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ASEAN and Global Rice Situation and Outlook

Eric J. Wailes and Eddie C. Chavez

No. 22 | August 2012

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Abbreviations

ADB	Asian Development Bank
AFSRB	ASEAN Food Security Reserve Board
AGREP	University of Arkansas Global Rice Economics Program
AGRM	Arkansas Global Rice Model
APTERR	ASEAN Plus Three Emergency Rice Reserve
ASEAN	Association of Southeast Asian Nations
FAO	Food and Agriculture Organization of the United Nations
FAPRI	Food and Agricultural Policy Research Institute
GDP	gross domestic product
IMF	International Monetary Fund
IRRI	International Rice Research Institute
kg	kilogram
Lao PDR	Lao People's Democratic Republic
mmt	million metric ton
mt	metric ton
OECD	Organisation for Economic Co-operation and Development
PRC	People's Republic of China
R&D	research and development
ROR	rest-of-region
US/USA	United States of America
USDA	United States Department of Agriculture
USDA–ERS	United States Department of Agriculture Economic Research Service
USDA–FAS	United States Department of Agriculture Foreign Agricultural Service
WTO	World Trade Organization

Executive Summary

1. Overview

Member states of the Association of Southeast Asian Nations (ASEAN) play a major role in the global rice market. Over the next decade, the ASEAN region is projected to account for 53% of net exports, 14% of net imports, 29% of harvested area, 25% of total production, and 22% of total rice consumption. Rice is the major food staple in ASEAN countries and thus plays a significant role in the food security concerns of the region. The rice price crisis that occurred in 2007–2008 has created a widespread sense of urgency among policy makers and other rice stakeholders to forge coordinated efforts to avoid a repeat of such an experience.

This paper documents the current and projected status of the rice economies in ASEAN countries by assessing their potential supply and demand paths over the next decade. Other Asian nations that have a significant role in the behavior and performance of the global rice economy are also discussed—the People's Republic of China (PRC), Japan, and the Republic of Korea, as well as India and Pakistan.

The outlook estimates are not predictions but provide a baseline framework to discuss the direction of supply and demand and the management of risks of rice price volatility and their causes, including policies, supply distortions, and climate change. The framework of the Arkansas Global Rice Model provides ASEAN and its agencies, such as the ASEAN Food Security Reserve Board, with models that can assess intermediate and longer term challenges to meet the objective of designing coherent and coordinated policy actions for the ASEAN region.[1]

The 10-year baseline deterministic and stochastic estimates presented in this paper are generated using the Arkansas Global Rice Model (AGRM). The estimates are generated based upon the following assumptions:

(i) a continuation of existing rice sector policies;
(ii) macroeconomic projections from IHS Global Insight, a global information company which provides economic forecasts, industry analysis, and market intelligence for over 200 countries and 170 industries;
(iii) no Doha Development Round of World Trade Organization (WTO) trade reforms; and
(iv) average weather conditions.

The AGRM is disaggregated into 43 of the major rice producing, consuming, and trading rice countries as well as five rest-of-the-world regional aggregations: Africa, the Americas, Asia, Europe, and Oceania. Each country and regional model includes a supply sector, a demand

[1] This paper was originally prepared by the lead author, Eric J. Wailes, for the pilot implementation of the ASEAN Rice Trade Forum on 19–20 June 2012 in Siem Reap, Cambodia. The paper was discussed in the first session of the forum, which tackled the current situation and outlook of the regional and global rice markets. The ASEAN Food Security Reserve Board convened the pilot forum in coordination with the ASEAN Secretariat and the Asian Development Bank (ADB). ADB provided technical assistance, with financing from the Japan Fund for Poverty Reduction. Dr. Wailes holds the title of Distinguished Professor at the Department of Agricultural Economics and Agribusiness at the University of Arkansas. He conducts research on agricultural policy, trade, and marketing, with emphasis on the rice sector. He received his degree in agricultural economics at Cornell University, with a specialization in tropical agriculture, and his doctorate degree in agricultural economics at Michigan State University, with an emphasis on international policy and marketing. Eddie C. Chavez is a member of Dr. Wailes's team, which developed and maintains the Arkansas Global Rice Model and Riceflow model.

sector, a trade sector, and stocks and price linkage equations.

2. ASEAN Rice Outlook

The primary conditioning environment for the outlook with respect to macroeconomic variables is based on projections of economic growth (gross domestic product) and population growth for the region.

Total ASEAN rice output is projected to grow at 1.37% annually, from nearly 110.5 million metric tons (mmt) in 2010–2011 to 128.3 mmt by 2021–2022. Most of this growth is based on improved yields, increasing by 1.22% annually. The harvested area will increase from slightly more than 46 million hectares in 2011 to nearly 47 million hectares by 2021–2022, a marginal annual growth of only 0.15%. Production constraints include limits on land and water for irrigation, competition from other crops and alternative land uses, and higher input prices, particularly energy-based inputs and the high carbon and water footprints of rice and climate change.

The ASEAN total rice consumption accounts for 22% of the world total. Over the next decade, ASEAN rice consumption is projected to expand from 100 mmt in 2011 to 111.3 mmt in 2021, attaining a growth of 1% annually. The average ASEAN rice per capita use is 2.5 times the world average (164 kg vs. 65 kg). Adequate supplies and reasonably priced rice are critical for the food security of ASEAN consumers. Key questions in this regard include whether to pursue self-sufficiency or food security through a deepening of intraregional trade, whether growth in demand in the rest of the world will push the net trade of the region to a point that ASEAN consumer prices increase above tolerable levels, and whether current and projected stock levels will be sufficient to deal with production shocks emanating from within the region as well as outside the region. For this, it is useful to look at both the projected ASEAN trade picture as well as the global supply and demand balance sheet to assess potential price paths and net trade positions for the ASEAN region.

ASEAN net rice exports declined 16.6% in 2011 from the 2010 level, mainly due to the flood related and paddy pricing program constraints on Thai exports. Over the baseline, the combined rice net exports of ASEAN are projected to grow at 3.3% per year, from 15.5 mmt in 2011 to 21.5 mmt in 2021. On average, ASEAN rice net exports accounted for 53.3% of the total global volume over the last decade, and will increase to nearly 54.8% over the baseline.

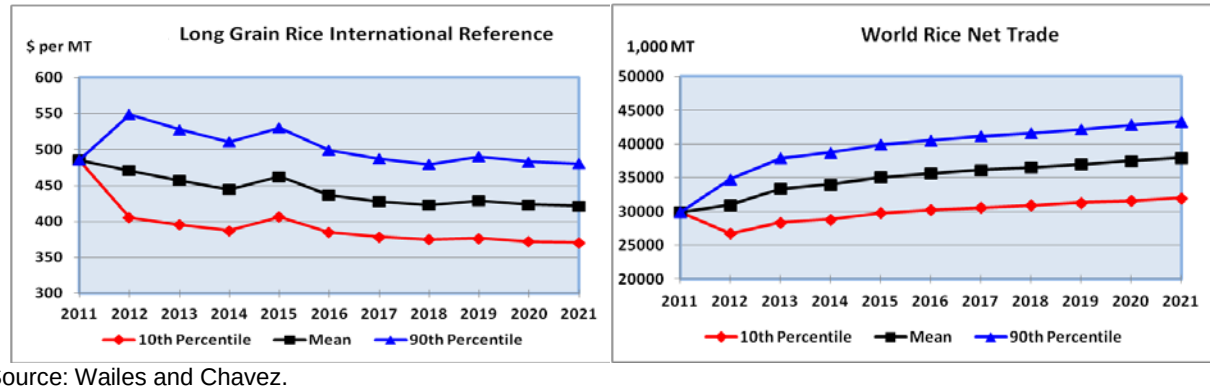
Despite current strong competition from other main rice exporters (especially India), Thailand is projected to return as the top exporter over the baseline. However, Viet Nam is projected to be replaced by India as the second-ranked rice exporter in the world. Cambodia, the Lao People's Democratic Republic (Lao PDR), and Myanmar have good production potential to expand rice exports given the availability of land and water resources. Expansion of trade, however, will be subject to the ability of both countries to build the necessary infrastructure and institutional support. Indonesia and the Philippines are projected to continue generating gains from their rice self-sufficiency efforts—expanding output mostly from increased yields by increasing the use of high-yielding hybrids and slight expansion in planted area. However, these two countries are projected to remain as the top rice net importers in the ASEAN region, with the Philippines ranked second in the world, and Indonesia, third, both accounting for 11.6% of global rice import volume over the baseline period.

3. Global Rice Outlook

One cannot fully appreciate rice trade in the ASEAN region by discussing it in isolation. As demonstrated in 2011, trade performance and policies in other key rice exporting and importing countries have had important effects on the ASEAN rice economy. Over the next decade, world rice output is projected to grow at 1.12% per year, with 0.97% of the growth resulting from yield improvement and 0.15% from slight growth in area harvested. Driven solely by population growth, global rice consumption will gain 1.14% annually as per capita use declines slightly. Net rice trade will continue to grow at 2.27% per year. International rice prices are projected to decline slightly as self-sufficiency in rice and the use of higher yielding hybrids and other improved production technologies increasingly become the focus of major rice consuming countries.

The international rice market is highly volatile due to a number of reasons. Rice has inelastic supply and demand throughout much of Asia and is thinly traded. Global rice exports are highly concentrated where the top five exporters (Thailand, India, Viet Nam, Pakistan, and the United States, in that order) control 87% of global net trade. A combination of slow growth in rice consumption and increased output are expected to dampen international rice prices over the baseline period. The international rice reference price for long grain rice is projected to decline steadily from $486 per metric ton (mt) in 2011 to $421 per mt in 2021. The medium grain rice price, however, is expected to be stable above $800 per mt.

International Rice Reference Price and Rice Net Trade



Source: Wailes and Chavez.

In light of these structural characteristics of the global rice economy, the AGRM framework provides stochastic estimates to give an understanding of likely upper and lower bounds for all projected variables. Stochastic estimates are generated by simulating the AGRM 500 times based on random yields drawn from historical yield distributions for each country.

For 2012, while the stochastic average price is $471 per metric ton (mt), the stochastic distribution indicates that 10% of the time, the average price will be higher than $549 per mt, and lower than $405 per mt 10% of the time. That is, the gap between the two percentiles is $144 per mt. This gap varies across the estimation period. Similarly, for world rice net trade, the stochastic average global net trade is 38.3 mmt, but there is a 10% chance of world net trade being higher than 43 mmt and a 10% chance of it being lower than 32 mmt.

4. Conclusion

The ASEAN and global rice market fundamentals in 2011–2012 indicate record production and growth in global stocks. International reference prices for long grain white rice have declined significantly from levels of the previous 3 years. The baseline projections presented in this paper imply a growth in output, consumption, stocks and trade, assuming normal weather and a continuation of current policies. Should India revert to an export ban as it liquidates its rice stock and suffers from monsoon failure, the global rice economy could tighten quickly. This is particularly true if Thailand insists on maintaining its paddy pledging price floor and implicit tax on its rice exports.

Implicit in the rice trading behavior of several nations is the view that food security can only be addressed through self-sufficiency production policies. Such an approach makes sense if the result is removing productivity gaps that do not require large public expenditures (i.e., subsidies and price supports) that distort the country's competitive advantage to produce and trade in other products. However, when the country achieves self-sufficiency at great cost to itself, there is the external cost that makes the global market thinner and prices more likely to be more volatile, and incurs losses for producers in countries that have a competitive advantage to supply rice on the world market.

