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Arkansas Agricultural Experiment Station
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Division of Agriculture
Fayetteville, Arkansas 72704

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The supplementary Microsoft Excel Tables include detailed country-by-country deterministic and stochastic projections.

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International Rice Outlook: International Rice Baseline Projections 2021–2031

Alvaro Durand-Morat and Subir Bairagi[1]

Highlights

- The war in Ukraine and the lingering effects of the COVID-19 pandemic are pushing input costs to record levels. Although rice prices have increased some in the last several months, production costs have increased more than proportionally, undermining rice profitability.
- We project global rice production will surpass global rice consumption for most of the coming decade, with a small deficit developing by the end of the projected period.
- The projected growth in production is almost exclusively due to productivity gains since the global rice area is projected to increase only marginally by 2029–2031.
- The projected growth in global rice consumption is exclusively based on population growth, as the average global per-capita consumption of rice is estimated to decrease in the coming decade.
- The international price of long-grain and medium-grain rice is projected to increase in nominal terms but decrease in real terms in the next decade due to ample rice supplies.
- We project that rice demand in Africa will continue to grow at a high pace, thus supporting a fast growth in regional production and imports.
- Global rice trade is projected to increase in nominal and relative (to supply) terms, with Africa being the main driver of the expansion.
- Rice exports will remain highly concentrated among the top-5 exporters. India will remain the largest exporter of rice, while Thailand will consolidate as the second largest exporter in the coming decade. Myanmar and Cambodia are expected to grow their export market share, while Vietnam, Pakistan, and the U.S. are expected to lose market share in the coming decade.
- On the rice import side, we project that China, the Philippines, the EU, and Saudi Arabia will lose market share, while Nigeria, Cote d'Ivoire, and Iran will grow their market shares by 2029–2031 relative to the situation in 2018–2020.

Introduction

Rice prices in Asia receded to levels similar to those observed before the coronavirus pandemic (COVID-19) as COVID-related constraints on global production slowly fade away. Moreover, the improved production prospects in Thailand and record production level in India in 2021 helped achieve a global rice surplus and a high level of global rice stocks, which kept international rice prices under control (Fig. 1). Thailand's export price for 100% B rice averaged US$423 per metric ton (mt) in the first four months of 2022, which represents a 19% decrease relative to the average US$521/mt observed in the first four months of 2021. Vietnamese rice export prices also followed a similar pattern.

The main reason that rice prices remain mostly stable despite soaring input prices is the outstanding production numbers out of India. While the stable price is true for rice overall, prices of aromatic and *japonica* rice have been on the rise since the beginning of 2022. The Food and Agriculture Organization (FAO) reports a 14.4% and 9.9% increase in the price index of aromatic and *japonica* rice, respectively, between January and May 2022. In that same period, the price index of *indica* (long-grain) and all-rice increased by 6.2% and 7.7%, respectively The latest numbers from the USDA (USDA-FAS, 2022a) point to a record 2021/2022 crop, estimated at 129.6 million metric tons (mmt), which is more than 5 mmt larger than the 2020/2021 crop. In the last five years (since the 2016/2017 rice crop), the volume of rice produced by India increased by 20 mmt, and such an outstanding performance allowed India to export record volumes at very competitive prices. India's export prices for long-grain 5% broken have ranged between US$345–360/mt, compared to other Asian competitors such as Thailand and Vietnam, whose export prices have, for the most part, remained above US$400 and gone up as high as US$450/mt (according to various issues of the Creed Rice Market Report). Thus, it is fair to say that India is putting a cap on the prices from other exporters, primarily across Asia.

Recent events, such as the war in Ukraine, coupled with lingering COVID-19 supply-chain issues, are having dire effects on input and output prices and inflation rates worldwide. The price of oilseeds, corn, and wheat are surging, threatening the food security situation of millions of people around the globe.

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For producers of those commodities, the increase in output prices is keeping them profitable amid soaring input prices. Although rice prices have increased some, the gains are more modest than those for other major field crops. Low rice prices are saving us from a full-blown food crisis (Blas, 2022), but are also putting rice farmers in a very difficult position when facing increasing production costs, more so considering how input-intensive rice is.

The primary goal of this report is to discuss the main findings of our 2021–2031 baseline projections for the global rice market. The projected period includes the ongoing 2021 marketing year since, at the time of the estimation, a large share of the 2021 rice crop in the northern hemisphere and most of the 2021 rice crop in the southern hemisphere was still underway. It is important to state that the results in this report do not account for the changes in the global economy that have occurred since January 2022. Most notoriously, the results do not account for the changes in agricultural input and output prices and the overall increase in inflation in many countries around the world observed since January 2022.

Materials and Methods

Arkansas Global Rice Model (AGRM)

The Arkansas Global Rice Model (AGRM) is used to generate a baseline projection of the global rice economy. The AGRM is a partial equilibrium economic model that covers over 70 rice-producing, -consuming, and -trading countries around the world. Each country's rice economy is specified as a system of equations representing rice demand, production, trade, and prices for the two major rice types, namely, long-grain and medium-grain rice. Domestic support and trade policies are embedded in the model equations.

Mathematically, the AGRM can be specified with the following system of linear equations (demand, supply, and price transmission).

$$PC_{c,r,t} = \alpha_0 \times RP_{c,r,t}^{\alpha_1} \times SRP_{c,r,t}^{\alpha_2} \times I_{c,r,t}^{\alpha_3} \quad (1)$$

$$TC_{c,r,t} = PC_{c,r,t} \times POP_{c,t} \quad (2)$$

$$AH_{c,r,t} = \beta_0 \times AH_{c,r,t-1}^{\beta_1} \times PP_{c,r,t}^{\beta_2} \times SPP_{c,r,ct}^{\beta_3} \quad (3)$$

$$Y_{c,r,t} = \gamma_0 \times Fert_{c,r,t}^{\gamma_1} \times Time^{\gamma_2} \quad (4)$$

$$TP_{c,r,t} = \sigma \times Y_{c,r,t} \times AH_{c,r,t} \quad (5)$$

$$ES_{c,r,t} = \delta_0 \times TP_{c,r,t}^{\delta_1} \times RP_{c,r,t-1}^{\delta_2} \quad (6)$$

$$RP_{c,r,t} = \theta_0 \times PP_{c,r,t}^{\theta_1} \times MP_{c,r,t}^{\theta_2} \times (1 \times \lambda) \quad (7)$$

$$PP_{c,r,t} = \varphi_0 \times RP_{c,r,t}^{\varphi_1} \times MP_{c,r,t}^{\varphi_2} \times MSP_{c,r,t}^{\varphi_3} \quad (8)$$

$$MP_{c,r,t} = WP_{r,t} \times ER_{c,r,t} \times (1 + \tau) \quad (9)$$

$$XP_{c,r,t} = WP_{r,t} \times ER_{c,r,t} \times (1 - \omega) \quad (10)$$

$$TS_{c,r,t} = TP_{c,r,t} + M_{c,r,t} + BS_{c,r,t} \quad (11)$$

$$TD_{c,r,t} = TC_{c,r,t} + X_{c,r,t} + ES_{c,r,t} \quad (12)$$

$$\sum_c M_{c,r,t} = \sum_c X_{c,r,t} \quad (13)$$

$$TD_{c,r,t} = TS_{c,r,t} \quad (14)$$

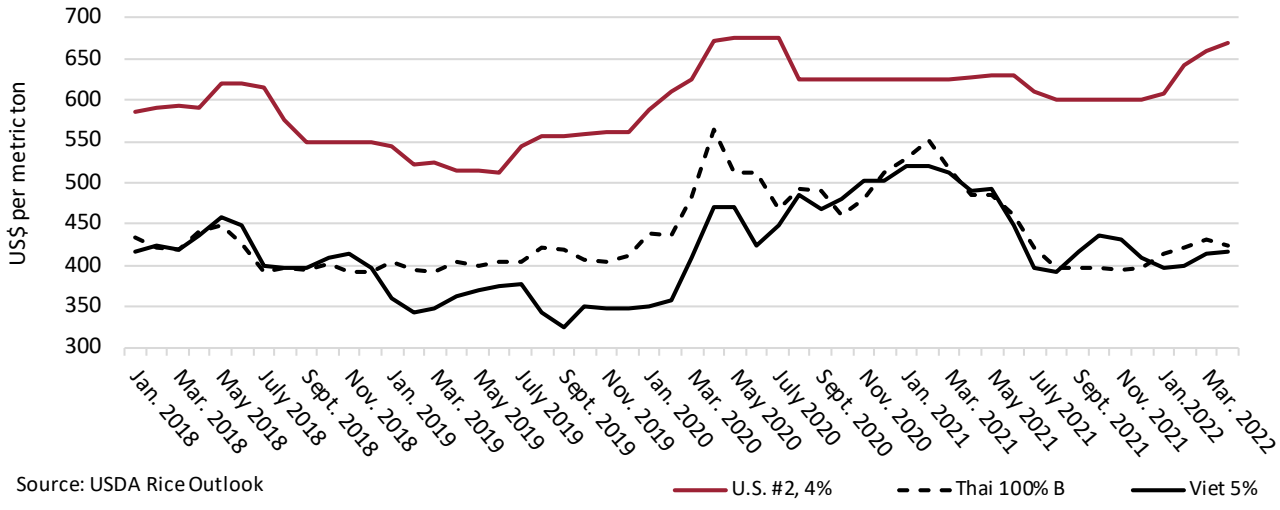


Fig. 1. The monthly average price of long-grain rice from selected exporters.

where the subscripts c, r, and t respectively are the country, rice types (long- and medium-grain), and year; PC and TC are respectively the per capita and total rice consumption; POP = population; RP, PP, MP, and XP are the retail, farm, import, and export prices, respectively; SRP and SPP are, respectively, the retail and farm prices of substitute crops for rice, such as wheat. I = per capita income; AH = harvested rice area; Y = paddy rough rice) yield; M = imports; X = exports; BS and ES are the beginning and ending stock, respectively, where $BS = ES_{t-1}$; WP = world rice price (Thai 5% broken), which clears the rice markets; ER = exchange rates; TS and TD are the total supply of rice and demand for rice, respectively; σ = paddy to rice conversion ratio; τ and ω are import tariff and export tax, respectively; λ = floor price; MSP = minimum support paddy price; α, β, γ, δ, θ, and φ are the respective demand, supply, and price transmission elasticities, either estimated or taken from the relevant literature. A more detailed specification of the model can be found in Mane and Wailes (2012) and Wailes and Chavez (2011).

