhere in the world, responding to price signals. World rice consumption continues to rise but at a reduced pace. Southeast Asia is a likely supply source for this global consumption growth.

Southeast Asia's rice exports compete with U.S. rice in the global market. USDA projections anticipate that this will continue. Shifts in supply and demand in Southeast Asia affect global and U.S. rice prices. Larger shifts could occur than those projected by USDA. Southeast Asia has the capacity to produce more rice if prices for high-yield varieties increase in its export markets. El Niños and other weather events could reduce production and exportable supplies in some years, bumping prices up. Lower-than-anticipated consumption in Southeast Asia could also occur. Policymakers in Indonesia—the region's most populous country—currently call for lower rice consumption there. Lower consumption in the region would boost rice exports to the rest of the world, often in competition with U.S. rice.

Southeast Asia is likely to remain a dominant force in world rice trade, and it is important to consider both its rice production and consumption in projections of the world rice market and of global food security.

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## Appendix 1: Rice Types of Southeast Asia

### *Differentiated by type of rice grown:*

- **Indica:** Dominant type of rice grown and traded worldwide. Produced heavily in the tropics. Cooks dry, fluffy, and separate. Can be long-, medium-, or short-grain.
- **Japonica:** Grown only in temperate climates. Cooks moist, clingy, and sticky. Grain lengths can vary. Little, if any, japonica is grown in Southeast Asia. Typically sells at a premium to indica rice.
- **Glutinous:** A specialty rice, also called waxy or sweet rice. Completely breaks down during cooking. Peninsular Southeast Asia produces a large share of global glutinous rice and is the main exporter.
- **Aromatic:** A premium-priced long-grain specialty rice with a distinct aroma and taste. Also called fragrant rice.

### *Differentiated by degree of processing:*

- **Rough rice:** Rice harvested from the field with both the husk (or hull) and the bran layer still attached. Sometimes called paddy rice.
- **Brown rice:** Rough rice that has had its husk removed, but the bran layer is still attached. Has a short shelf life and turns rancid quickly in the tropics.
- **Regular milled white rice:** Rice with both the husk and bran layer removed. Accounts for the bulk of rice traded and consumed globally.
- **Parboiled rice:** Rough rice that is steamed under such intense pressure that it pushes nutrients from the bran layer into the kernel, which is sturdier and less likely to break when milled than nonparboiled rice. Can be sold as rough, brown, or fully milled rice.
- **Head rice:** Fully milled rice grains that remain intact—or unbroken—during milling.
- **Brokens:** Rice grains that break during milling. Brokens typically sell at a discount to head rice.

## Appendix 2: Rice Production in Four Distinct Ecosystems

Rice ecosystems can be defined in various ways. The following classifications are used by the International Rice Research Institute (IRRI) and were based on surveys it conducted in the mid-1990s (Maclean et al., 2002).

**Dryland rice:** Sometimes referred to as upland rice, dryland rice is grown in unpuddled soil without any standing water, similar to field conditions for wheat and corn. About 13 percent of global rice area is classified as dryland rice. Yields are typically quite low and most dryland rice is grown for subsistence. In Southeast Asia, most dryland rice is grown on rolling or mountainous land.

**Flood prone rice:** About 8 percent of global rice area is classified as flood prone rice (also known as deepwater or floating rice). In this ecosystem, the rice plant must withstand temporary submergence or long periods of standing water. Many flood prone rice varieties can grow several meters in a short time to reach the surface in a flooded environment. Yields are quite low and can vary substantially due to unpredictable combinations of droughts and flooding. Most flood prone rice is grown in South (India, Pakistan, Bangladesh, Nepal, Sri Lanka, Afghanistan, and Bhutan) and Southeast Asia. In Southeast Asia, most flood prone rice is produced in the floodplains and deltas of the Irrawaddy, Mekong, and Chao Phraya Rivers.

**Irrigated rice:** More than half of all rice land is classified as irrigated rice, where water is added to banded fields—embanked to retain water—for at least part of the year. In some areas, irrigation supplements natural rainfall during the wet season. In other areas, a dry season crop is grown solely with irrigated water. Generally, farmers with irrigated land use more purchased inputs than farmers of nonirrigated lands. Irrigated fields produce the highest yields, primarily because water levels can be controlled, making fertilizer use more effective. Crops are grown in shorter durations in irrigated fields, often allowing two or more crops a year. More than three-fourths of global rice production comes from irrigated fields. Most of the modern short- and stiff-statured high-yield varieties (HYV) developed during the Green Revolution were designed for irrigated rice.<sup>30</sup> Rice grown in the dry season—when irrigation is required—also receives more sunlight than wet season crops, further boosting yields.