The baseline projections indicate that global rice stocks can be expected to grow, and increases in the stocks-to-use ratio imply a more comfortable cushion to absorb climate and policy shocks. But increased investment in R&D, logistics, and infrastructure will enhance a more stable and responsive rice trading environment to ensure this growth. Within the ASEAN region, it is clear that the basic resource endowments in countries such as Cambodia, the Lao PDR, and Myanmar would need to be buttressed with capital investments in infrastructure to support a larger and more stable Southeast Asian rice production hub.

While other grain and oilseed markets are being destabilized by severe drought and crop failure in the United States, the rice market can be expected to remain stable. Nevertheless, delayed monsoons in India have already resulted in lowered expectations for its 2012–2013 rice production. Given the precarious thin and concentrated market structure of the global rice economy, maintaining a careful watch on the current production year and consumption responses is of utmost importance to avoid the onset of the rice price crisis of 2007–2008.

1. Overview

1.1 Purpose of this Outlook and its Significance for ASEAN

Member states of the Association of Southeast Asian Nations (ASEAN) play a major role in the global rice market. Over the next decade, the ASEAN region is projected to account for 53% of net exports, 14% of net imports, 29% of harvested area, 25% of total production, and 22% of total rice consumption. Rice is the major food staple in ASEAN countries and thus plays a significant role in the food security concerns of the region. The rice price crisis that occurred in 2007–2008 has created a widespread sense of urgency among policy makers and other rice stakeholders to forge coordinated efforts to avoid a repeat of such an experience.

This paper documents the current and projected status of the rice economies in ASEAN countries by assessing their potential supply and demand paths over the next decade, based on a set of assumptions regarding the macro economy, domestic and trade policies, and climate. The global rice outlook is also presented with particular attention to other Asian nations that have a significant role in the behavior and performance of the global rice economy—the People's Republic of China (PRC), Japan, the Republic of Korea, and India and Pakistan.

The outlook estimates are not predictions but provide a framework to discuss the direction of supply and demand and the management of risks of rice price volatility and their causes, including policies, supply distortions, and climate change. The framework of the Arkansas Global Rice Model provides ASEAN and its agencies such as the ASEAN Food Security Reserve Board with a framework that can assess intermediate and longer term challenges to meet the objective of designing coherent and coordinated policy actions for the ASEAN region.

1.2 The Arkansas Global Rice Model

The 10-year baseline deterministic and stochastic estimates presented in this paper are generated using the Arkansas Global Rice Model (AGRM). The estimates are generated based upon the following assumptions:

(i) a continuation of existing domestic rice sector policies;
(ii) macroeconomic projections from IHS Global Insight, a global information company which provides economic forecasts, industry analysis, and market intelligence for over 200 countries and 170 industries;
(iii) a continuation of current trade policies, i.e., no Doha Development Round of World Trade Organization (WTO) trade reforms or other regional trade reforms; and
(iv) average weather conditions.

The AGRM is a nonspatial, multicountry statistical simulation, and econometric framework. The AGRM is maintained in conjunction with another framework, the Riceflow model, which is a spatial equilibrium framework that tracks bilateral trade flows and rice value chain adjustments (Appendix 1).

These models are updated on a regular basis (monthly or quarterly) and have been used to provide analyses for the Asian Development Bank (ADB), Food and Agriculture Organization of the United Nations (FAO), International Rice Research Institute (IRRI), Organisation for Economic Co-operation and Development (OECD), United States Department of Agriculture (USDA), World

Bank, as well as many national governments and research institutes.

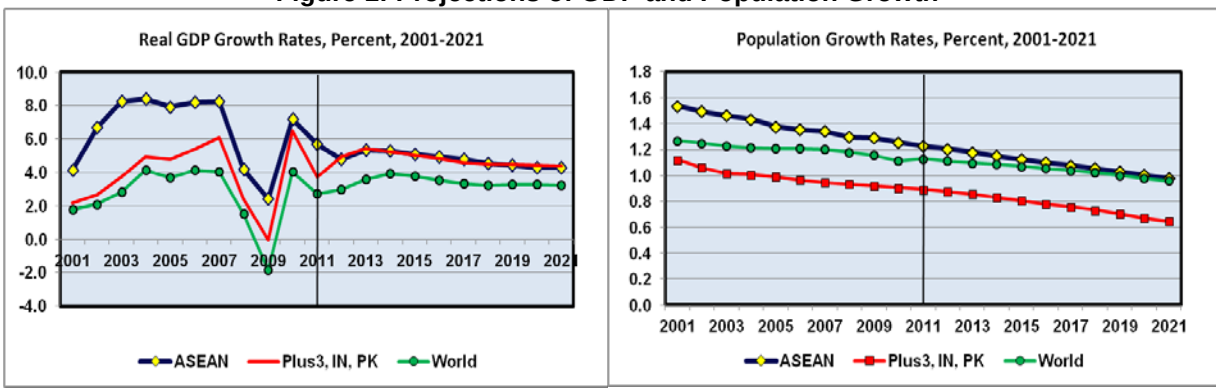
The AGRM is disaggregated into 43 of the major rice producing, consuming, and trading rice countries as well as five regional aggregations (Appendix 1). All ASEAN member nations are modeled individually in AGRM. The model links all countries through rice prices and trade (Wailes 2012). By providing a framework of the global rice economy and ASEAN countries as an integrated system, the AGRM is able to address a wide range of issues regarding infrastructure investments, impacts of new technologies, price risks, macroeconomic and sectoral policies, and supply and demand distortions (Wailes 2012).

The AGRM model is simulated interactively with other global and United States (US) models maintained by the Food and Agricultural Policy Research Institute (FAPRI) at Iowa State University (FAPRI 2012). The historical rice data are obtained from the Production, Supply, and Distribution online database of the Rice Outlook produced by the USDA Foreign Agricultural Service (USDA–FAS) and Economic Research Service (USDA–ERS) as of May 2012. The AGRM rice marketing years by individual country follow the USDA system. For example, the year 2011 in the model refers to Jan 2012–Dec 2012 for Indonesia, Thailand, and Viet Nam; Oct 2011–Sep 2012 for India; and July 2011–June 2012 for the Philippines. Hence, supply values for 2011 are known for some countries while still estimated for a number of countries.[2]

2. ASEAN Rice Outlook

The primary conditioning environment for the outlook with respect to macroeconomic variables is based on projections of economic growth (gross domestic product [GDP]) and population growth for the region. Projections for ASEAN and the ASEAN Plus Three,[3] and for India and Pakistan, have slightly declining GDP growth but clearly more robust than for the rest of the world (Figure 1). While the ASEAN population growth has historically exceeded world averages, it converges toward the global average of close to 1% until 2021.

Figure 1: Projections of GDP and Population Growth



Source: Wailes and Chavez.

Table 1 provides estimates of the supply and demand of rice for ASEAN beginning with 2010–

[2] See the USDA Foreign Agricultural Service site for details. http://www.fas.usda.gov/psdonline/psdAvailability.aspx

[3] The ASEAN Plus Three is composed of the 10 member nations of ASEAN—Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam—plus the three East Asian nations of the People's Republic of China, Japan, and the Republic of Korea.

2011 and extending to 2021–2022. Rice supply and utilization tables for individual ASEAN member countries are provided in Appendix 2. The following discussion will take each variable in Table 1 in turn.

Table 1: Total Rice Supply and Utilization of 10 ASEAN Countries from 2010–2011 to 2021–2022

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	Annual Percent Growth
						Thousand Hectares							
Area Harvested	46,197	46,121	46,866	46,875	46,855	46,906	46,897	46,896	46,894	46,891	46,921	46,973	**0.15%**
						Metric Tons per Hectare							
Yield	2.39	2.43	2.45	2.49	2.53	2.56	2.59	2.62	2.65	2.68	2.71	2.73	**1.22%**
						Thousand Metric Tons							
Production	110,466	111,965	114,849	116,709	118,507	120,175	121,574	122,920	124,345	125,753	127,173	128,345	**1.37%**
Beginning Stocks	19,441	17,653	18,638	20,867	22,703	24,447	26,352	28,076	29,628	30,965	32,142	33,288	**5.01%**
Domestic Supply	129,907	129,618	133,487	137,576	141,211	144,623	147,926	150,996	153,974	156,718	159,315	161,633	**2.01%**
Consumption	99,572	99,973	102,151	103,248	103,866	104,946	106,026	107,154	108,232	109,209	110,292	111,328	**1.02%**
Ending Stocks	17,653	18,638	20,867	22,703	24,447	26,352	28,076	29,628	30,965	32,142	33,288	34,322	**6.23%**
Domestic Use	117,225	118,611	123,018	125,951	128,313	131,298	134,102	136,783	139,197	141,351	143,580	145,650	**1.99%**
Net Trade	12,682	11,007	10,468	11,624	12,898	13,325	13,823	14,213	14,776	15,367	15,735	15,982	**2.12%**
						Percent							
Stocks-to-Use Ratio	17.73	18.64	20.43	21.99	23.54	25.11	26.48	27.65	28.61	29.43	30.18	30.83	

Source: Wailes and Chavez.

2.1 Rice Supply

As shown in Table 1, total ASEAN rice output is projected to grow at 1.37% annually, from nearly 110.5 million metric tons (mmt) in 2010–2011 to 128.3 mmt by 2021–2022. Most of this growth is based on improved yields, increasing by 1.22% annually. The harvested area is expected to increase from slightly more than 46 million hectares in 2011 to nearly 47 million hectares by 2021–2022, a marginal annual growth of only 0.15%. While the ASEAN rice area harvested accounts for 29% of global rice area, slightly lower yields relative to the world average translate into a 25% global production share for ASEAN.

From a food security perspective, in the near term, the ASEAN region has ample rice supplies with increases in both production and ending stocks in 2012. Over the longer term, the stocks-to-use estimates indicate significant increases in stocks relative to use, primarily as a result of the Thai paddy pledging program[4] that will result in burdensome stocks. Also important are improving land and water productivity and generating investments in processing infrastructure for rice production, both of which should be goals for the region. Relative to world average yields, the projection for ASEAN yields suggests that the 15% lower average for ASEAN is expected to narrow over the baseline, but this will require investments in rice research; improvements in production infrastructure; and the adoption and diffusion of higher yielding, more stress-tolerant rice varieties, and improved production technologies. Production constraints include limits on land and water for irrigation, competition from other crops and alternative land uses, and higher input prices, particularly energy-based inputs and the high carbon and water footprints of rice and climate change. Changing demographics, including aging farm populations, and rural-to-urban

[4] The Thai government reintroduced the program in October 2011 with a higher pricing scheme for paddy rice to allow Thai rice farmers to pledge their paddy as collateral for loans, which they can choose to redeem by repaying the loans at a minimal interest or to forfeit in the hands of government.

migration of the younger populations seeking off-farm incomes will become a challenge for the small farm structure typical of this region.

2.2 Rice Consumption

Rice consumption is driven by income growth, population, and other socio-demographic variables such as urbanization, changing lifestyles, and food preferences. Rising incomes dampen rice demand in some key ASEAN countries where rice is considered an inferior good. Other factors include aging populations and increasing health consciousness that shift diet preferences away from carbohydrates and toward proteins.