Global Macroeconomic Assumptions

The macroeconomic projections used for the calibration of the AGRM model came from IHS Markit. These macroeconomic projections were estimated in January 2022 and consequently do not account for the impact of the Ukraine war and account only partially for the rise in input costs that started in 2021. Hence, these projections do not incorporate the impact of the sharp increase in input and output costs observed since January. The projections suggest that, globally, the economy will grow at a higher rate in the next decade (3.3% a year) compared to the last decade (2.3%). Looking at the top-5 rice-consuming countries, the projections over the next decade relative to the last decade point to a lower rate of economic growth in Bangladesh and China and a higher rate in India, Indonesia, and Vietnam (Fig. 2). Looking at the largest rice markets in the Western hemisphere, economic growth is projected to strengthen in Brazil, the U.S., Colombia, and Peru relative to their performance in the last decade.

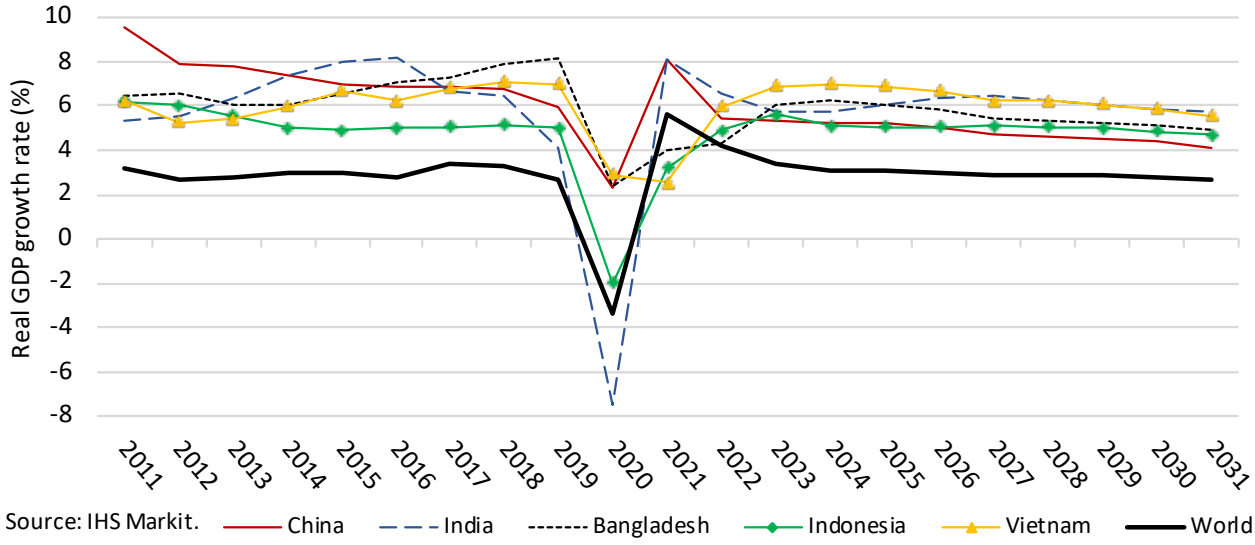


Fig. 2. Economic growth projections for the top-5 rice-consuming countries in the world.

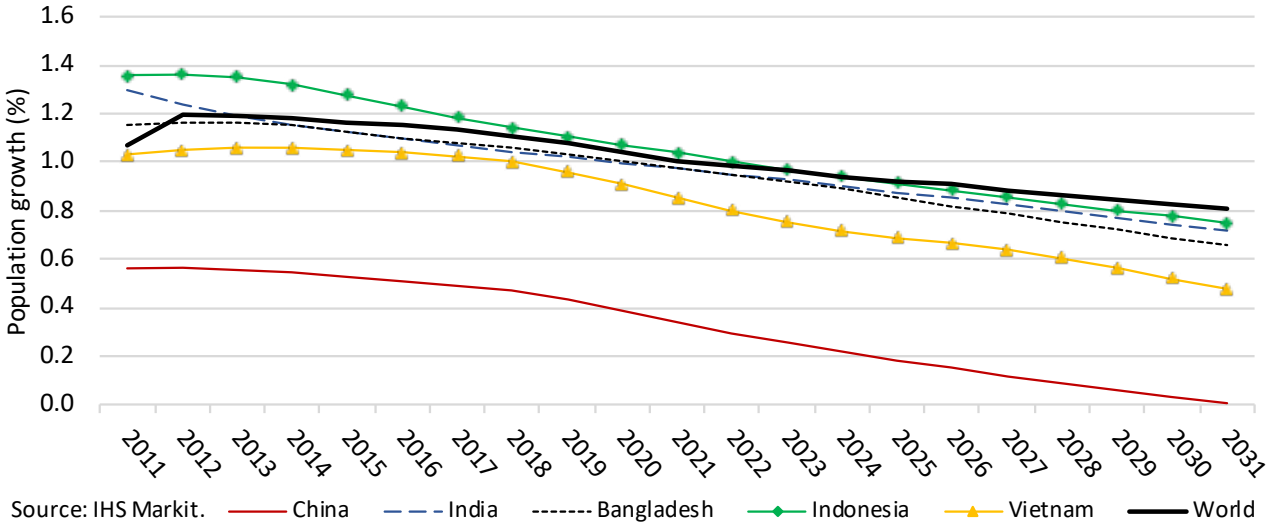


Fig. 3. Population growth projections for the top-5 rice-consuming countries in the world.

The population is projected to grow globally over the next decade (0.9% a year) but at a lower rate than that observed in the last decade (1.1% a year) and is expected to reach 8.55 billion by 2031. The rate of population growth will decline across all regions but most severely among developed countries. For instance, the rate of population growth is expected to decrease to 0.3% a year among Organization for Economic Cooperation and Development (OECD) countries, relative to 0.6% in the last decade. Among developing countries, population is expected to grow at 2.0% a year in the coming decade relative to 2.1% in the past decade. Population growth rates in the top-5 rice-consuming countries are expected to continue decreasing in the coming decade, following a similar trend observed in the last several years (Fig. 3).

Stochastic Simulation Method

A stochastic component based on the probabilistic distribution of rice yields is also integrated into the AGRM to capture risk and uncertainties associated with the global rice sector.

The integration steps involve estimating a fixed-effect model for rice yields and simulating yields with 500 iterations with a multivariate normal distribution. Finally, we randomly select 100 iterated yields for each country and incorporate those into the AGRM baseline model.

The fixed effect regression is specified as:

$$Y_{it} = \vartheta_0 + \vartheta_1 Temp + \vartheta_2 Rain + \vartheta_3 Time + \sum_{\rho=1}^{N-1} \rho Z + e_{it} \quad (15)$$

where Y_{it} is the rice yield for the i^{th} country at period t; *Temp* is the annual temperature in degrees Celsius; *Rain* is the annual precipitation in millimeters; *Time* is a year index to capture technological advancements over time; Z is a vector of country dummies; ϑ and ρ are the parameters to be estimated; and e_{it} are error terms. The data were gathered from various sources. The historical yields are from the USDA-FAS (2022b) Production, Supply and Distribution online database (https://apps.fas.usda.gov/psdonline/app/index.html#/app/advQuery); temperature and rainfalls are from the Climate Change Knowledge Portal, the World Bank (https://climateknowledgeportal.worldbank.org/download-data); for the U.S. model, statewide rainfall and temperature data were gathered from https://www.ncdc.noaa.gov/cag/.

After estimating equation (15), we use the multivariate normal distribution (MVN) for stochastic simulation to generate 500 yield iterations, out of which 100 iterations were randomly selected to generate the stochastic analysis. The MVN is a generalization of the univariate normal distribution to two or more variables, which has two parameters, a mean vector (μ) and covariance matrix Σ. Suppose that $\Sigma = A'A$, where the diagonal elements are the variances for each variable, and the off-diagonal elements are the covariances between variables. The probability density function (PDF) of the d-dimensional MVN can be specified as:

$$y = f(x, \mu, \Sigma) = \frac{1}{\sqrt{|\Sigma|}(2\pi)^d} \exp\left(-\frac{1}{2}(x-\mu)\Sigma^{-1}(x-\mu)'\right) \quad (16)$$

where x and μ are $1 \times d$ vector and Σ is a $d \times d$ symmetric and positive definite matrix. The simulation steps are: we first generate x such that $x \sim N(0,1)$, and then $y = A'x + \mu$ with $y \sim N(\mu, \Sigma)$. Finally, we use STATA's "drawnorm" command to general 500 yields for each country in the AGRM. For detailed stochastic simulation, see (Kotz et al., 2000; Ripley, 1987; Rubinstein and Kroese, 2017).

Results and Discussion

Global and Regional Rice Market Outlook: Results from the Deterministic Baseline Analysis

Table 1 presents the current and projected global rice supply and utilization. Recently (2018–2020), global production has outpaced consumption by more than 9.2 million metric tons (mmt) a year, which pushed global rice stocks up to more than a quarter of rice use (Table 1), which is the highest level since 2001 (USDA-FAS, 2022a). Despite the high level of global rice stocks, rice prices have trended upward since 2015, which partly reflects that most rice stocks are not readily available for trade but rather play an important food security role in some markets. For instance, China and India held 64% and 18% of the global rice stocks in 2018–2020, largely for domestic food security reasons, and therefore they may not be readily available for trade. The stocks held by the top-five net rice exporters (excluding India), which may be deemed as readily tradable,

Table 1. Projected world rice supply and utilization (in 1,000 metric tons of milled rice unless indicated).

Attributes	2018–2020	2029–2031	Nominal Change	% Change
Area Harvested (1000 ha)	163,288	164,221	933	0.57%
Yield (kg/ha)	3.07	3.25	0.2	6.51%
Production	501,294	533,162	31,868	6.36%
Beginning stocks	174,001	206,880	32,879	18.90%
Domestic supply	675,295	740,042	64,747	9.59%
Consumption	492,039	536,089	44,050	8.95%
Ending stocks	181,580	207,500	25,920	14.27%
Domestic use	673,619	743,589	69,970	10.39%
Total trade	45,950	60,299	14,349	31.23%
Stocks-to-use ratio (%)	26.96	27.91	0.95	3.52%

amounted to 5.2% of the global rice stocks in 2018–2020, down from 11.2% in 2013–2015, driven primarily by a sharp decrease in ending stocks in Thailand.

Despite the growth in rice trade relative to supply observed over the last two decades, rice remains thinly traded, with only 9.2% of the rice supply traded internationally in 2018–2020, compared to 16% for corn and 25% for wheat. Aside from the fact that most rice is consumed where it is produced without crossing borders, the low trade share may also result from the fact that rice remains a highly protected commodity, particularly in many Asian counties where rice is the staple food. Asia dominates the global rice market and accounts for 90% of production, 86% of consumption, 95% of stocks, and 83% of global exports in the 2018–2020 period. We project that the share of rice production that is traded internationally will grow to an average of 11.3% by 2029–2031, as demand continues to grow and outpace production in many regions, including Africa and the Middle East.