**Rainfed lowland rice:** Rainfed lowland rice is grown in banded fields that are flooded at least part of the cropping season by the natural flow of water from rivers and streams. Rainfed rice area is characterized by lack of water control, flooding, and droughts. Yields are typically low due to adverse climate, poor soils, and a lack of suitable modern technologies. Indonesia, the Philippines, and Thailand, however, have developed rainfed rice varieties that can achieve yields close to those attained by some irrigated fields.

<sup>30</sup>The Green Revolution refers to a period of intensified development and distribution of high-yield grain varieties, principally in the 1960s and 1970s.

## Appendix 3: Hybrid Rice in Southeast Asia

Hybrid crops are the offspring of parent cultivars with different genetic make-ups. Self-pollinating crops like rice are more difficult to hybridize than cross-pollinated crops like corn. Chinese scientists first produced hybrid rice in 1974, which led to widespread cultivation. Over half of China's rice area was planted to hybrids in 2007 (Tripp et al., 2010).

Hybrid rice generally provides a higher yield than inbred rices. A phenomenon known as heterosis, or hybrid vigor, causes hybrid rice to produce a higher yield than parental varieties. The seeds of harvested hybrid rice plants, however, usually do not preserve the hybrid rice's characteristics well or consistently. Therefore, new hybrid seed must be purchased before each planting season. Developing hybrid rice seeds is more expensive than growing certified or improved seeds that are not produced as hybrids (FAO, 2004; Tripp et al., 2010). Incorporating the quality characteristics valued by consumers into hybrid seeds is also difficult. Thus, providing hybrid seeds that offer the variety and quality desired by Asian consumers becomes a challenge for breeders.

Hybrid rice adoption in Southeast Asia has been spotty and controversial. Vietnam has planted hybrid seed since 1991 (Kuyek, 2000) and reportedly planted 600,000 hectares (ha) to hybrid rice in 2007, or 8.1 percent of total rice area (Pandey and Bhandari, 2009). Hybrid rice is planted in the Red River Delta in the northern part of Vietnam, "where farmers' cooperatives and state farms are heavily subsidized and strongly influenced by government decisions" (Pandey and Bhandari, 2009). The Mekong River Delta in the south produces some hybrid seed but does not plant it (CLDRRI, 2007).

Government-supported programs designed to increase hybrid rice use have been ongoing for years in the Philippines and Indonesia. The Philippine Government's 2007 target for hybrid rice use was 400,000 ha, or about 9 percent of the total rice area (Corpuz, 2007). In Indonesia, the target area for hybrid rice was 240,000 ha in 2008, or about 2 percent of total area (Wagner and Meylinah, 2007). A smaller amount of hybrid rice use was reported from Burma (FAO, 2004; Pandey and Bhandari, 2009) and Malaysia (Pandey and Bhandari, 2009), but not for Thailand (Kuyek, 2000).<sup>31</sup> Hybrid rice seed and technology imported from China are important in Vietnam and the Philippines (Quan, 2008; Corpuz, 2005; Kuyek, 2000; Pandey and Bhandari, 2009).

Hybrid rice farming requires much more expensive seeds and more fertilizer than nonhybrid rice, if the hybrid is to achieve its higher potential yield. Hybrid rice also has the reputation in Southeast Asia of being more prone to disease and pests than other rice varieties (Meylinah, 2008); thus, extra pesticide expenditures are often needed (Wagner and Meylinah, 2007). After harvest, hybrid rice usually receives a lower price in the marketplace than other rice because consumers prefer quality attributes that may not be found in hybrid rice (Meylinah, 2008; Pandey and Bhandari, 2009). Thus, with higher production costs and lower output prices, the yield advantage of hybrid rice must be considerable to make cultivation profitable.

<sup>31</sup>Winn (2012) reports that Burma's Government required each township to plant 100 ha to hybrid rice, "for a total of 36,000 ha... However, the results have been disappointing as the promised 10 mt/ha have not materialized."

In spite of the substantial cost, the Philippine and Indonesian Governments distribute hybrid rice seed to producers for free. In addition, both countries subsidize fertilizer costs. Hybrid rice varieties require greater attention to seed and seedling management, so cultivation would be unprofitable without government subsidies (Cororaton and Corong, 2009). In Vietnam, government support is also important for economically viable use of hybrid seed by farmers (Quan, 2008). Unsubsidized use of hybrid rice has not yet been reported in the Philippines or Indonesia.