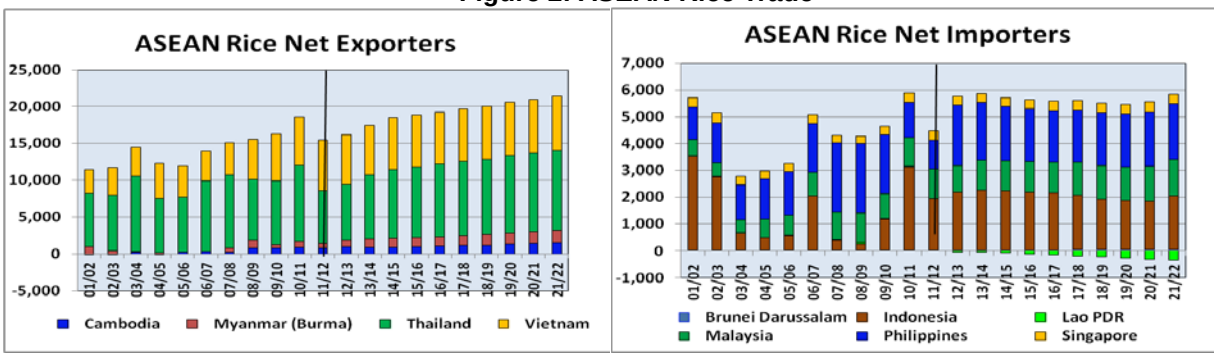
The ASEAN total rice consumption accounts for 22% of the world total. Over the next decade, ASEAN rice consumption is projected to expand from 100 mmt in 2011 to 111.3 mmt in 2021, attaining a growth of 1% annually. The average ASEAN rice per capita use is 2.5 times the world average (164 kg vs. 65 kg). The growth in the region's total rice consumption is driven by population growth of 1.10% annually, as average per capita use declines marginally.

Nevertheless, rice constitutes a high share of the caloric diet of the ASEAN population. Therefore, adequate supplies and reasonably priced rice are critical for the food security of ASEAN consumers. Key questions in this regard include whether to pursue self-sufficiency or food security through a deepening of intraregional trade, whether growth in demand in the rest of the world will push the net trade of the region to a point that ASEAN consumer prices increase above tolerable levels, and whether current and projected stock levels will be sufficient to deal with production shocks emanating from within the region as well as outside the region. For this, it is useful to look at both the projected ASEAN trade picture as well as the global supply and demand balance sheet to assess potential price paths and net trade positions for the ASEAN region.

2.3 Rice Trade

ASEAN net rice exports declined 16.6% in 2011 from the 2010 level, mainly due to the flood related and paddy pricing program constraints on Thai exports (Figure 2). Over the baseline, the combined net rice exports of ASEAN are projected to grow at 3.3% per year, from 15.5 mmt in 2011 to 21.5 mmt in 2021.

Figure 2: ASEAN Rice Trade



Source: Wailes and Chavez.

On average, ASEAN rice net exports accounted for 53.3% of the total global volume over the last decade, and will increase to nearly 54.8% over the baseline. Two of the top five world rice exporters, Thailand and Viet Nam, are both ASEAN members, accounting for a combined 48% of

global net exports.

Despite current strong competition from other main rice exporters (especially India), Thailand is projected to remain the top exporter over the baseline. The baseline assumes that Thailand will decouple its export prices through government-to-government sales to recover from the loss of exports as a result of the paddy price pledging scheme. However, Viet Nam is projected to be replaced by India as the second-ranked rice exporter in the world.

Cambodia and Myanmar have good production potential to expand rice exports given the availability of land and water resources. Expansion of trade, however, will depend on the ability of both countries to build the necessary infrastructure and institutional support to export larger volumes on a sustained basis. Improvements in certified rice seed production and investments to enhance production and milling quality are much needed. Transportation infrastructure must also be developed to reduce export supply costs ex-mill to the ports. Over the baseline, Cambodia and Myanmar are projected to have similar rice export expansion paths. The Lao People's Democratic Republic (Lao PDR) also has the potential to improve rice exports—again, subject to the country's ability to successfully undertake infrastructure and institution building.

Indonesia and the Philippines are projected to continue generating gains from their rice self-sufficiency efforts—expanding output mostly through the increased use of high-yielding hybrids and slight expansion in planted area. However, these two countries are projected to remain as the top net rice importers in the ASEAN region, with the Philippines ranked second in the world, and Indonesia, third, both accounting for 11.6% of global rice import volume over the baseline period.

The growth in demand is driven mainly by population growth, as the potential of opening new areas for rice production remains limited. Another consideration included in the projections is the expectation that both Indonesia and the Philippines will eventually have to maintain relatively safe levels of stocks based on historical experience, typically indicated by the equivalent number of days of consumption.

3. ASEAN Country Rice Outlook[5]

3.1 Brunei Darussalam

3.1.1 Economy

The country's economy is heavily dependent on revenues from crude oil and natural gas. Projected economic growth is 1.73% annually in real terms over the next decade. Brunei Darussalam is the third largest oil producer in Southeast Asia and the fourth largest producer of liquefied natural gas in the world. By sector, the country's GDP is composed of 0.9% agriculture, 72.3% industry, and 26.8% services. Per capita income is $49,400, one of the highest in the world. The country's population of 402,000 in 2011 is projected to grow at 1.62% per year, reaching 471,000 by 2021. The local currency, the Brunei dollar (BND or B$), appreciates relative to the US dollar over the baseline period, with the exchange rate projected to decline from $1.25 in 2011 to $1.19 by 2021.

[5] See Appendix 2 for individual ASEAN country rice situation and outlook supply and demand estimates.

3.1.2 Rice Supply and Demand

The country consumed 41,000 metric tons of milled rice in 2011, with about 97% coming from imports. Per capita consumption is projected to grow at 0.37% per year, from 102 kg in 2011 to 108 kg in 2021. Given population growth, this translates to an annual increase of about 2% in total rice consumption. To meet this demand, net rice imports are estimated to grow by 2% per year. The USDA reports that the country produces approximately 1,000 metric tons of milled rice from 1,000 harvested hectares. Eventually, the government plans to increase the planted area to 5,000 hectares as it finds suitable land, without damaging the ecological balance.

To improve food security, a goal of 60% rice self-sufficiency is targeted by 2015 although only about 2% of the country's 5,765-square kilometer land area is considered arable. The government has been seriously exploring ways to increase rice output since 1978, and indications are that it will continue to do so. Recent efforts are focused on availing of rice technical assistance and training from neighboring countries. Another option being studied is entering into joint venture agreements with neighboring rice-producing countries to own and operate rice farms.

3.2 Cambodia

3.2.1 Economy

The country's real GDP growth rate at 6.58% per year is among the strongest in Southeast Asia. The Cambodian economy is composed of 30% agriculture, 30% industry, and 40% services. The total population of 14.7 million in 2011 is expected to grow at 1.57% per year over the baseline period, reaching 17.2 million by 2021. Per capita income is $2,300. The local currency, the riel (KHR or KR), is projected to depreciate relative to the US dollar, with the exchange rate rising from $4,039 in 2011 to $5,074 by 2021. This will improve export competitiveness.

3.2.2 Rice Supply and Demand

The country harvested 2.77 million hectares of rice in 2011, yielding 1.54 mt per hectare on average. Total milled rice production stands at 4.27 mmt, escalating at 2.92% per year, of which 2.90% comes from yield growth and only 0.02% from an increase in area harvested. Total rice consumption (3.45 mmt in 2011) grows at 2.18% annually, mainly resulting from 1.57% population growth, as per capita use increases by only 0.60%. The USDA's export figures for Cambodia are much higher than those quoted or reported elsewhere because the USDA includes both the estimated cross-border trade and official trade. This involves some information gathering and verification from the ground. The USDA believes this approach makes the supply and demand figures more realistic.

As the country attains improvements in yields and continued production surplus, rice exports are expanding steadily, almost doubling from just under 0.8 mmt in 2011 to an estimated 1.5 mmt by 2021. However, to accelerate official rice exports, Cambodia would need to control and manage the reportedly rampant unofficial cross-border trade of unmilled rice into its neighboring countries. In so doing, the country and its farmers can improve value-added revenues by directly exporting milled rice. Settling the cross-border trade issue will require political will from the top-level officials of the countries involved to formulate coordinated and implementable diplomatic solutions.

3.3 Indonesia

3.3.1 Economy

The average real economic growth of Indonesia over the next decade is projected at 5.54%, slowing down from 6.31% in 2011 to 4.65% in 2021. By sector, the country's economy is composed of 14.9% agriculture, 46% industry, and 39.1% services. Per capita income is currently $4,700. The country's population of 245.6 million in 2011 is projected to grow at 0.96% annually, reaching 269.8 million by 2021. The local currency, the Indonesian rupiah (IDR or Rp), is projected to depreciate relative to the US dollar, with the exchange rate rising from $8,690 in 2011 to $9,287 by 2021.

3.3.2 Rice Supply and Demand

The country's 12.11 million hectares of harvested rice produced 36.35 mmt of milled rice in 2011, or an average yield of 3 mt per hectare. Total rice production is projected to increase at 1.33% annually over the baseline, largely due to yield improvement of 1.25%, as the increase in harvested area is marginal (0.08%). Total rice consumption (39.55 mmt in 2011) grows at 0.90% per year solely due to population growth, as per capita consumption is projected to decline by 0.06% annually over the baseline.

Indonesia sources nearly 5% of its domestic rice needs from imports and has long been aiming for self-sufficiency. The country's rice imports recently declined dramatically, from 3.1 mmt in 2010 to 1.9 mmt in 2011, due to increased domestic production. Area harvested increased by 38,000 hectares and yields improved by 60 kg per hectare over the same period. Rice imports are projected to increase slightly to 2.1 mmt in 2012 as the country is expected to replenish its stocks to a reasonable level of about 4 mmt. Imports remain around 2 mmt over the baseline.

3.4 Lao People's Democratic Republic

3.4.1 Economy

The economy of the Lao PDR is projected to have a robust growth averaging 7.15% per year over the next decade, with annual values ranging from 6.4% to 9%. By sector, the economy is composed of 27.8% agriculture, 34.8% industry, and 37.4% services. Per capita income is $2,700. The country's population of 6.48 million in 2011 is projected to grow at 1.56% per year, reaching 7.55 million by 2021. The local currency, the kip (LAK or KN), is projected to depreciate relative to the US dollar, with the exchange rate rising from $8,058 in 2011 to $10,271 by 2021.

3.4.2 Rice Supply and Demand

The country has 821,000 hectares of rice, which produced 1.44 mmt of milled rice in 2011 at an average yield of 1.76 mt per hectare. Total rice production grows at 3.61% per year, mainly due to an average annual yield gain of 2.88%, with the harvested area increasing only by 0.71%. Total rice consumption (1.46 mmt in 2011) grows at 1.67% per year, mainly due to population growth, as per capita rice consumption grows only 0.10% annually over the baseline.

With production growing faster than consumption, the country is expected to become a minor rice exporter over the next decade, with projected shipments increasing from 41,000 mt in 2012 to 360,000 mt by 2021.

3.5 Malaysia

3.5.1 Economy

The Malaysian economy is projected to grow at 4.54% annually over the baseline. By sector, the economy is composed of 12% agriculture, 40% industry, and 48% services. Per capita income stands at $15,600. The country's population is projected to increase from 28.73 million in 2011 to 33.07 million in 2021, attaining a growth of 1.43% per year. The local currency, the ringgit (MYR or RM), is projected to have a stable exchange rate of around $3.04 relative to the US dollar over the next decade.

3.5.2 Rice Supply and Demand

The country harvested 675,000 hectares of rice in 2011, producing 1.69 mmt of milled rice at an average yield of 2.50 mt per hectare. Total rice production grows at 1.48% annually, which comes from yield improvement of 1.09% and an increase in area harvested of 0.38%. Total rice consumption (2.71 mmt in 2011) grows at 1.83% per year, largely due to a population growth of 1.43%, as per capita consumption increases only 0.39% annually.

Rice self-sufficiency stands approximately at 60%. The balance of Malaysia's rice needs is sourced mainly from Viet Nam, Thailand, and Pakistan, in that order. The country's net rice imports grow by 2.2% per year, from 1.08 mmt in 2011 to 1.37 mmt by 2021.