The international price of long-grain (LG) rice, the most popular type of rice produced and traded worldwide, is projected to grow steadily but marginally in nominal terms over the next decade (Fig. 4). We project that the nominal price of Thai LG 100% B rice will increase on average 0.80% annually, reaching $486/mt in 2029–2031, while the price of U.S. LG (#2 LG Gulf) will increase by 0.77% a year on average and reach $653/mt by 2029-2031 (Fig. 4). The significant gap between the price of LG rice from Asia and the Western Hemisphere witnessed over the last several years is expected to continue over the next decade. The reason is that importers in the Western Hemisphere continue to source rice mainly from regional suppliers (e.g., U.S. and Mercosur) despite the price discounts for Asian rice. The international nominal price of medium-grain (MG) rice, represented by the U.S. MG#2 (FOB California), is projected to remain above US$1,000/mt throughout the projected period but to actually reach its highest value in the current 2021 crop year, decrease in the medium term, and start increasing back again to reach $1,039/mt by the end of the projected period. In real terms (adjusting for inflation), the international price of LG (Thai LG 100% B) and MG (U.S. #2 MG California) are projected to decline by 1.09% and 2.00% annually, respectively, over the next decade.

At the regional level, Asia is projected to account for the bulk (73.49%, or 23.4 mmt out of the 31.9 mmt increase) of the growth in rice production in the next decade, followed by Africa with 5.4 mmt or 16.84% of the growth, and America with 2.4 mmt or 7.50% of the growth (Fig. 5). The share of production from Africa and America is expected to expand at the expense of Asia, but the later will still account for the bulk (88.87%) of global rice production in 2029–2031. Relative to the 2018–2020 production levels, Africa will experience the largest growth in production with a 22.58% cumulative increase from 2018–2020 to 2029–2031. The efforts to bolster production in Africa after the rice crisis of 2007–2008 resulted in an impressive 51.50% increase in rice production in the last decade (2008–2010 to 2018–2020). We project that the growth will slow down relative to that benchmark but still continue strong in the coming decade.

The projections on the consumption side are similar to those on the production side. Asia is projected to account for the largest nominal growth in consumption (50.86%, or 22.4 mmt out of the 44.1 mmt), followed by Africa with 17.2 mmt or 39.10% of the projected growth (Fig. 5). Africa is expected to experience the largest growth in consumption over the next decade relative to the 2018–2020 level, increasing rice consumption from 38.9 mmt in 2018–2020 to 56.1 mmt in 2029–2031, a 44.26% increase. In the last decade, rice consumption in Africa grew 61.02% due to rapid growth in per-capita consumption and population. We project that growth will slow down some but will remain strong in the coming decade. Africa's share of global consumption is projected to increase over the next decade, primarily at the expense of Asia.

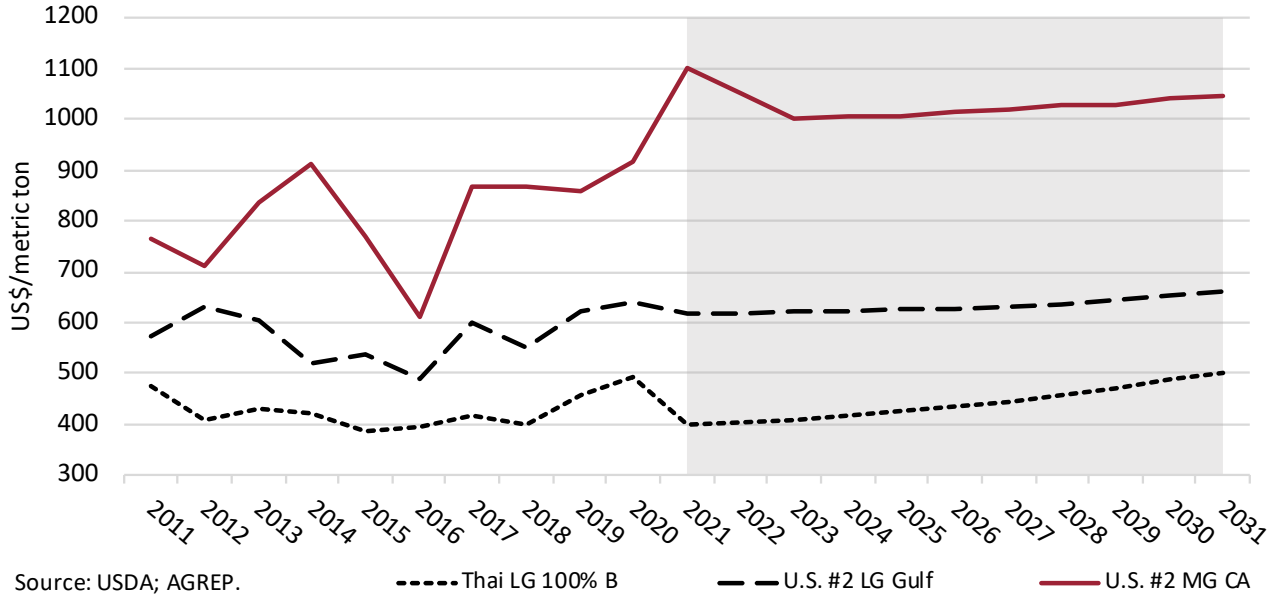


Fig. 4. The nominal international price of long-grain (LG) and medium-grain (MG) rice.

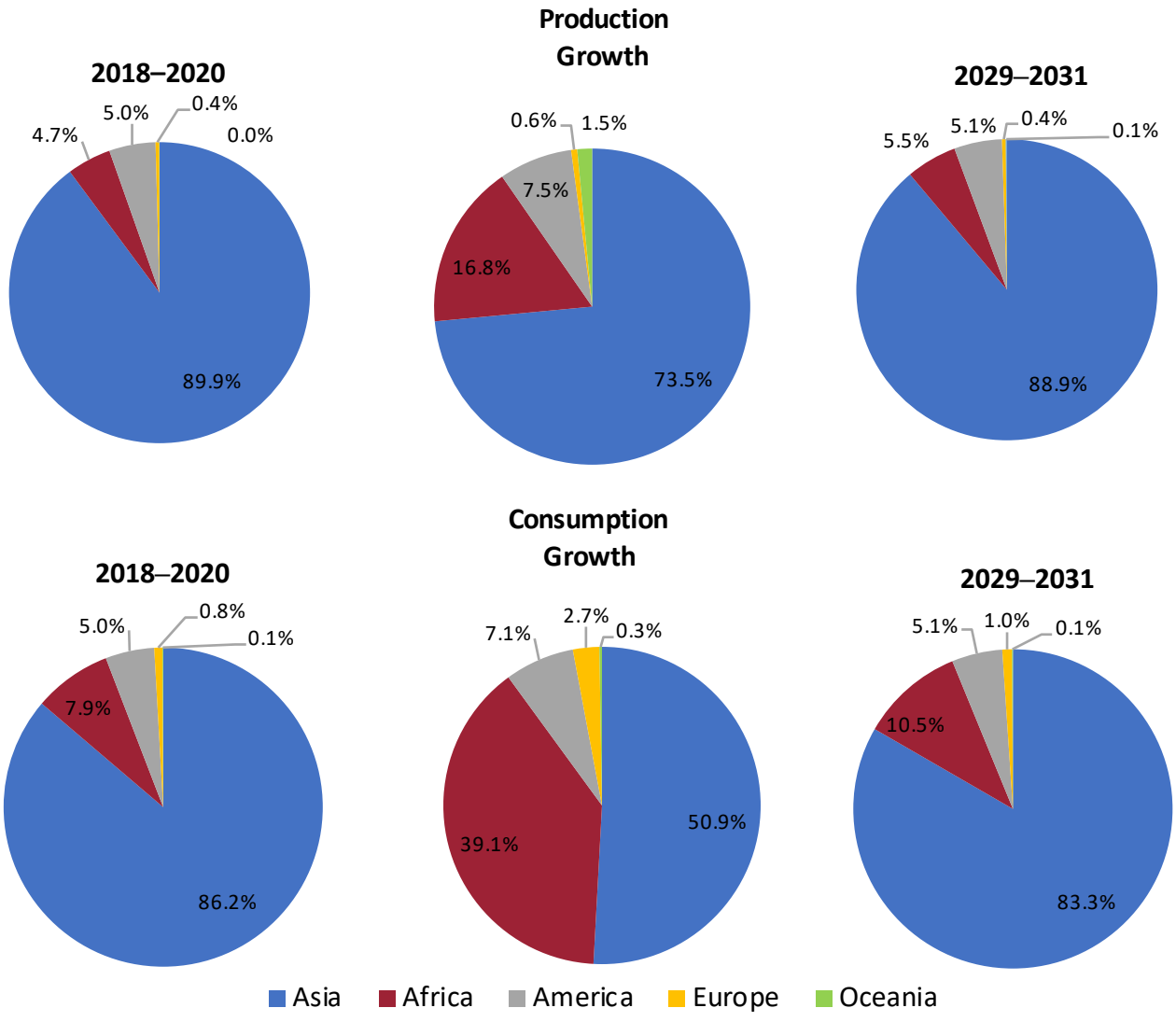


Fig. 5. Projected trend of regional rice production and consumption over the next decade.

Africa is projected to continue driving the growth in the global rice trade to serve the fast-growing demand. We project that Africa will account for 93.55% of the growth in imports in the next decade and that it will surpass Asia and become the largest rice importer in 2029–2031. Asia accounts for the bulk (86.13%) of the growth in exports and will expand its dominance on the export side (Fig. 6).

Country-Specific Rice Market Outlook: Results from the Deterministic Baseline Analysis

Rice Consumption. Several recent articles argue that the food basket in various developing countries will transform in mainly two directions, namely, substitution between food items, such as increasing consumption of animal protein and less of cereals, and within food items, such as increasing consumption of aromatic or brown rice at the expense of regular white rice (Bairagi et al., 2020; 2022; Mottaleb et al., 2018). Therefore, it is often argued that the demand for staple food in Asia, such as rice and wheat, will decline, and the demand for non-staple food, such as vegetables, will increase in the future (Pingali, 2015).

Our projections suggest that per-capita consumption in many Asian countries, including the five largest rice consumers (China, India, Bangladesh, Indonesia, and Vietnam), will decline in the coming decade (Fig. 7). However, total consumption will increase purely based on population growth, except in Japan and South Korea, where total consumption is projected to decline. Moreover, total rice consumption is projected to increase strongly across most African countries, based on both higher per-capita consumption (supported in part by growing income levels in some countries where rice is a normal good) (Kruseman et al., 2020; Van Oort et al., 2015), and strong population growth. For instance, looking at the three largest rice markets in the continent, we project that total consumption in Nigeria will grow by 39.64% over the next decade, driven mainly by population growth since per-capita consumption is expected to decrease by 3.84%. In Madagascar, rice consumption is expected to grow by 27.41% based on both per-capita and

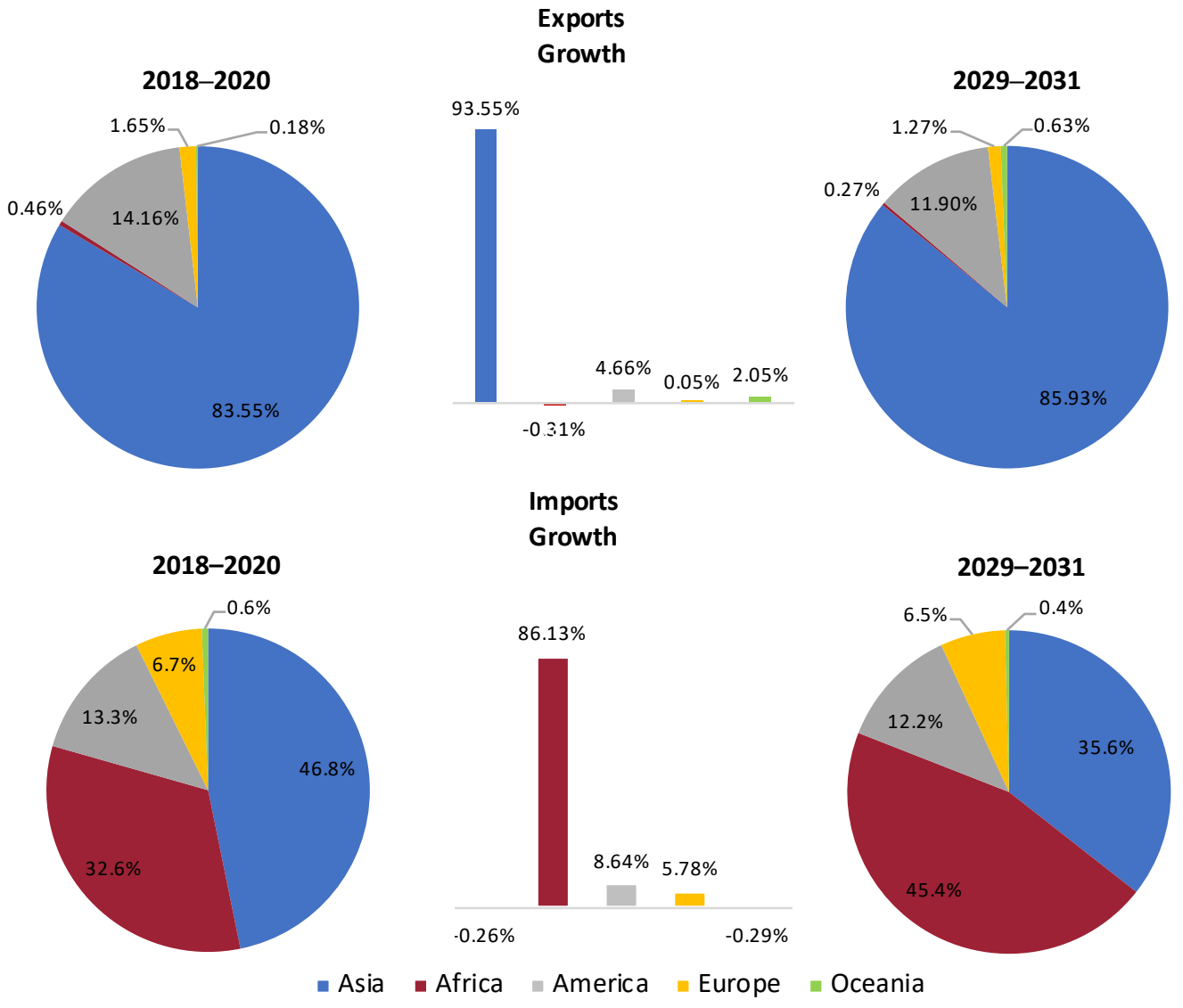


Fig. 6. Projected trend of regional rice export and import shares over the next decade.

population growth. Finally, rice demand is projected to grow in all Latin American countries except in Brazil, the largest rice market outside Asia, where a 6.88% decline in per-capita consumption will more than offset population growth and lead to a 1.23% decline in rice consumption by 2029–2031. For the projected changes in consumption in other countries, see Appendix Table A1.

Rice Production. We project that production in China, the largest rice producer in the world, will decrease a cumulative 2.91% over the next decade (Fig. 8). Some of the reasons explaining this decrease in production include the increasing competition with other field crops such as soybeans and corn and the lower pressure on rice from a food security point of view as demand slows down and the stock level remains high. On the other hand, we project that production in India will continue to grow but at a slower pace than that observed in the last decade and supported primarily by yield gains as the area expands only marginally. The future path of rice yields in India is a key variable that could greatly impact the global rice market in the coming decade. In Indonesia, we project that the rice area will decrease only marginally in the coming decade, which signifies a slowdown in area reduction relative to the trend observed in recent years. However, we project yield gains large enough that will help in achieving a 5.96% increase in rice production. In Nigeria, Africa's largest rice producer, we project both rice area and yield to continue growing at rates similar to those observed in the last decade, leading to a 21.36% growth in production by the end of the next decade (2029–2031). In Latin America, we project that the shift in production in Brazil from upland to irrigated rice will ease some as the bulk of the shift has already happened, and the area of upland rice stands at an average of 25% of the total area in 2015–2020 relative to 38% in the 1990s. Consequently, the rice area is projected to decrease a cumulative 5.93%, while yields are expected to increase by 6.00%, yielding a net reduction in rice production of 0.25%. In Peru, the second-largest rice producer in Latin America, we project rice area and yield to grow, leading to an 18.10% increase in production by the end of the next decade. For the projected changes in production in other countries, see Appendix Table A1.

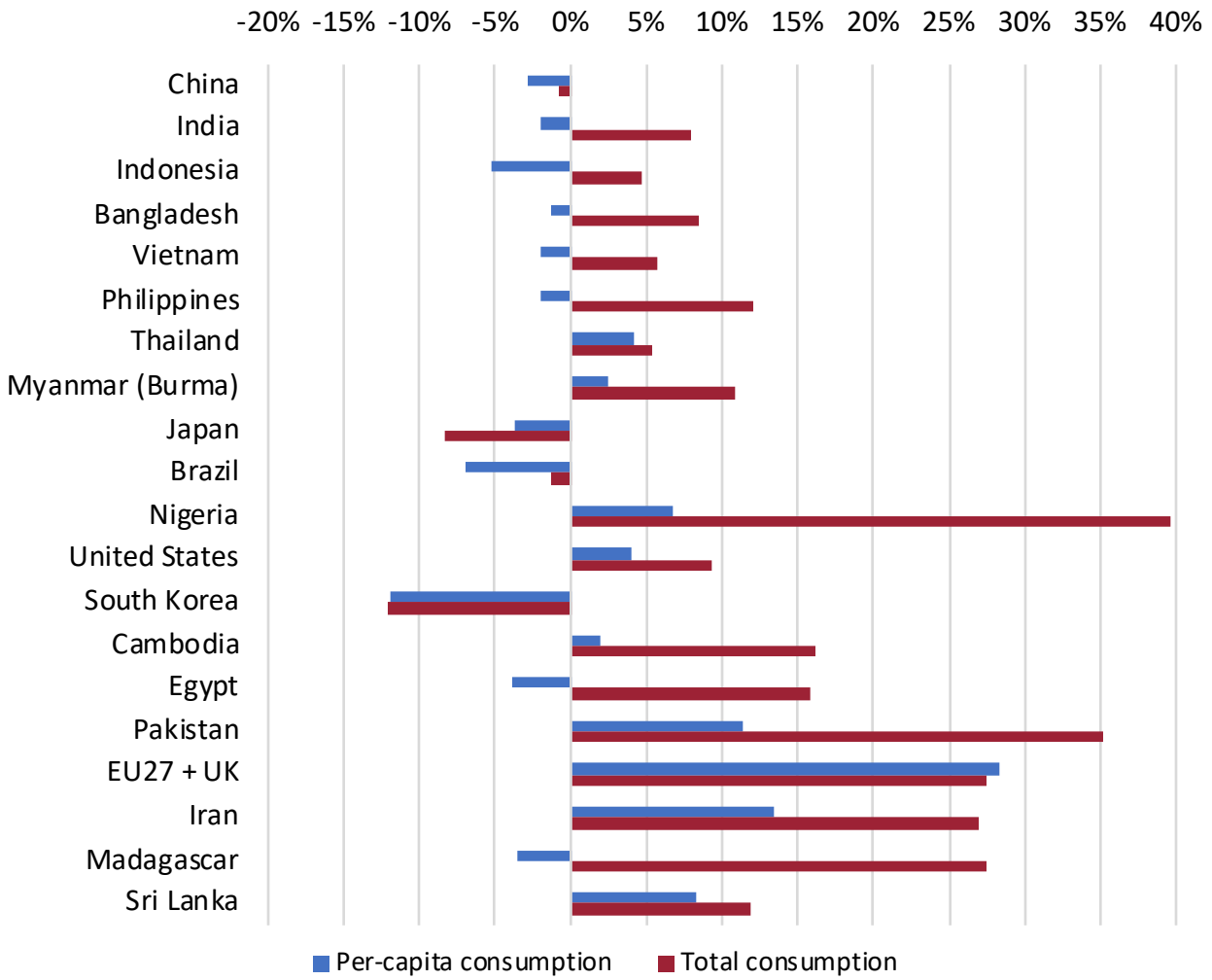


Fig. 7. Projected changes in per-capita and total rice consumption among the 20 largest rice markets in 2029–2031 compared to 2018–2020.

Rice Trade. Global rice trade grew 50.14% in the last decade (from 30.6 mmt in 2006–2008 to 46.0 mmt in 2018–2020), and we project it will continue to grow but at a slower pace, reaching 60.3 mmt by 2029–2031, that is, a cumulative 31.23% growth from its 2018–2020 level. Rice trade is highly concentrated on the export side, with five countries (India, Thailand, Vietnam, Pakistan, and the U.S.) accounting for 74.28% of the total volume of exports in 2018–2020, down from 80.34% in 2006–2008. We project the same 5 countries will continue to dominate rice exports, with their cumulative share increasing slightly to 76.42% by the end of the next decade. Myanmar's exports are projected to grow and get almost on par with U.S. exports. Arguably the most prominent development on the export side in the last decade has been the rise of India as a steady and leading exporter of rice, growing from a 13.60% export share in 2006–2008 to nearly one-third (31.27%) in 2018–2020 (Fig. 9). We project that India will remain the largest exporter of rice in the coming decade, accounting for 36.12% of the global rice exports in 2029–2031. Thailand has recently lost market share due to a series of weather-related production shocks that have tightened the market and undermined its competitiveness. We project that Thailand will regain its presence and consolidate as the second-largest exporter after India. While Myanmar and Cambodia are expected to grow their export market share in the coming decade, Vietnam, Pakistan, and the U.S. are expected to increase their exports in nominal terms but lose market share. Finally, China has been in and out of the export market in the last decade, but we project it will become a more consistent exporter, holding a 4.43% market share by 2029–2031.