3.6 Myanmar

3.6.1 Economy

Myanmar's real GDP is projected to grow annually at 4.58% over the next decade. By sector, the country's economy is composed of 43% agriculture, 20.5% industry, and 36.6% services. Per capita income currently is $1,300. The country's population of 54 million in 2011 is estimated to grow at 1.01% per year over the baseline period, reaching 59.7 million by 2021. The local currency, the kyat (MMK or MK), is projected to have a relatively stable exchange rate over the baseline in relation to the US dollar.

3.6.2 Rice Supply and Demand

The country's harvested rice area remains relatively flat over the baseline at approximately 7 million hectares, gaining only marginal growth of 0.12% per year. Total milled rice production is 10.60 mmt, growing at 1.82% per year, of which 1.03% comes from yield growth and 0.78% from increased area. The average yield of 1.61 mt per hectare in 2011 is projected to improve to 1.79 in 2021. Total rice consumption is estimated to increase from 10.1 mmt in 2011 to 11.1 mmt in 2021, which is equivalent to a growth of 0.92% annually that is due solely to population growth, as per capita consumption contracts by 0.19% per year over the baseline.

As Myanmar's yield-based growth in rice production continues to exceed that of domestic consumption, rice exports are projected to expand steadily over the baseline, from 651,000 mt in 2011 to 1.64 mmt by 2021—a substantial increase of 152%. As with Cambodia, to achieve this growth, infrastructure investment will be required. Myanmar's rice exports are thus projected to surpass that of Cambodia, and possibly catch up with the US level by the end of the baseline period.

3.7 Philippines

3.7.1 Economy

The Philippine economy is projected to grow at 4.77% annually over the baseline. By sector, the country's GDP is composed of 12.3% agriculture, 33.3% industry, and 54.4% services. Per capita income stands at $4,100. The country's population is projected to increase from 101.8 million in 2011 to 121.3 million in 2021, which translates to an annual growth of 1.78%. The local currency, the peso (PHP or P), is projected to depreciate slightly relative to the US dollar, with the exchange rate rising from $43.66 in 2011 to $45.14 in 2021.

3.7.2 Rice Supply and Demand

The country produced 10.64 mmt of milled rice from 4.56 million hectares in 2011, based on an average yield of 2.33 mt per hectare. Total rice production grows at 2.08% annually, 1.73% of which comes from yield improvement and 0.34% from an increase in area harvested. Total rice consumption (12.39 mmt in 2011) grows at 1.54% per year due solely to population growth, as per capita consumption declines by 0.23% annually.

About 20% of domestic rice consumption is sourced from imports although the government has long been seriously trying to attain self-sufficiency. The new target for self-sufficiency is 2013, with the goal of reducing rice imports from 1.6 mmt in 2011 to 0.5 mmt by 2012 by increasing support to farmers, the size of planted area, and the use of hybrids. Despite projected gains in rice output, the country is expected to remain a rice importer over the baseline period as the population continues to grow and a safe level of stocks is maintained for food security reasons. This level is assumed to be at least 2 months of equivalent consumption, which is even lower than the historical 30-year average of 3 months.

3.8 Singapore

3.8.1 Economy

The economy of Singapore grows at 4.46% per year in real terms. By sector, the economy is composed of 0% agriculture, 26.6% industry, and 73.4% services. Per capita income is $59,900, one of the highest levels in the world. Singapore ranks third in the rating of countries with the highest income per capita, according to both the International Monetary Fund (IMF) and the World Bank. In Asia, only Qatar has a higher level of per capita income at $102,000 (ranked first by the IMF and second by the World Bank). Singapore's population of 5.25 million in 2011 grows at 1.89% per year over the baseline period, reaching 6.32 million by 2021. The local currency, the Singapore dollar (SGD or S$), is projected to slightly appreciate relative to the US dollar, with the exchange rate rising from $1.27 in 2011 to $1.25 by 2021.

3.8.2 Rice Supply and Demand

The country does not produce rice and depends entirely on the international market for its domestic rice needs. The USDA does not show any figures for rice stocks for Singapore; imports are thus assumed to simply match consumption (total use). The country's rice imports of 349,000 mt in 2011 increase by 0.29% annually, and are projected to reach 373,000 mt by 2021.

To ensure food security, Singapore is reportedly aiming to transform itself from being a passive food importer into a more active contributor to the regional and global food system through urban

agribusiness, realizing that it has little land to grow its own food (Kassim 2011). The strategy has four prongs: (i) to accelerate research and development; (ii) to turn Singapore into an agribusiness hub, where the private sector will play a key role; (iii) to develop Singapore's own domestic market into a "test lab" for urban agriculture (e.g., "rooftop farming"); and (iv) to shift toward greater local production of three key food items—eggs, leafy vegetables, and fish (Kassim 2011).

3.9 Thailand

3.9.1 Economy

The projected average real growth of Thailand's economy is 4.4% per year over the 10-year baseline, as it recovers steadily from the interruption brought about by the historic flood that occurred during the last quarter of 2011. The economy is composed of 13.3% agriculture, 34.0% industry, and 52.7% services. The total population is projected to increase from 66.7 million in 2011 to 69.8 million in 2021, or 0.46% annual growth—the lowest growth among ASEAN countries. Per capita income is $9,700. The local currency, the baht (THB or B), is projected to be stable relative to the US dollar over the next decade, with an exchange rate of $30.43 in 2011 and $30.85 in 2021.

3.9.2 Rice Supply and Demand

The country harvested 11 million hectares of rice in 2011, yielding 1.86 mt per hectare on average. Total milled rice production is 20.48 mmt, growing at 1.02% per year, of which 0.71% comes from yield growth and 0.31% from gain in area harvested. Total rice consumption (10.37 mmt in 2011) grows at 0.51% annually, solely resulting from population growth, as per capita consumption declines from 157.4 kg in 2012 to 156.1 kg in 2021. The rice pledging scheme implemented by the Thai government constrains rice exports, causing a decline in shipments and consequently a current substantial buildup in stocks. The baseline assumes that Thailand will regain its market share even with the paddy pledging program through government-to-government sales. It is reported that cross-border rice movement from Cambodia is enhanced by the Thai pledging scheme. However, this baseline assumes that this situation is temporary, and Thailand is expected to resume normal rice exports and reclaim its premier position in the international market over the baseline. Unless this happens, stock accumulation will become enormously expensive.

3.10 Viet Nam

3.10.1 Economy

Viet Nam's economy is projected to have a robust growth of 6.5% per year over the next decade—one of the strongest among the ASEAN countries. The economy is composed of 22% agriculture, 40% industry, and 38.0% services. Per capita income is $3,300. The total population is projected to increase from 90.6 million in 2011 to 99.5 million in 2021, or 0.96% annual growth. The local currency, the dong (VND or D), is projected to depreciate relative to the US dollar over the baseline, with an exchange rate of $20,515 in 2011 and $29,610 in 2021.

3.10.2 Rice Supply and Demand

Viet Nam harvested 7.60 million hectares and produced 26.50 mmt of milled rice in 2011, for an average yield of 3.49 mt per hectare that grows at 0.94% per year. Total milled rice production

increases at 0.85% per year, all of which comes from yield growth, as area harvested contracts slightly by 0.09% annually. Total rice consumption (19.57 mmt in 2011) increases at 0.90% annually, solely resulting from population growth, as per capita consumption declines by 0.06% per year.

To take advantage of reduced exports from Thailand as a result of the paddy pledging scheme, Viet Nam (along with India and Pakistan) is increasing its exports and pegging its rice export price at lower world reference levels. The country aims to strengthen its presence in the international market by focusing on improved rice quality and expanding export opportunities to new markets such as the PRC. An issue that the country may have to address is the reported unofficial cross-border rice trade coming from its neighboring countries. Over the next decade, Viet Nam is projected to expand its rice exports steadily with increased shipments by 1.22% per year, as its exchange rate path makes its rice export price more competitive.

4. Global Rice Outlook

One cannot fully appreciate rice trade in the ASEAN region by discussing it in isolation. The global market is mutually dependent on the ASEAN region for rice net exports. And clearly, as has been demonstrated in 2011, trade performance and policies in other key exporting and importing countries have had important effects on the ASEAN rice economy. First, we look at the global rice economy to understand the larger environment within which ASEAN rice competes. Then, we will look more closely at key Asian countries with which ASEAN has a formal relation through the ASEAN Plus Three Emergency Rice Reserve (APTERR)—the PRC, Japan, and the Republic of Korea (Appendix 2). A more detailed review of India and Pakistan is also provided as these are two of the major rice export competitors with whom ASEAN as a regional association has developed official relationships (Appendix 3).

4.1 Global Rice Supply and Demand

Over the next decade, world rice output is projected to grow at 1.12% per year, with 0.97% of the growth resulting from yield improvement and 0.15% from slight growth in area harvested (Table 2). Area harvested is estimated to expand by nearly 2 million hectares, and the rice output by 2021 will be approximately 505 mmt. Driven solely by population growth, global rice consumption will gain 1.14% annually, as per capita use declines slightly. Stocks-to-use ratio is projected to increase from 22% in 2011 to 26% by 2021. International prices are projected to decline slightly as self-sufficiency in rice and the use of higher yielding hybrids and other improved production technologies increasingly become the focus of major rice consuming countries (Figure 3).

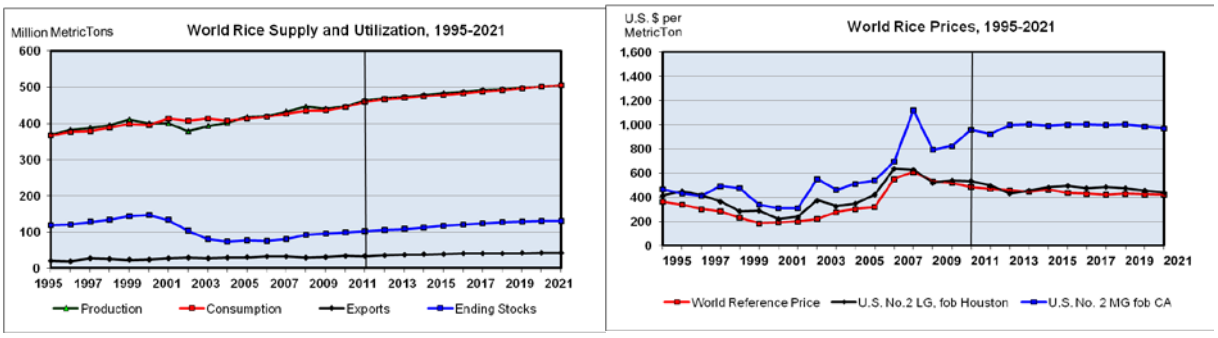
With lower prices, net trade is expected to grow at 2.27% per year. The bulk, 29.1%, of the total rice net import demand is projected to come from Nigeria, Indonesia, the Philippines, Iran, and Bangladesh, in that order; and 17.7% from Iraq, Saudi Arabia, Malaysia, the European Union (27 member countries), and Cote d'Ivoire, in that order.

Table 2: Global Rice Supply and Utilization from 2010–2011 to 2021–2022

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	Annual Percent Growth
						Thousand Hectares							
Area Harvested	157,935	158,741	159,998	159,961	159,947	160,369	160,460	160,512	160,336	160,477	160,738	160,637	**0.15%**
						Metric Tons per Hectare							
Yield	2.83	2.92	2.93	2.96	2.99	3.01	3.03	3.06	3.08	3.10	3.12	3.14	**0.97%**
						Thousand Metric Tons							
Production	446,493	463,280	468,988	473,794	477,790	483,218	486,832	491,195	494,131	497,703	502,175	504,901	**1.12%**
Beginning Stocks	95,231	98,769	102,017	104,685	107,956	111,642	116,520	120,304	124,108	126,611	128,469	129,876	**2.86%**
Domestic Supply	541,724	562,049	571,005	578,479	585,745	594,860	603,352	611,498	618,239	624,314	630,644	634,777	**1.45%**
Consumption	445,652	460,119	466,613	470,827	474,427	478,649	483,364	487,717	491,949	496,171	501,084	504,634	**1.14%**
Ending Stocks	98,769	102,017	104,685	107,956	111,642	116,520	120,304	124,108	126,611	128,469	129,876	130,473	**2.56%**
Domestic Use	544,421	562,136	571,298	578,782	586,069	595,169	603,668	611,824	618,561	624,640	630,960	635,107	**1.41%**
Trade	34,330	32,943	35,462	37,355	38,046	39,171	39,786	40,350	40,806	41,305	41,848	42,314	**1.92%**
						Percent							
Stocks-to-Use Ratio	22.16	22.17	22.44	22.93	23.53	24.34	24.89	25.45	25.74	25.89	25.92	25.85	

Source: Wailes and Chavez.

Figure 3: Global Rice Trends



Source: Wailes and Chavez.

4.2 Key Non-ASEAN Rice Countries

The return of India to the global long grain rice trade has had a significant effect on world prices and on the export performance of ASEAN key exporters, Thailand and Viet Nam. Without India, there can be no doubt that the global prices in 2011–2012 would have been significantly higher on the basis of the domestic pricing policy of Thailand, as already discussed. As a result, global rice prices have shown a wide disparity with Thai, United States, and South American export prices, maintaining levels $150 to $200 above the India, Pakistan, and Viet Nam export prices (FAO 2012). Given the significantly lower prices, the PRC has emerged as a more significant rice importer. A baseline situation and analysis of key Asian countries follows.

4.3 People's Republic of China

4.3.1 Economy

Since the PRC has restructured its economy from a closed, centrally-planned system to a more market-oriented one in the late 1970s, the efficiency gains have caused its GDP to expand over

tenfold. The growth of the country's economy is projected to remain strong over the next decade at 7.8% annually, albeit at a pace slightly lower than in previous years. By sector, the economy is composed of 10.1% agriculture, 46.8% industry, and 43.1% services. Per capita income is $8,400. The PRC is the world's most populous country, with its population projected to increase from 1.337 billion in 2011 to 1.388 billion in 2021, or 0.39% annual growth. The local currency, the yuan (CNY), is projected to appreciate relative to the US dollar over the baseline, with an exchange rate of $6.57 in 2011 and $5.12 in 2021.

4.3.2 Rice Supply and Demand

The country harvested 30 million hectares of rice and produced 140.5 mmt of milled rice in 2011, at an average yield of 4.68 mt per hectare. Yields are expected to grow at 0.67% annually. Total milled rice production grows at 0.20% per year, all of which comes from yield growth, as area harvested contracts by 0.47% annually. Total rice area is projected to contract by 1.6 million hectares over the next decade. Total rice consumption grows at 0.37% per year, all of which is due to population growth as per capita rice consumption declines marginally. The PRC was a rice net exporter of about 633,000 mt per year from 2005–2009, but became a rice net importer in 2011, with 1 mmt imports and 0.6 mmt exports, as it most likely took advantage of attractive international rice prices.

Whether the PRC will remain a net rice importer depends on its own supply and demand dynamics, as it already maintains a high level of average rice stocks of around 50 mmt over the baseline, which is equivalent to stocks-to-use ratio of 35% on average.

4.4 Japan

4.4.1 Economy

Japan's economy is just recovering from the devastation caused by the 9-magnitude earthquake and accompanying tsunami that occurred in March 2011. Its real GDP contracted by 0.6% in 2011 from a growth of 4% in 2010, and is expected to recover by 2.7% in 2012. On average, the country's economy is projected to grow at a relatively low rate of 1.12% annually over the next decade. By sector, the economy is composed of 1.4% agriculture, 24.0% industry, and 74.6% services. Per capita income stands at $34,300. The country's population is projected to decline from 127.47 million in 2011 to 125.13 million in 2021, or an annual decline of 0.18% per year. The local currency, the yen (JPY or ¥), is projected to appreciate relative to the US dollar, with the exchange rate declining from $82.56 in 2011 to $79.64 in 2021.

4.4.2 Rice Supply and Demand

The Arkansas Global Rice Model assumes the PRC to be an entirely medium grain rice market. The country harvested 1.58 million hectares of rice in 2011, producing 7.65 mmt of milled rice at an average yield of 4.85 mt per hectare. Total rice production declines by 0.82% annually, as area harvested contracts by 0.84% and yield increases only marginally. Total rice consumption (8.07 mmt in 2011) declines by 0.77% per year due to the combined effects of both reduced population (0.18%) and lower per capita consumption (0.60%). The country's net rice imports remain stable at the minimum access level of 482,000 mt over the projection period.

4.5 Republic of Korea

4.5.1 Economy

The economy of the Republic of Korea is projected to grow 3.46% annually over the next decade. Its real GDP growth slowed from 6.16% in 2010 to 3.46% in 2011, and growth will further weaken to 1.59% in 2012. By sector, the economy is composed of 2.6% agriculture, 39.2% industry, and 58.2% services. Per capita income is $31,700. The country's population is projected to increase from 48.75 million in 2011 to 49.39 million in 2021, or an annual gain of 0.14% per year. The local currency, the won (KRW or W), is projected to appreciate relative to the US dollar, with the exchange rate declining from $1,092.72 in 2011 to $968.44 in 2021.

4.5.2 Rice Supply and Demand

The model assumes the Republic of Korea to be an entirely medium grain rice market. The country harvested 854,000 hectares of rice in 2011, producing 4.22 mmt of milled rice at an average yield of 4.95 mt per hectare. Total rice production declines at 0.12% annually, as yield growth of 0.66% is not enough to compensate for an annual decline of 0.77% in area harvested. Total rice consumption (5.14 mmt in 2011) declines by 1.21% per year as the slight population growth of 0.14% partially offsets the decline in per capita consumption of 1.35% per year. Annual rice imports are based on preset minimum access level. However, the country revised the import schedule recently, advancing a part of the 2012 volume into 2011. This caused a price spike in 2011 and a decline in imports in 2012, spurring medium grain rice prices to rise given the thinness of the market. The preset volumes resume thereafter.

4.6 India

4.6.1 Economy

India is developing into an open market economy, and is projected to have one of the highest real GDP growth rates in Asia, at 8.42%, over the next decade. By sector, the economy is composed of 18.1% agriculture, 26.3% industry, and 55.6% services. Per capita income is $3,700. The country's population is projected to grow from 1,189.17 million in 2011 to 1,340.45 million in 2021, or 1.22% annual growth. The local currency, the Indian rupee (INR or Re/Rs), is projected to slightly appreciate relative to the US dollar over the next decade, with an exchange rate of $45.05 in 2011 and $43.94 in 2021.

4.6.2 Rice Supply and Demand

India harvested 44.1 million hectares of rice in 2011, producing 103.4 mmt of milled rice, at an average yield of 2.34 mt per hectare. Total milled rice production grows at 0.95% per year, of which 0.79% comes from yield growth and 0.15% from gain in area harvested. Total rice consumption (94.9 mmt in 2011) grows at 1.04% annually, solely resulting from population growth, as per capita use declines by 0.16% per year. Due to its mounting rice stocks, India officially lifted its ban on non-basmati rice exports in September 2011, putting a downward pressure on domestic and international reference prices. This policy effectively neutralized the upward price impact of recent weather-related calamities and rice production shortfalls in a number of countries in Asia, as the country's export supplies expand. Recently, India has embarked on an ambitious plan to create a legal entitlement to subsidized food grains for 63.5% of its population. However, funding and implementation logistics of this program remain a big challenge.

4.7 Pakistan

4.7.1 Economy

A combination of internal political conflicts and low levels of foreign investments have led to the country's slow economic growth. GDP is projected to grow by 4.32% per year over the next 10 years on average. Pakistan's economy is composed of 20.9% agriculture, 25.8% industry, and 53.3% services. Per capita income is $2,800. The country's population is projected to grow from 187.34 million in 2011 to 216.64 million in 2021, or a growth of 1.48% per year. The local currency, the Pakistani rupee (PKR or PRe/PRs), is projected to depreciate relative to the US dollar over the next decade, with an exchange rate of $85.30 in 2011 and $123.19 in 2021.

4.7.2 Rice Supply and Demand

Pakistan harvested 2.75 million hectares of rice in 2011, producing 6.50 mmt of milled rice, an average yield of 2.36 mt per hectare. Total milled rice production grows at 1.10% per year, of which 0.42% comes from yield growth and 0.68% from expansion in harvested area. Total rice consumption (2.47 mmt in 2011) grows at 3.67% annually due to population growth of 1.48% and gain in per capita use of 2.18%.

The country is projected to be a relatively stable rice exporter over the baseline period, with shipments in the range of 3.7–3.9 mmt. Over the same period, the country's exchange rate path increasingly makes its rice more competitive in the international market.

4.8 International Rice Prices

A combination of slow growth in rice consumption and increased output are expected to dampen international rice prices over the baseline period. The international rice reference price for long grain rice is projected to decline steadily from $486 per mt in 2011 to $421 in 2021. The medium grain rice price, however, would be stable above $800 per mt.

The international rice market is highly volatile due to a number of reasons. Rice has inelastic supply and demand throughout much of Asia, where it is the dominant food staple. While rice is the primary staple for half the world's population, it is thinly traded. Only 7% of rice production is traded as opposed to 10% for coarse grains and 16% for wheat (Wailes and Chavez 2012).

Global rice exports are highly concentrated with the top five exporters—Thailand, India, Viet Nam, Pakistan, and the US, in that order—which altogether account for 87% of global net trade.

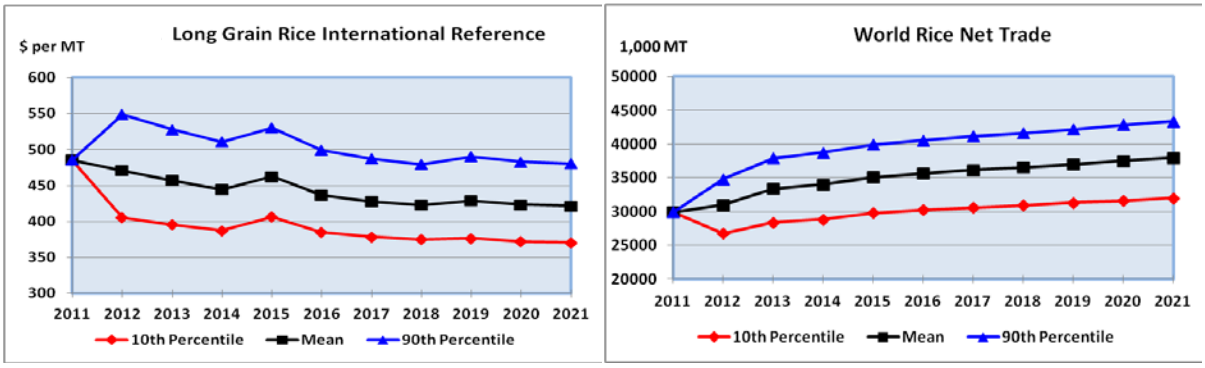
In light of the potential market volatility of the global rice economy, the AGRM framework provides stochastic estimates to give an understanding of likely upper and lower bounds for all projected variables. Stochastic estimates are generated by simulating the AGRM 500 times based on random yields drawn from historical yield distributions for each country.[6]

In Figure 4, the first chart presents the stochastic estimates over the 2011–2021 baseline for the

[6] Stochastic estimates differ from deterministic estimates by providing a realistic range of probable outcomes for each variable. Deterministic estimates are based on normal weather and, consequently, expected yields. However, if yields are allowed to fluctuate reflecting alternative climate and weather events, based on history, then the production, prices, and trade variables will be affected, as reflected in the stochastic estimates and confidence intervals.

long grain rice world reference price and the second chart shows the world rice net trade estimates. To show the direction and spread of the stochastic outcome distribution, three selected outcome items (stochastic average, 10th percentile, and 90th percentile) for selected price and trade variables are presented. Intuitively, the gap between the two percentiles (10th and 90th) indicates the magnitude of volatility. Widening indicates increased volatility and narrowing indicates decreased volatility.