The rice market is much less concentrated on the import side (Fig. 10). Looking at the rice import shares of top rice importers, we project a slight increase in the concentration of imports, but still the top 8 rice importers are expected to account for only one-third of the total volume of rice traded globally by the end of the next decade (2029–2031). There is little expected variation in the market shares held by the top importers. Noticeably, we project that China and Indonesia will lose market share, while

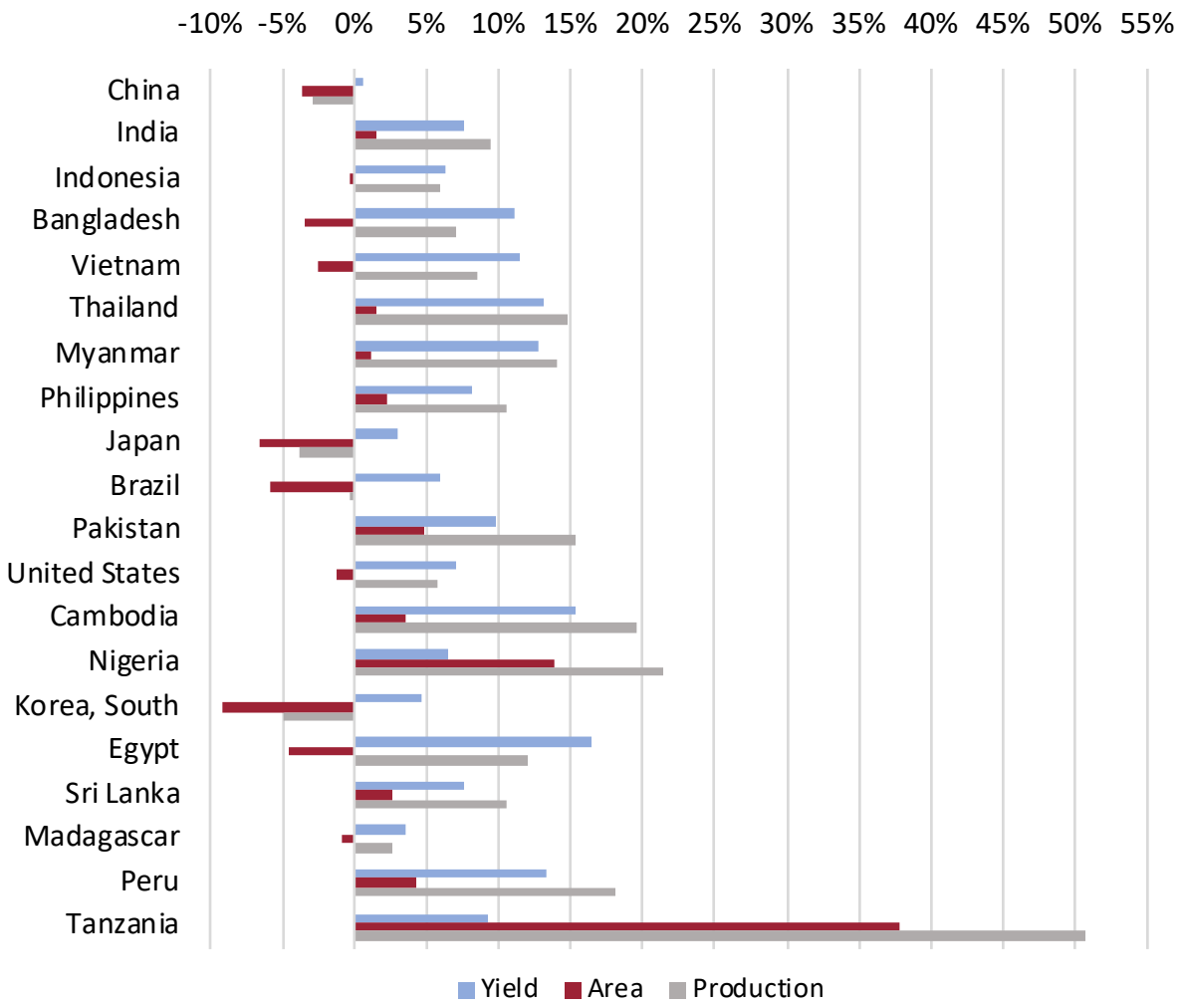


Fig. 8. Projected changes in rice yields, area, and total production among the 20 largest rice producers in 2029–2031 compared to 2018–2020.

Nigeria, Cote d'Ivoire, and Iran will grow their market shares relative to the situation in 2018–2020. For the projected changes in exports and imports in other countries, see Appendix Table A2.

U.S. Rice Market. The results presented in this section differ slightly from those presented by FAPRI in its 2022 U.S. Agricultural Market Outlook. Regardless of the slight differences, the main findings reported by FAPRI are consistent with those presented in this report.

Table 2 presents the U.S. rice supply and utilization by types (namely, LG and MG; MG includes both medium- and short-grain rice). We project that the production of LG rice will grow from 153.3 million hundredweight (cwt) in 2018–2020 to 167.1 million cwt by 2029–2031, equivalent to an annual rate of 0.86% (Fig. 11). To put these numbers in perspective, we project the LG rice crop in 2029–2031 to be similar to that harvested in 2016 (166.7 million cwt) and smaller than the 2020 crop (170.8 million cwt). Most of the gains are expected to come from yield improvements, which include farm-level as well as milling yield gains. The baseline projections implicitly assume that the industry follows through with its commitments to improve the milling and culinary quality of LG rice, which will not only increase milled rice output (higher milled rice and head rice yields generate more milled rice per unit of paddy rice) but also help reverse the loss of competitiveness that U.S. LG rice has experienced in core export markets such as Mexico and Central America in the last decade.

Exports of LG rice are projected to decrease in the short-term but eventually rebound in the medium- and long-term, reaching 72.0 million cwt by 2029–2031, a volume similar to the average exported in 2015–2017 (Fig. 11). We expect that the U.S. will continue trading LG rice primarily across markets in the Western hemisphere, in many of which U.S. rice has preferential treatment under regional trade agreements. In recent years, U.S. LG rice has not been competitive vis-à-vis LG Asian rice in other markets of interest, such as the Middle East and Africa, and we project that that situation will continue in the next decade. We project that domestic use (consumption plus residual) will grow at a slower pace in the coming decade

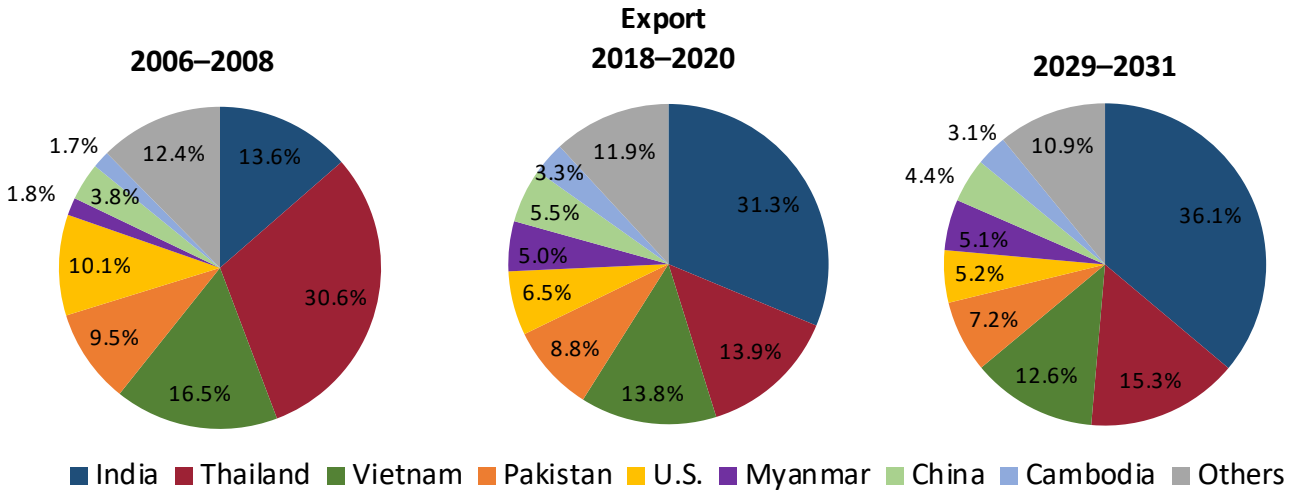


Fig. 9. Historical and projected export shares by the top rice exporters.

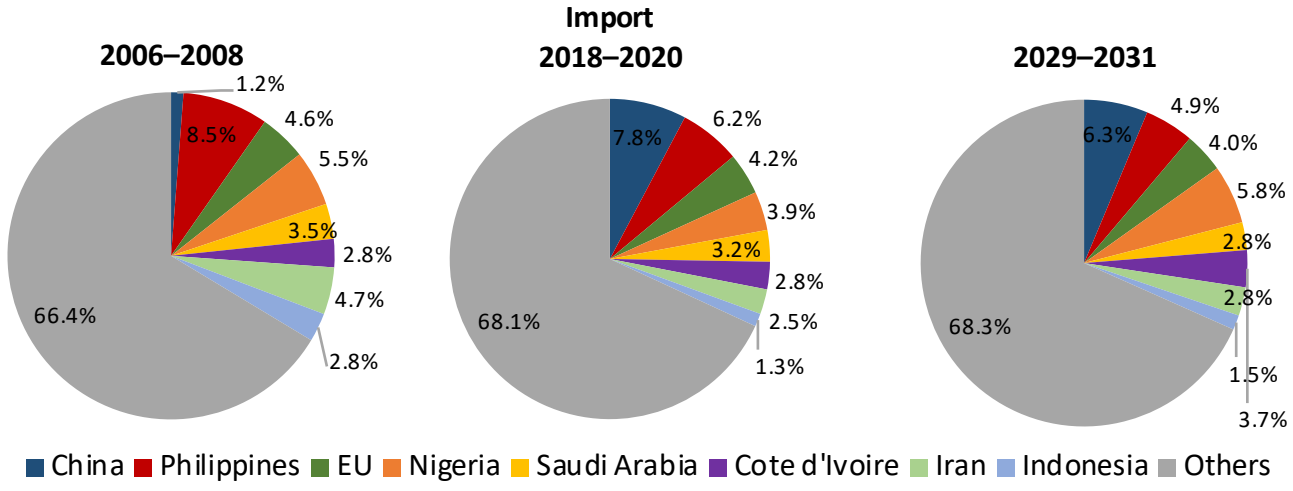


Fig. 10. Historical and projected import shares by the top rice importers.