Figure 4: Long Grain Rice World Reference Price and World Rice Net Trade



Source: Wailes and Chavez.

For 2012, while the stochastic average price is $471 per metric ton (mt), the stochastic distribution indicates that 10% of the time, the average price will be higher than $549 per mt, and lower than $405 per mt 10% of the time. That is, the gap between the two percentiles is $144 per mt. This gap varies across the estimation period. Similarly, for world rice net trade, the stochastic average global net trade is 38.3 mmt, but there is a 10% chance of world net trade being higher than 43 mmt and a 10% chance of it being lower than 32 mmt.

4.9 Sources of Market Instability and Challenges for ASEAN

From a food security perspective, it is important to understand what causes the volatility in global rice prices and world rice net trade. For this framework, we draw upon historical yield variability as correlated across countries and across time to simulate probabilistic price outcomes. For each year, we draw 500 correlated yield estimates for the AGRM countries modeled.

The larger the country or the more important role the country plays in world rice trade, the more important is its yield volatility. Yield shocks in the PRC and India, for example, can have significant impacts on world prices and trade. High levels of rice production in India over the past several years have resulted in large accumulation of rice stocks while the government continued the export ban instituted during the 2007–2008 rice crisis. The current rice market situation for ASEAN has been affected by the decision of the Indian government to end the export ban in September 2011 and to use world rice trade as an outlet for its current surplus stocks. What has this meant for ASEAN rice exporters and importers? Downward price pressures have challenged the leading ASEAN rice exporters while these lower prices have also benefitted consumers in importing countries. The PRC has been active in the import market as the current world price levels are attractive. But what does this in-and-out world rice market behavior of the PRC and India mean for ASEAN members?

For Thailand, the entrance of India came at a particularly bad time, just when it had adopted the high paddy support price pledging program. Thai exports have declined precipitously and rice

stocks have accumulated. In fact, for the baseline, we estimate that as long as Thailand maintains the paddy pledging program and India benefits from normal weather, Thailand could well develop stock levels equivalent to or greater than its annual rice output.

What are the implications of production and policy events that catapult rice prices up and down? Clearly, higher or lower prices have different effects on producers and consumers in the ASEAN region and in the world. Price instability in general results in less efficient production planning and greater risks for poor consumers regarding their household food security, which gives rise to national policy concerns and incentives to insulate domestic rice sectors from the international market through self-sufficiency policies.

5. Conclusion

The ASEAN and global rice market fundamentals in 2011–2012 indicate record production and growth in global stocks. International reference prices for long grain white rice have declined significantly from levels of the previous 3 years. The baseline projections presented in this paper imply a growth in output, consumption, stocks and trade, assuming normal weather and a continuation of current policies. Should India revert to an export ban as it liquidates its rice stock and suffers from monsoon failure, the global rice economy could tighten quickly. This is particularly true if Thailand insists on maintaining its paddy pledging price floor and implicit tax on its rice exports.

Implicit in the rice trading behavior of several nations is the view that food security can only be addressed through self-sufficiency production policies. Such an approach makes sense if the result is removing productivity gaps that do not require large public expenditures (i.e., subsidies and price supports) that distort the country's competitive advantage to produce and trade in other products. However, when the country achieves self-sufficiency at great cost to itself, there is the external cost that makes the global market thinner and prices more likely to be more volatile, and incurs losses for producers in countries that have a competitive advantage to supply rice on the world market.

The baseline projections indicate that global rice stocks can be expected to grow, and increases in the stocks-to-use ratio imply a more comfortable cushion to absorb climate and policy shocks. But increased investments in R&D, logistics, and infrastructure will enhance a more stable and responsive rice trading environment to ensure this growth. Within the ASEAN region, it is clear that the basic resource endowments in countries such as Cambodia, the Lao PDR, and Myanmar would need to be buttressed with capital investments in infrastructure to support a larger and more stable Southeast Asian rice production hub.

While other grain and oilseed markets are being destabilized by severe drought and crop failure in the United States, the rice market can be expected to remain stable. Nevertheless, delayed monsoons in India have already resulted in lowered expectations for its 2012–2013 rice production. Given the precarious thin and concentrated market structure of the global rice economy, maintaining a careful watch on the current production year and consumption responses is of utmost importance to avoid the onset of the rice price crisis of 2007–2008.

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An Overview of the Rice Models of the Arkansas Global Rice Economics Program

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1. Arkansas Global Rice Model

The Arkansas Global Rice Model (AGRM) is a nonspatial, multicountry statistical simulation and econometric analytical framework developed and maintained for 20 years by the University of Arkansas Global Rice Economics Program (AGREP) in Fayetteville, USA. The model is disaggregated into five world regions: Africa, the Americas, Asia, Europe, and Oceania. There are 43 key countries, areas, or regions explicitly included in the model, and all other countries or areas not individually modeled are included in one of the five rest-of-region (ROR) models:[7]

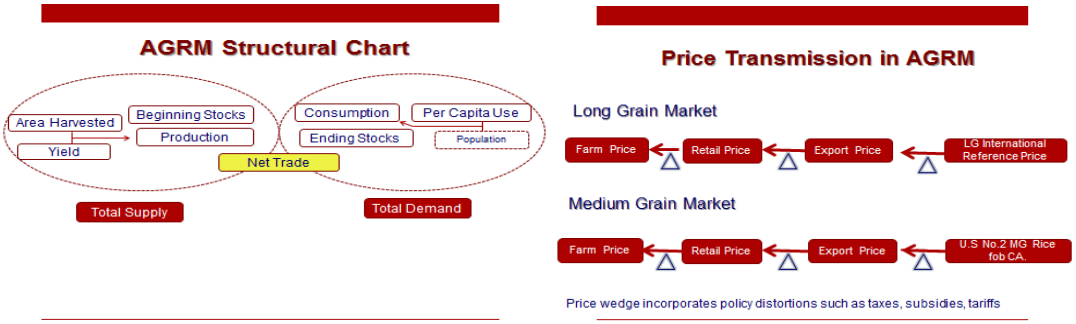
- **Africa:** Cameroon, Cote D'Ivoire, Egypt, Ghana, Guinea, Kenya, Mali, Mozambique, Nigeria, Senegal, Sierra Leone, South Africa, Tanzania, and Rest-of-Africa
- **Americas:** Argentina, Brazil, Canada, Mexico, United States, Uruguay, and Rest-of-Americas
- **Asia:** Bangladesh; Brunei Darussalam; Cambodia; People's Republic of China; Hong Kong, China; India; Indonesia; Iran; Iraq; Japan; Republic of Korea; the Lao People's Democratic Republic; Malaysia; Myanmar; Pakistan; Philippines; Saudi Arabia; Singapore; Taipei,China; Thailand; Turkey; Viet Nam; and Rest-of-Asia
- **Europe:** European Union (27 member countries) and Rest-of-Europe
- **Oceania:** Australia and Rest-of-Oceania

The AGRM can be used to generate annual projections of the world rice economy for a 10-year period and up to 2035. Simulation is conducted for the purpose of the baseline projection, scenarios on technology, trade, production shocks, consumption shocks, and policy analyses. The model can be used to generate both deterministic average outcomes and stochastic distribution of outcomes.

The major components of a country or regional model in AGRM include a supply sector, a demand sector, trade, stocks, and price linkage equations (Figure A1). As a system of equations, the model links countries through prices and trade to obtain global and national estimates that add up consistently using data from the United States Department of Agriculture. The model makes assumptions about key macroeconomic variables and links to other crop and livestock models. A key component is government-determined policy variables that reflect the various mechanisms by which countries intervene in their rice sector economy.

[7] The names of some countries or areas in this list have been adjusted in line with the official names under ADB guidelines.

Figure A1: The Arkansas Global Rice Model (AGRM)



Source: Wailes, Chavez, and Durand-Morat.

Computationally, the simulation model solves for the set of farm level, retail level, and export (import) prices that simultaneously balances all markets (long and medium grain rice) in a given year. An international reference price (for long grain rice) and California No. 2 medium grain rice ex-mill price are used to balance the international rice markets, by equating net exports and net imports.

Projections include national levels of production (area harvested and yields), consumption (per capita use multiplied by given population), net trade, stocks, and prices. The international rice market is unique because it is differentiated between long and medium grain rice markets and is also heavily distorted by respective government policies (taxes, subsidies, tariffs). These policies are incorporated in the model's equations for supply, demand, export (or import), stocks, and price transmission, and are thus implicitly reflected in the model solution. Other details and the theoretical structure and the general equations of the AGRM can be found in the online documentation by Wailes and Chavez (2011) at http://ageconsearch.umn.edu/handle/102650.

2. Riceflow Model

Riceflow is a spatial partial equilibrium model of the global rice sector, with detailed specification of the basic components of the rice supply chain:

(i) Factors of production (land, labor, and capital) and intermediate inputs (fertilizer, pest control, fuel, etc.)
(ii) Paddy production, area harvested, and yield per hectare
(iii) Rice storage and drying costs and quantities
(iv) Rice milling, costs of milling, and degree of milling
(v) Rice wholesale and import/export shipments by country source or destination
(vi) Rice consumption

The model builds from national or subnational models to generate disaggregated bilateral trade flow volumes subject to trade policies and import/export fees. It disaggregates rice by type depending on availability of data (long grain, medium grain, fragrant, percent brokens, and degree of milling (white, brown, and paddy). By treating sectors and products separately, the

model allows for a detailed disaggregation by production systems and rice types, and household types, conditional on the existence of reliable data.

Rice production in Riceflow is disaggregated into primary production, primary milling (paddy to brown), and secondary milling (brown to milled). The model is flexible to allow alternative production systems. Furthermore, a number of technology-related variables are defined to deal with technological changes affecting production at any stage.

Riceflow also accounts for rice stocks, and allows the user to specify alternative behaviors regarding stock management, such as for food security programs and policies at the national, regional, or international level. Other details of the model can be found in online documentation by Wailes and Durand-Morat (2010) at http://ageconsearch.umn.edu/handle/92010.

The latest Riceflow database corresponds to calendar year 2009, and is disaggregated into 60 regions (including all ASEAN countries), three rice types (long grain, medium and short grain, and fragrant rice), and three milling degrees (paddy, brown, and milled), for a total of nine rice commodities.

Riceflow has been used extensively to assess different rice market scenarios:

(i) Technological changes (e.g., adoption of hybrid rice, etc.)
(ii) Policy changes (e.g., impact of trade integration in Asia, the Western Hemisphere, changes in domestic support policies, etc.)
(iii) Consumption changes (e.g., impact of changes in population growth and income)
(iv) Weather-related events (e.g., impact of calamities and other weather events, etc.)

Furthermore, Riceflow can be used to help in the design of new rice policy and investment. The model's framework can contribute to the design of the policy and investment by simulating alternative scenarios and providing insights into the potential costs and market-related impacts of the policy and investment. Sensitivity analysis on supply and demand related variables are feasible, and can generate stochastic assessments.

Riceflow can complement the Arkansas Global Rice Model and can be used for forecasting purposes, thus generating baseline projections against which the medium-term and long-term impacts of alternative scenarios can be assessed.

ASEAN Member Country Rice Supply and Utilization Tables from 2010–2011 to 2021–2022

The Arkansas Global Rice Model provided the framework for the following rice supply and utilization tables for the 10 ASEAN member countries of Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam.

Table A2.1: Brunei Darussalam Rice Supply and Utilization

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	Annual Percent Growth
						Thousand Hectares							
Area Harvested	1	1	1	1	1	1	1	1	1	1	1	1	**0.00%**
						Metric Tons per Hectare							
Yield	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**0.00%**
						Thousand Metric Tons							
Production	1	1	1	1	1	1	1	1	1	1	1	1	**0.00%**
Beginning Stocks	0	0	0	0	0	0	0	0	0	0	0	0	
Domestic Supply	1	1	1	1	1	1	1	1	1	1	1	1	**0.00%**
Consumption	41	41	43	44	44	45	46	47	48	49	50	51	**1.99%**
Ending Stocks	0	0	0	0	0	0	0	0	0	0	0	0	
Domestic Use	41	41	43	44	44	45	46	47	48	49	50	51	**1.99%**
Net Trade	-40	-40	-42	-43	-43	-44	-45	-46	-47	-48	-49	-50	**2.04%**

Source: Wailes and Chavez.

Table A2.2: Cambodia Rice Supply and Utilization

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	Annual Percent Growth
						Thousand Hectares							
Area Harvested	2,777	2,774	2,852	2,825	2,786	2,804	2,789	2,789	2,775	2,770	2,775	2,783	**0.02%**
						Metric Tons per Hectares							
Yield	1.52	1.54	1.58	1.61	1.66	1.71	1.77	1.82	1.87	1.95	2.03	2.09	**2.90%**
						Thousand Metric Tons							
Production	4,233	4,268	4,507	4,559	4,612	4,787	4,932	5,065	5,193	5,397	5,640	5,808	**2.92%**
Beginning Stocks	150	158	183	148	151	154	157	160	162	165	168	171	**1.20%**
Domestic Supply	4,383	4,426	4,690	4,708	4,763	4,941	5,089	5,224	5,355	5,562	5,808	5,979	**2.86%**
Consumption	3,370	3,449	3,593	3,664	3,742	3,821	3,892	3,959	4,036	4,112	4,187	4,273	**2.18%**
Ending Stocks	158	183	148	151	154	157	160	162	165	168	171	174	**0.90%**
Domestic Use	3,528	3,632	3,741	3,815	3,896	3,978	4,052	4,121	4,201	4,280	4,358	4,448	**2.13%**
Net Trade	855	794	949	893	867	963	1,037	1,103	1,154	1,282	1,450	1,531	**5.44%**
Exports	860	799	954	898	872	968	1,042	1,108	1,159	1,287	1,455	1,536	**5.42%**
Imports	5	5	5	5	5	5	5	5	5	5	5	5	**0.00%**

Source: Wailes and Chavez.

Table A2.3: Indonesia Rice Supply and Utilization

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	Annual Percent Growth
Thousand Hectares													
Area Harvested	12,075	12,113	12,152	12,143	12,145	12,154	12,160	12,163	12,169	12,167	12,171	12,181	**0.08%**
Metric Tons per Hectare													
Yield	2.94	3.00	3.04	3.10	3.18	3.22	3.24	3.27	3.31	3.34	3.36	3.37	**1.25%**
Thousand Metric Tons													
Production	35,500	36,350	36,989	37,696	38,644	39,169	39,443	39,822	40,267	40,601	40,919	41,046	**1.33%**
Beginning Stocks	6,577	6,175	4,877	4,051	3,612	3,805	4,144	4,337	4,483	4,567	4,609	4,628	**-3.14%**
Domestic Supply	42,077	42,525	41,866	41,747	42,257	42,974	43,587	44,159	44,750	45,168	45,528	45,673	**0.75%**
Consumption	39,000	39,551	39,944	40,341	40,635	40,979	41,356	41,718	42,063	42,394	42,707	43,038	**0.90%**
Ending Stocks	6,175	4,877	4,051	3,612	3,805	4,144	4,337	4,483	4,567	4,609	4,628	4,636	**-2.57%**
Domestic Use	45,175	44,428	43,995	43,953	44,440	45,123	45,693	46,201	46,630	47,003	47,335	47,674	**0.49%**
Net Trade	-3,098	-1,903	-2,129	-2,205	-2,183	-2,149	-2,106	-2,042	-1,879	-1,835	-1,807	-2,000	**-3.90%**

Source: Wailes and Chavez.

Table A2.4: Lao People's Democratic Republic Rice Supply and Utilization

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	Annual Percent Growth
Thousand Hectares													
Area Harvested	870	821	874	867	868	878	883	893	905	916	928	940	**0.71%**
Metric Tons per Hectares													
Yield	1.60	1.76	1.75	1.79	1.83	1.89	1.94	2.00	2.05	2.10	2.14	2.18	**2.88%**
Thousand Metric Tons													
Production	1,390	1,443	1,530	1,553	1,591	1,662	1,709	1,784	1,856	1,919	1,986	2,053	**3.61%**
Beginning Stocks	63	67	69	70	71	72	72	73	74	75	76	77	**1.83%**
Domestic Supply	1,453	1,510	1,599	1,623	1,662	1,734	1,782	1,857	1,930	1,994	2,062	2,130	**3.54%**
Consumption	1,410	1,459	1,488	1,514	1,531	1,552	1,574	1,597	1,621	1,643	1,668	1,692	**1.67%**
Ending Stocks	67	69	70	71	72	72	73	74	75	76	77	78	**1.37%**
Domestic Use	1,477	1,528	1,558	1,585	1,602	1,624	1,647	1,671	1,696	1,719	1,745	1,770	**1.66%**
Net Trade	-24	-18	41	39	59	110	135	186	234	275	317	360	**-227.93%**

Source: Wailes and Chavez.

Table A2.5: Malaysia Rice Supply and Utilization

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	Annual Percent Growth
						Thousand Hectares							
Area Harvested	672	675	683	688	692	696	699	700	700	701	701	701	**0.38%**
						Metric Tons per Hectare							
Yield	2.44	2.50	2.49	2.49	2.53	2.56	2.59	2.63	2.66	2.69	2.73	2.75	**1.09%**
						Thousand Metric Tons							
Production	1,642	1,690	1,703	1,717	1,752	1,781	1,812	1,838	1,862	1,888	1,912	1,930	**1.48%**
Beginning Stocks	706	733	796	728	771	775	782	789	799	809	818	822	**1.39%**
Domestic Supply	2,348	2,423	2,499	2,445	2,523	2,555	2,594	2,627	2,661	2,696	2,730	2,752	**1.45%**
Consumption	2,690	2,710	2,775	2,823	2,868	2,913	2,974	3,038	3,102	3,130	3,198	3,285	**1.83%**
Ending Stocks	733	796	728	771	775	782	789	799	809	818	822	834	**1.17%**
Domestic Use	3,423	3,506	3,504	3,594	3,643	3,695	3,763	3,837	3,911	3,948	4,021	4,119	**1.70%**
Net Trade	-1,075	-1,083	-1,004	-1,149	-1,120	-1,139	-1,168	-1,210	-1,249	-1,252	-1,290	-1,366	**2.20%**
Exports	1	2	2	2	2	2	2	2	2	2	2	2	6.50%
Imports	1,076	1,085	1,006	1,151	1,122	1,141	1,170	1,212	1,251	1,254	1,292	1,368	2.21%

Source: Wailes and Chavez.

Table A2.6: Myanmar Rice Supply and Utilization

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	Annual Percent Growth
						Thousand Hectares							
Area Harvested	7,000	6,566	6,954	6,992	7,012	7,027	7,039	7,048	7,060	7,073	7,086	7,096	**0.12%**
						Metric Tons per Hectare							
Yield	1.36	1.61	1.62	1.64	1.65	1.67	1.70	1.72	1.74	1.76	1.77	1.79	**2.50%**
						Thousand Metric Tons							
Production	10,528	10,599	11,249	11,455	11,595	11,726	11,933	12,096	12,264	12,434	12,564	12,688	**1.71%**
Beginning Stocks	855	505	366	389	353	224	204	225	227	223	208	195	**-12.56%**
Domestic Supply	11,383	11,104	11,615	11,845	11,948	11,950	12,137	12,321	12,491	12,656	12,772	12,884	**1.13%**
Consumption	10,100	10,087	10,326	10,376	10,426	10,515	10,614	10,702	10,801	10,900	10,990	11,052	**0.82%**
Ending Stocks	505	366	389	353	224	204	225	227	223	208	195	194	**-8.34%**
Domestic Use	10,605	10,453	10,715	10,729	10,650	10,720	10,838	10,929	11,024	11,107	11,185	11,246	**0.53%**
Net Trade	778	651	900	1,115	1,298	1,230	1,299	1,392	1,466	1,549	1,587	1,638	**7.00%**

Source: Wailes and Chavez.

Table A2.7: Philippines Rice Supply and Utilization

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	Annual Percent Growth
						Thousand Hectares							
Area Harvested	4,528	4,563	4,634	4,654	4,661	4,680	4,684	4,683	4,684	4,692	4,698	4,702	**0.34%**
						Metric Tons per Hectare							
Yield	2.33	2.33	2.39	2.43	2.48	2.52	2.57	2.62	2.67	2.71	2.76	2.81	**1.73%**
						Thousand Metric Tons							
Production	10,539	10,639	11,054	11,308	11,559	11,794	12,051	12,282	12,496	12,731	12,986	13,213	**2.08%**
Beginning Stocks	3,520	2,459	1,799	1,986	2,027	2,043	2,043	2,042	2,032	2,038	2,032	2,033	**-4.87%**
Domestic Supply	14,059	13,098	12,853	13,293	13,586	13,837	14,094	14,325	14,527	14,769	15,018	15,246	**0.74%**
Consumption	12,900	12,389	13,130	13,401	13,578	13,765	13,963	14,248	14,471	14,693	15,022	15,262	**1.54%**
Ending Stocks	2,459	1,799	1,986	2,027	2,043	2,043	2,042	2,032	2,038	2,032	2,033	2,046	**-1.66%**
Domestic Use	15,359	14,188	15,115	15,428	15,620	15,808	16,005	16,280	16,510	16,724	17,055	17,307	**1.09%**
Net Trade	-1,300	-1,090	-2,263	-2,135	-2,034	-1,971	-1,911	-1,955	-1,982	-1,955	-2,037	-2,062	**4.28%**

Source: Wailes and Chavez.

Table A2.8: Singapore Rice Supply and Utilization

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	Annual Percent Growth
						Thousand Metric Tons							
Production	0	0	0	0	0	0	0	0	0	0	0	0	
Beginning Stocks	0	0	0	0	0	0	0	0	0	0	0	0	
Domestic Supply	0	0	0	0	0	0	0	0	0	0	0	0	
Consumption	361	349	322	330	334	340	345	352	354	360	367	373	**0.29%**
Ending Stocks	0	0	0	0	0	0	0	0	0	0	0	0	
Domestic Use	361	349	322	330	334	340	345	352	354	360	367	373	**0.29%**
Net Trade	-361	-349	-322	-330	-334	-340	-345	-352	-354	-360	-367	-373	**0.29%**

Source: Wailes and Chavez.