Table 2. United States rice supply and utilization by types.

	All Rice			Long-grain			Medium- and short-grain		
Variables	**2018–2020**	**2029–2031**	**Annual Growth**	**2018–2020**	**2029–2031**	**Annual Growth**	**2018–2020**	**2029–2031**	**Annual Growth**
Planted area (1000 acres)	2791.0	2758.6	-0.12%	2069.0	2095.6	0.13%	722.0	663.0	-0.85%
Yield (lb/ac)	7594.7	8137.4	0.69%	7400.1	7973.5	0.75%	8151.8	8655.5	0.60%
Production (million cwt)	212.2	224.5	0.57%	153.3	167.1	0.86%	58.8	57.4	-0.25%
Beginning stocks (million cwt)	32.8	35.2	0.72%	23.3	25.2	0.78%	9.5	10.1	0.57%
Imports (million cwt)	33.5	36.8	0.95%	26.8	29.1	0.81%	6.6	7.7	1.49%
Supply (million cwt)	278.4	296.5	0.63%	203.4	221.3	0.85%	75.0	75.1	0.02%
Domestic use (million cwt)	147.1	160.8	0.89%	111.7	123.5	1.02%	35.4	37.3	0.50%
Exports (million cwt)	93.8	99.7	0.61%	65.4	72.0	0.97%	28.4	27.7	-0.26%
Ending stocks (million cwt)	37.2	36.0	-0.32%	26.4	25.8	-0.22%	10.8	10.2	-0.57%
Demand (million cwt)	278.1	296.5	0.64%	203.4	221.3	0.85%	74.6	75.1	0.07%
Farm price ($/cwt)	13.4	15.2	1.24%	11.8	13.6	1.40%	21.2	22.6	0.66%

relative to that observed in the past decade. On the import side, it is important to notice that we include imports of aromatic (jasmine and basmati) rice as LG rice. With that in mind, we project imports will continue to grow but at a slower pace (2.06% a year between 2021–2031) than that observed in the last decade (5.64% a year on average between 2010–2020), in accordance with the slower growth in domestic use and the expected increase in production (Fig. 11).

Looking at the MG segment of the market, we project that the production of MG rice will decrease slightly in the coming decade relative to the 2018–2020 benchmark period (Fig. 12). To put these numbers in perspective, we project a volume of production in 2029–2031 similar to the average production in 2016–2019. The decrease in production is driven exclusively by a decrease in planted area, primarily in the mid-South (Arkansas and Louisiana). The projections assume that the critical water situation in California will be reversed in the coming years and that planted acres will bounce back and reach between 495–500 thousand acres by 2029–2031. Exports of MG rice are expected to decrease marginally from 28.4 million cwt in 2018–2020 to 27.7 million cwt in 2029–2031 (Fig. 12). Although we treat MG as a single commodity, in reality, California Calrose MG rice and mid-South MG rice serve very different markets and attract different prices. California MG rice is exported primarily to markets in Northeast Asia (e.g., Japan, South Korea, and Taiwan) and within WTO-negotiated schedules, which are expected to remain

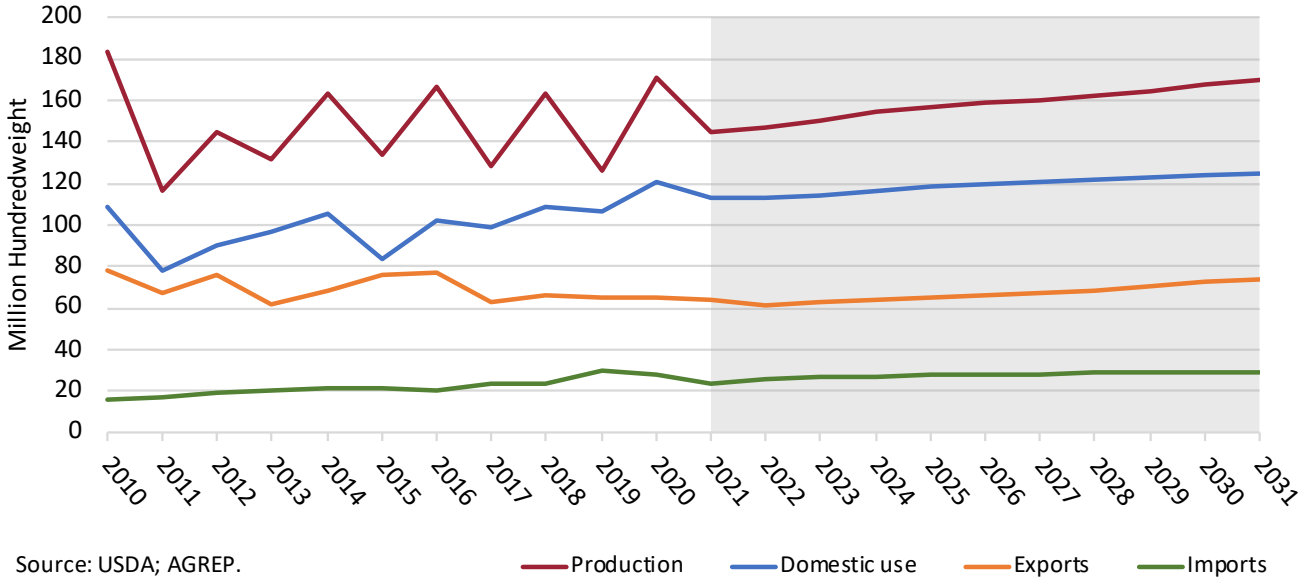


Fig. 11. Historical and projected behavior of selected U.S. long-grain rice market variables.

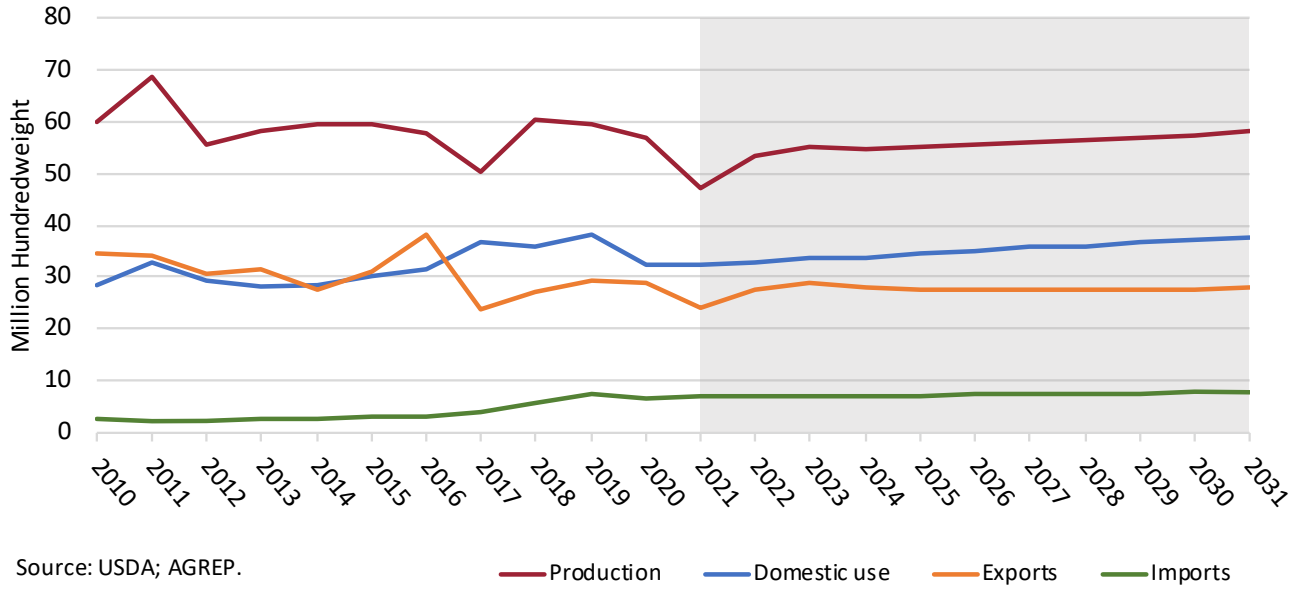


Fig. 12. Historical and projected behavior of selected U.S. medium-grain rice market variables.

mostly fixed in the near future. On the other hand, MG rice from the mid-South competes more openly in key markets in northern Africa, the Middle East, and a few Western hemisphere markets such as Canada and Puerto Rico, where it has recently faced strong competition from China. Imports of MG rice (primarily to Puerto Rico), although small relative to total supply, have increased sharply since 2016/2017 and are expected to continue growing but at a significantly slower pace in the coming decade. We project that domestic use (consumption plus residual) will grow at a similar pace in the coming decade relative to the last, which ultimately allows the market to be balanced with only marginal changes in stocks (Fig. 12).

Figure 13 illustrates the dynamics of U.S. rice farm prices. The price of LG rice is projected to decrease slightly in the short term and grow steadily but marginally thereafter, reaching $13.6/cwt by 2029–2031. The price of MG from California is projected to decrease in the short term from the record-high prices observed so far in 2021, but nevertheless to remain above the average $21.2/cwt observed in 2018–2020. In the medium- and long-term, we project the price of California MG rice to grow slowly but steadily, reaching $22.6/cwt by 2029–2031. We project that the significant price gap between MG from California and LG and MG from the mid-South will remain in the coming decade.

Key Results from the Stochastic Analysis

The stochastic simulation generates a probability distribution for each endogenous variable in the model. For the sake of brevity, we discuss here the stochastic projections for a few selected variables. All other stochastic results are available from the authors upon request.

Table 3 shows the stochastic results, represented by the mean, 10th, and 90th percentile values for the international reference price of LG rice (represented by Thai 100% B), the global level of production, consumption, and exports. Figure 14 shows the stochastic projected behavior of the export price of Thailand LG 100% B rice, the reference price that clears the international LG market. The vertical lines mark the range of variability between the 10th and 90th percentile. We project that the export price of Thai LG 100% B, and by extension, the international price of LG rice, will be highly volatile in the short term, with an 80% confidence that the price will be between US$352/mt and US$463/mt in 2022. We estimate that the volatility will recede some by the end of the projected period, with an 80% confidence that the price for Thai LG 100% B will be between US$474/mt and US$530/mt by 2031.

Looking at the stochastic projections of global production and consumption (Fig. 15), we see that their volatility is low and decreases over the projected period. This low volatility is due in part to the aggregate nature of the variables; production and consumption at the regional and country level (not shown) show a much more uncertain behavior. Finally, we project with 80% confidence that global rice trade in 2022 will be between 49.4 and 54.8 mmt, and the uncertainty will decrease slightly over the next decade.