Table A2.9: Thailand Rice Supply and Utilization

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	Annual Percent Growth
						Thousand Hectares							
Area Harvested	10,667	11,006	11,115	11,111	11,110	11,102	11,085	11,072	11,053	11,029	11,022	11,035	**0.31%**
						Metric Tons per Hectare							
Yield	1.90	1.86	1.90	1.93	1.94	1.97	1.99	2.00	2.01	2.03	2.04	2.05	**0.71%**
						Thousand Metric Tons							
Production	20,262	20,476	21,067	21,435	21,571	21,831	22,050	22,160	22,238	22,349	22,486	22,652	**1.02%**
Beginning Stocks	6,100	5,615	8,637	11,548	13,686	15,361	16,905	18,329	19,651	20,813	21,840	22,854	**12.76%**
Domestic Supply	26,362	26,091	29,704	32,983	35,257	37,192	38,955	40,489	41,889	43,162	44,326	45,506	**5.09%**
Consumption	10,300	10,372	10,561	10,613	10,642	10,678	10,719	10,757	10,804	10,824	10,855	10,894	**0.51%**
Ending Stocks	5,615	8,637	11,548	13,686	15,361	16,905	18,329	19,651	20,813	21,840	22,854	23,737	**14.00%**
Domestic Use	15,915	19,010	22,109	24,299	26,003	27,583	29,048	30,408	31,617	32,664	33,709	34,631	**7.32%**
Net Trade	10,447	7,082	7,595	8,684	9,254	9,609	9,907	10,081	10,271	10,498	10,617	10,875	**0.37%**
Exports	10,647	7,282	7,828	8,895	9,469	9,829	10,122	10,297	10,489	10,715	10,834	11,092	**0.37%**
Imports	200	200	233	211	215	220	215	217	217	216	217	217	**0.73%**

Source: Wailes and Chavez.

Table A2.10: Viet Nam Rice Supply and Utilization

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	Annual Percent Growth
						Thousand Hectares							
Area Harvested	7,607	7,602	7,601	7,594	7,579	7,564	7,556	7,546	7,547	7,542	7,537	7,534	**-0.09%**
						Metric Tons per Hectare							
Yield	3.47	3.49	3.52	3.55	3.59	3.63	3.66	3.69	3.73	3.77	3.81	3.84	**0.94%**
						Thousand Metric Tons							
Production	26,371	26,498	26,749	26,983	27,182	27,424	27,643	27,871	28,169	28,434	28,679	28,954	**0.85%**
Beginning Stocks	1,470	1,941	1,911	1,947	2,032	2,015	2,044	2,121	2,200	2,275	2,391	2,508	**4.97%**
Domestic Supply	27,841	28,439	28,659	28,930	29,214	29,439	29,686	29,993	30,370	30,710	31,070	31,461	**1.12%**
Consumption	19,400	19,565	19,969	20,143	20,066	20,339	20,543	20,735	20,931	21,106	21,248	21,409	**0.90%**
Ending Stocks	1,941	1,911	1,947	2,032	2,015	2,044	2,121	2,200	2,275	2,391	2,508	2,624	**2.78%**
Domestic Use	21,341	21,475	21,916	22,175	22,081	22,383	22,665	22,936	23,206	23,497	23,756	24,033	**1.09%**
Net Trade	6,500	6,964	6,743	6,756	7,133	7,056	7,021	7,057	7,164	7,213	7,314	7,428	**1.22%**
Exports	7,000	7,364	7,143	7,156	7,533	7,456	7,421	7,457	7,564	7,613	7,714	7,828	**1.02%**
Imports	500	400	400	400	400	400	400	400	400	400	400	400	**-2.01%**

Source: Wailes and Chavez.

Other Non-ASEAN Country Rice Supply and Utilization Tables from 2010–2011 to 2021–2022

The Arkansas Global Rice Model provided the framework for the following rice supply and utilization tables for the People's Republic of China, Japan, and the Republic of Korea, and for India and Pakistan.

Table A3.1: People's Republic of China Rice Supply and Utilization

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
						Thousand Hectares						
Area Harvested	29,873	29,996	29,902	29,565	29,262	29,215	29,003	28,857	28,580	28,526	28,504	28,365
						Metric Tons per Hectare						
Yield	4.59	4.68	4.74	4.79	4.84	4.87	4.90	4.92	4.93	4.94	4.94	4.94
						Thousand Metric Tons						
Production	137,000	140,500	141,664	141,581	141,656	142,349	142,099	142,027	140,983	140,871	140,765	140,071
Beginning Stocks	40,534	42,574	43,253	44,371	45,480	46,816	49,014	50,822	52,560	53,194	53,531	53,403
Domestic Supply	177,534	183,074	184,917	185,952	187,136	189,165	191,113	192,849	193,543	194,065	194,296	193,474
Consumption	135,000	140,252	140,464	140,294	140,083	139,874	140,021	139,976	140,064	140,235	140,610	140,577
Ending Stocks	42,574	43,253	44,371	45,480	46,816	49,014	50,822	52,560	53,194	53,531	53,403	52,689
Domestic Use	177,574	183,505	184,836	185,775	186,899	188,888	190,843	192,536	193,258	193,765	194,013	193,266
Net Trade	-40	-431	81	178	237	277	269	314	285	300	283	208
Exports	500	578	701	830	917	966	985	1,049	1,042	1,071	1,068	1,008
Imports	540	1,008	620	653	680	688	716	735	757	771	786	800

Source: Wailes and Chavez.

Table A3.2: Japan Rice Supply and Utilization

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
						Thousand Hectares						
Area Harvested	1,628	1,576	1,539	1,549	1,551	1,543	1,533	1,520	1,510	1,502	1,491	1,484
						Metric Tons per Hectare						
Yield	4.74	4.85	4.72	4.80	4.82	4.82	4.82	4.81	4.80	4.79	4.77	4.75
						Thousand Metric Tons						
Production	7,720	7,646	7,268	7,442	7,474	7,434	7,394	7,319	7,247	7,196	7,115	7,055
Beginning Stocks	2,693	2,689	2,745	2,495	2,484	2,553	2,611	2,683	2,741	2,779	2,804	2,820
Domestic Supply	10,413	10,335	10,013	9,936	9,958	9,988	10,005	10,001	9,988	9,975	9,918	9,875
Consumption	8,200	8,072	8,000	7,935	7,886	7,859	7,804	7,743	7,691	7,654	7,580	7,530
Ending Stocks	2,689	2,745	2,495	2,484	2,553	2,611	2,683	2,741	2,779	2,804	2,820	2,827
Domestic Use	10,889	10,817	10,495	10,418	10,440	10,470	10,487	10,483	10,470	10,457	10,400	10,357
Net Trade	-476	-482	-482	-482	-482	-482	-482	-482	-482	-482	-482	-482
Exports	200	200	200	200	200	200	200	200	200	200	200	200
Imports	676	682	682	682	682	682	682	682	682	682	682	682

Source: Wailes and Chavez.

Table A3.3: Republic of Korea Rice Supply and Utilization

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
						Thousand Hectares						
Area Harvested	892	854	848	847	845	842	840	836	831	826	821	820
						Metric Tons per Hectare						
Yield	4.82	4.95	4.96	5.01	5.04	5.06	5.08	5.10	5.12	5.14	5.16	5.17
						Thousand Metric Tons						
Production	4,295	4,224	4,201	4,246	4,264	4,262	4,268	4,261	4,259	4,246	4,240	4,241
Beginning Stocks	1,513	1,034	717	329	290	341	396	508	633	760	886	1,001
Domestic Supply	5,808	5,258	4,918	4,575	4,554	4,603	4,664	4,769	4,892	5,005	5,126	5,242
Consumption	5,175	5,137	4,873	4,686	4,622	4,615	4,564	4,545	4,541	4,528	4,533	4,525
Ending Stocks	1,034	717	329	290	341	396	508	633	760	886	1,001	1,125
Domestic Use	6,209	5,854	5,202	4,976	4,963	5,012	5,072	5,178	5,301	5,414	5,535	5,650
Net Trade	-401	-596	-284	-400	-409	-409	-409	-409	-409	-409	-409	-409
Exports	4	4	0	0	0	0	0	0	0	0	0	0
Imports	405	600	284	400	409	409	409	409	409	409	409	409

Source: Wailes and Chavez.

Table A3.4: India Rice Supply and Utilization

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
						Thousand Hectares						
Area Harvested	7,000	6,566	6,954	6,992	7,012	7,027	7,039	7,048	7,060	7,073	7,086	7,096
						Metric Tons per Hectare						
Yield	1.36	1.61	1.62	1.64	1.65	1.67	1.70	1.72	1.74	1.76	1.77	1.79
						Thousand Metric Tons						
Production	10,528	10,599	11,249	11,455	11,595	11,726	11,933	12,096	12,264	12,434	12,564	12,688
Beginning Stocks	855	505	366	389	353	224	204	225	227	223	208	195
Domestic Supply	11,383	11,104	11,615	11,845	11,948	11,950	12,137	12,321	12,491	12,656	12,772	12,884
Consumption	10,100	10,087	10,326	10,376	10,426	10,515	10,614	10,702	10,801	10,900	10,990	11,052
Ending Stocks	505	366	389	353	224	204	225	227	223	208	195	194
Domestic Use	10,605	10,453	10,715	10,729	10,650	10,720	10,838	10,929	11,024	11,107	11,185	11,246
Net Trade	778	651	900	1,115	1,298	1,230	1,299	1,392	1,466	1,549	1,587	1,638

Source: Wailes and Chavez.

Table A3.5: Pakistan Rice Supply and Utilization

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
						Thousand Hectares						
Area Harvested	2,100	2,750	2,845	2,826	2,811	2,830	2,855	2,875	2,907	2,930	2,940	2,943
						Metric Tons per Hectare						
Yield	2.38	2.36	2.37	2.38	2.39	2.40	2.41	2.42	2.43	2.45	2.46	2.46
						Thousand Metric Tons						
Production	5,000	6,500	6,743	6,719	6,714	6,790	6,893	6,964	7,070	7,169	7,232	7,253
Beginning Stocks	1,100	500	705	887	970	848	759	727	716	691	789	812
Domestic Supply	6,100	7,000	7,448	7,606	7,683	7,638	7,652	7,691	7,786	7,860	8,020	8,065
Consumption	2,247	2,471	2,694	2,794	2,921	3,015	3,112	3,191	3,330	3,395	3,480	3,544
Ending Stocks	500	705	887	970	848	759	727	716	691	789	812	839
Domestic Use	2,747	3,176	3,582	3,764	3,770	3,775	3,838	3,907	4,021	4,184	4,292	4,383
Net Trade	3,353	3,824	3,867	3,842	3,914	3,864	3,814	3,784	3,765	3,676	3,729	3,682
Exports	3,385	3,874	3,867	3,842	3,914	3,864	3,814	3,784	3,765	3,676	3,729	3,682
Imports	32	50	0	0	0	0	0	0	0	0	0	0

Source: Wailes and Chavez.

ASEAN and Global Rice Situation and Outlook

Member states of the Association of Southeast Asian Nations (ASEAN) play a major role in the global rice market. In this paper, lead author Eric Wailes, agricultural economics and agribusiness professor at the University of Arkansas, presents the current and projected status of the rice economies in ASEAN countries until 2022. The baseline situation of the rice market is generated using the Arkansas Global Rice Model, a multicountry statistical simulation. The global rice outlook is also discussed with particular attention to other Asian nations with which ASEAN as a regional association has developed official relationships—the People's Republic of China, Japan, the Republic of Korea, as well as India and Pakistan. The outlook estimates are not predictions but provide a framework to analyze the direction of supply and demand and the management of risks of rice price volatility and their causes. Through the rice model, the paper presents a useful tool to assess intermediate and longer term challenges for the ASEAN region and to determine alternative pathways for designing policy actions for sustainable rice trade.

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