Key Market Variables to Watch

China's Rice Stocks

China currently has a record level of stocks, estimated at an average of 116.0 mmt in 2018–2020, compared to the previous highest level of 97.4 mmt in 1999. Relative to the demand, the current stock level amounts to nearly 79.0% of China's annual rice consumption, compared to 73.0% back in 1999. The stock buildup that started in the late 2000s is supported by a sustained level of production facilitated by favorable domestic policies, a steady volume of imports under the auspice of the WTO, and a slowdown in total rice consumption. One of the

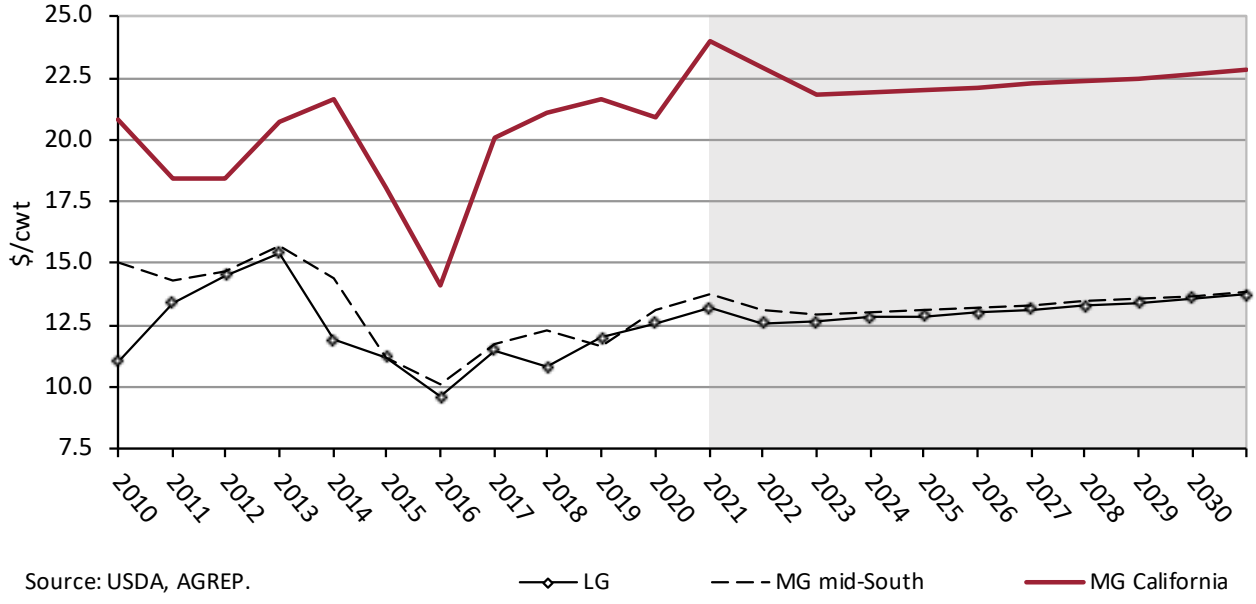
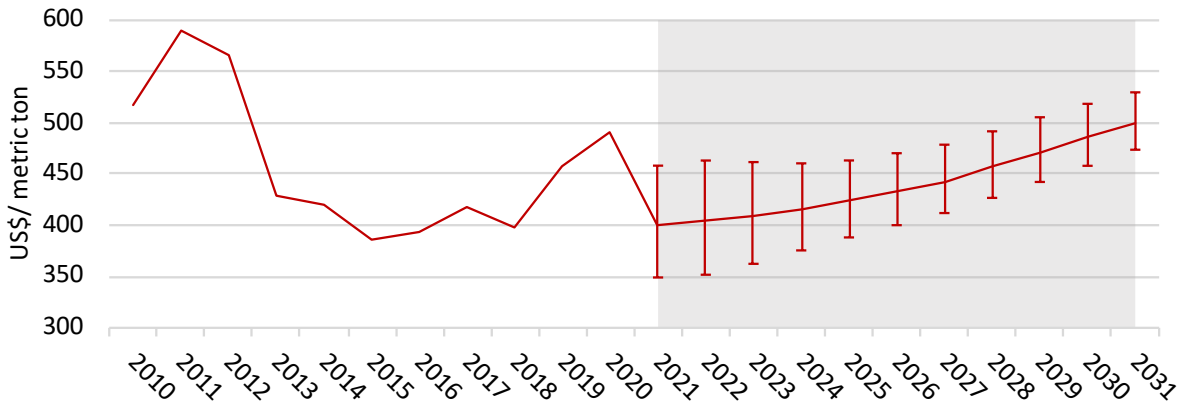


Fig. 13. Historical and projected behavior of U.S. rice prices by type, in nominal U.S. dollars.

Table 3. Stochastic projections (10th and 90th percentile) of the international reference price (Thai 100% B), global production, consumption, and exports.

	Thai 100% B (US$/mt)			Production (mmt)			Consumption (mmt)			Exports (mmt)		
Year	10th	Mean	90th	10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
2010		518.0			451.6			444.1			35.2	
2011		590.0			469.6			455.3			40.0	
2012		565.0			476.1			462.2			39.4	
2013		428.0			481.2			472.1			43.3	
2014		420.0			482.7			473.0			43.9	
2015		386.0			477.1			467.9			40.7	
2016		394.0			491.8			477.8			47.5	
2017		418.0			494.4			480.6			47.4	
2018		399.0			497.3			484.8			44.1	
2019		457.0			496.4			494.5			43.4	
2020		491.0			507.3			498.5			50.3	
2021	349.1	400.5	458.2	503.4	509.2	514.9	498.0	501.4	504.6	48.4	50.1	52.3
2022	351.8	404.6	463.2	507.6	511.9	516.9	501.4	504.8	508.0	49.4	52.0	54.8
2023	362.4	408.8	461.7	510.0	514.2	517.9	506.1	509.1	511.9	50.4	53.0	56.1
2024	375.5	415.6	460.5	513.2	517.0	520.4	510.5	513.2	515.6	52.0	54.5	57.6
2025	388.2	424.0	463.3	516.1	519.8	523.1	514.9	517.3	519.6	53.6	56.1	59.0
2026	400.2	433.3	470.4	518.4	522.0	525.2	519.1	521.3	523.4	54.4	56.8	59.7
2027	412.0	443.2	478.7	521.2	524.6	527.8	523.1	525.2	527.1	55.3	57.6	60.5
2028	426.8	456.9	491.7	524.1	527.4	530.5	527.0	529.0	530.8	56.2	58.5	61.4
2029	442.3	471.1	505.5	527.4	530.6	533.6	530.8	532.6	534.3	57.2	59.4	62.2
2030	458.1	485.4	518.5	530.1	533.3	536.2	534.4	536.2	537.7	58.1	60.3	63.1
2031	473.8	499.1	529.8	533.1	536.3	539.2	538.1	539.7	541.1	59.0	61.2	63.8



Source: USDA; AGREP.

Fig. 14. Stochastic projection of the export price of Thai long-grain 100% B rice in the next decade.

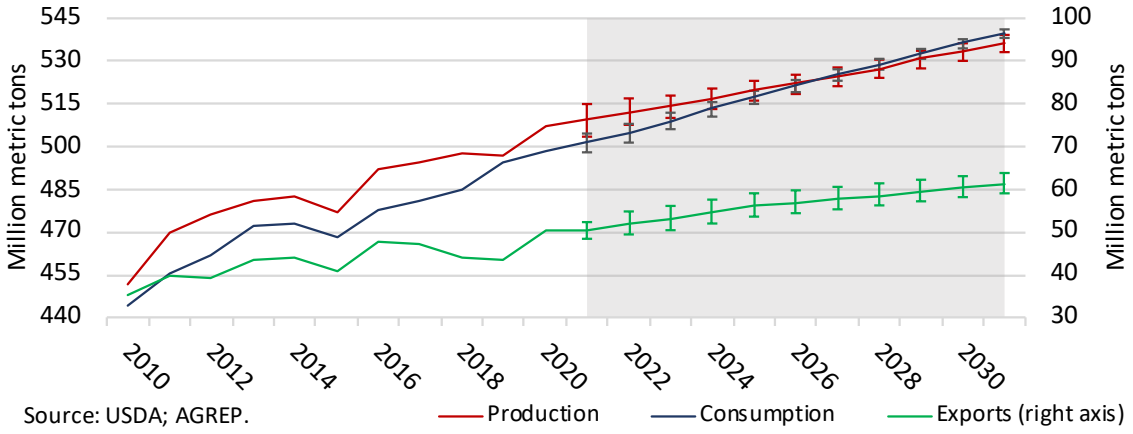


Fig. 15. Stochastic projection of global rice production, consumption, and ending stocks in the next decade.

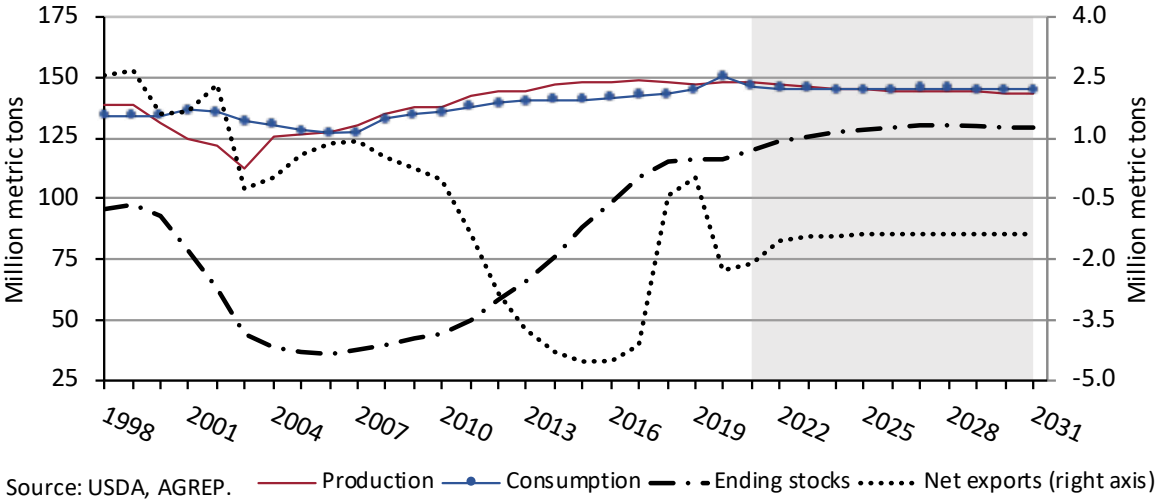


Fig. 16. China rice supply and utilization (exports shown on right axis).

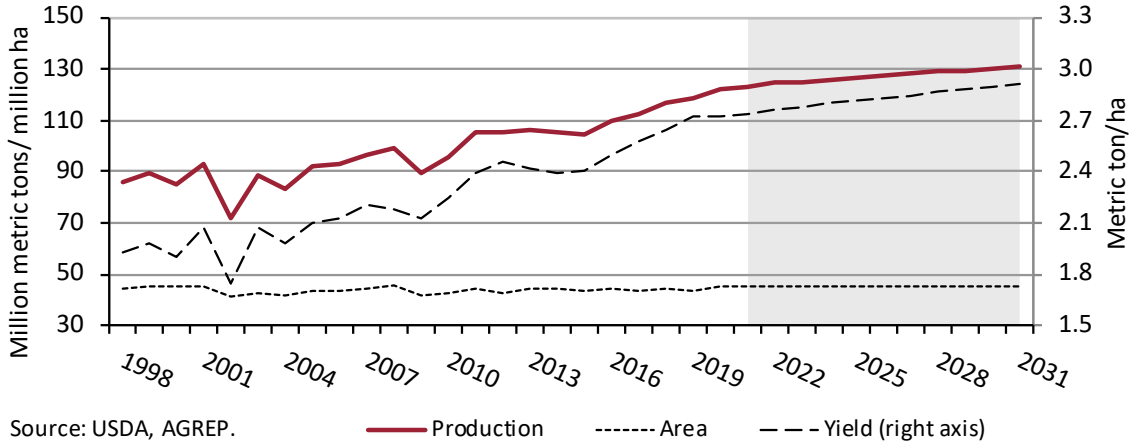


Fig. 17. India's historical and projected rice area, yield, and volume of production.

key questions looming over the rice market is what China will do with its rice stocks, more precisely, whether stocks will continue building up (stats from the last few years suggest a slowdown in stock buildup) or will be disposed of and, if so, how. The scarce evidence from the last few marketing years suggests that China relies on both exports and increased domestic use to curve down stocks. Rice auctions for feed have been ramping up and are seen as the least disruptive way to address the situation. China used 23.5 mmt of old-stock rice as a feedstock in 2020/2021 and is projected to use 21.4 mmt in 2021/2022 (USDA-FAS 2022c). However, China has also been ramping up rice exports, primarily of LG rice destined to Africa and of *japonica* (medium- and short-grain) rice at highly competitive prices to markets in northern Africa (primarily in Egypt), Turkey, and Puerto Rico. Because of the relatively small size of the *japonica* rice market and the large volume of stocks of that type held by China (according to USDA-ERS, 2021, 85% of the existing rice stocks are *japonica* rice), the management of stocks is crucial for that segment of the rice market. Our assumption for the next decade (Fig. 16) is that China will strive to maintain rice stocks at the 2018–2020 level, but we can infer how a change in this assumption could have enormous implications for the global rice market.

India's Rice Yields and Production

India's production record in the last 20 years has been impressive, expanding from 85.0 mmt in 2000 to 122.3 in 2020. This trend in production translates to an average growth rate of 1.84% a year, more than double the global average rate over the same period. The production gain came exclusively from yield improvements since the actual area harvested remained somewhat constant since 2000. Average rice yields grew 1.81% a year from 1.90 metric tons per hectare in 2000 to 2.72 metric tons per hectare in 2020 (Fig. 17). Such productivity growth was mainly due to the development and dissemination of improved production technologies such as high-yielding and flood/drought-tolerant rice varieties, the development of irrigation infrastructure, and the use of chemical fertilizer (Kavi Kumar, 2021; Mahajan et al., 2017). Our projections indicate that rice yields in India will continue to grow but at a much slower pace in the coming decade. We hypothesize that the yield growths of many of the established rice varieties have nearly exhausted, and productivity gains from increasing input use will increase but at a decreasing rate. We project that the rice yield will grow 0.62% a year, and the area will increase slightly by 0.25% annually, leading to a 0.82% average annual increase in production over the next decade. Even with this projected slowdown in production growth, we expect India to remain the largest rice exporter worldwide. If India manages to keep the growth observed in the last two decades (e.g., via increasing adoption of hybrid rice and irrigation), then we can expect that the international rice market will find an equilibrium at much lower prices than what our projections suggest, which will have strong implications for the patterns of production and consumption worldwide.

Price Gaps Between Asian and Western Hemisphere Rice

Historically, long-grain rice exports from the Western Hemisphere (e.g., the U.S. and Mercosur) have been priced higher than most of those originating from Asia. To illustrate, Fig. 18 shows that the nominal and relative premium has varied widely but in general trended downward from 1982 until the rice market crisis of 2007/2008, when the international market price of Thai 100%B rice tripled from $335/mt to over $1000/mt (Dawe and Slayton, 2010). The price premium remained close to zero and even reversed in 2012 when Thailand launched its ambitious rice-pledging program, resulting in higher Thai rice prices and lower export competitiveness. Nonetheless, the price premium increased sharply in 2013 and has been 35% on average since 2015. We forecast that the gap will peak in 2021 and steadily decrease thereafter until reaching 34% in 2029–2031. One of the main reasons supporting the price gap between Western Hemisphere and Asian rice is the level of trade integration in the former

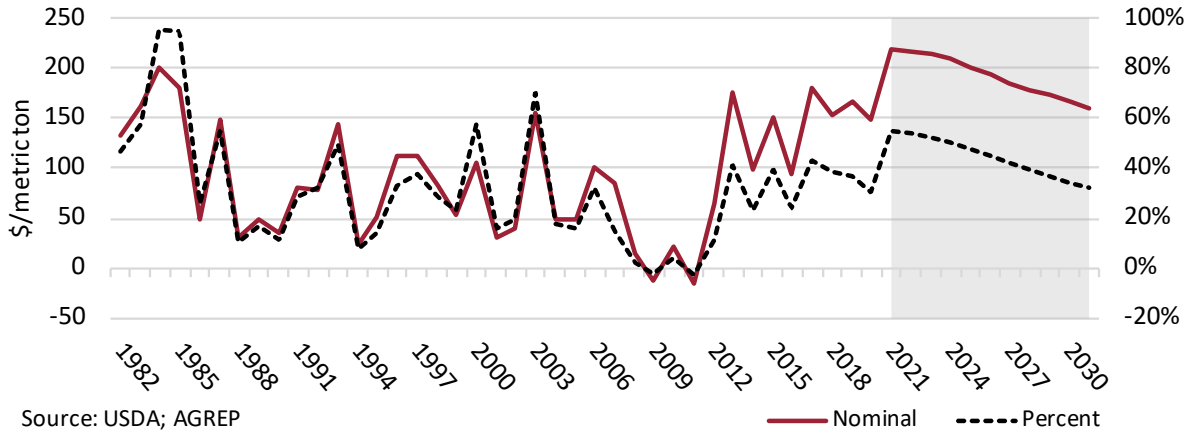


Fig. 18. The price gap between Thai 100%B and U.S. #2 long-grain rice (percent = price gap/price of Thai 100%B).

and the fact that most rice trade remains regional and benefits from a preferential trade policy treatment. Another reason for the price gap that is often cited anecdotally by rice traders (although not well referenced scientifically) is the difference in quality that results, among other things, from having a more modern milling industry in the Western Hemisphere. We argue that some market and policy developments could reduce the price premium in the coming decade. For instance, trade integration between Western Hemisphere and Asian countries (e.g., Trans-Pacific Partnership) may create a more leveled playing field and improve the competitiveness of Asian rice in key core markets in the Americas. Additionally, upgrades in the rice supply chains across Asia are ongoing and resulting in high-quality rice that can compete very well in the most demanding markets.

Summary and Conclusion

Rice is a crucial global staple and the cornerstone of food security programs around the world and remains one of the most regulated global staple foods. Hence, understanding the future behavior of the global rice market is of the utmost importance from a food security point of view, as well as from an economic perspective, since rice is the main source of income for millions of rice farmers and agents throughout the rice supply chain around the world. This report outlines the main findings from the 2021–2031 baseline projections of the global rice market outlook developed by the Arkansas Global Rice Economics Program.

Based on the results from model simulations, over the next decade, the overall rice story is that global production and consumption will continue to grow strong, with a marginal deficit developing by the end of the projected period.

At the regional level, most of the nominal growth in production and consumption is expected to happen in Asia, but Africa is projected to become more relevant from a production and consumption point of view in the next decade. Africa is projected to account for the vast majority of the growth in imports in the next decade, surpassing Asia as the largest rice importer in 2029–2031.

At the country level, rice production is projected to decrease in China, Japan, South Korea, and Brazil and grow the most in Tanzania, Nigeria, Cambodia, and Peru relative to the production level observed in 2018–2020. On the other hand, total rice consumption is projected to decline in China, Japan, South Korea, and Brazil and increase strongly in the African nations of Madagascar and Nigeria, as well as Pakistan and Iran.

These differential changes in production and consumption across countries will push global rice trade to new records. India will continue to be a leader on the export side, while Thailand is projected to secure its place as the second-largest exporter of rice. Rice exports will continue to be highly concentrated among the top 5 largest exporters.

The global rice market is subject to many factors that could alter its projected path. Among the key factors to keep an eye on in the future because of their potential impact on the global rice market, we highlight the following three: (1) China's rice stock management, (2) India's yield and overall production trend, and (3) the price gap between Asian and American LG rice. In the short term, the behavior of the rice market, as well as the entire economy, depends largely on the evolution of the conflict in Ukraine as well as the lingering effects of COVID-19.

Literature Cited

Bairagi, S., S. Mohanty, S. Baruah, and H.T. Thi. 2020. Changing food consumption patterns in rural and urban Vietnam: Implications for a future food supply system. Australian J. Agric. Resource Econ. 1–26. https://doi.org/10.1111/1467-8489.12363

Bairagi, S., B.S. Zereyesus, and S. Mohanty. 2022. Structural Shifts in Food Basket Composition of Rural and Urban Philippines: Implications for the Food Supply System. PLoS ONE (forthcoming).

Blas, J. 2022. All That's Stopping a Full-Blown Food Crisis? Rice. Bloomberg. March 25, 2022. Washington Post. https://www.washingtonpost.com/business/all-thats-stopping-a-full-blown-food-crisis-rice/2022/03/24/dd15331e-ab40-11ec-8a8e-9c6e9fc7a0de_story.html

Dawe, D. and T. Slayton. 2010. The World Rice Market Crisis of 2007-2008. In: Dawe, D. (ed.) The Rice Crisis: Markets, Policies and Food Security (1st ed.). Routledge. https://doi.org/10.4324/9781849776684

Kavi Kumar K.S. 2021. Rice Production Systems and Drought Resilience in India. *In*: Dasgupta P., Saha A.R., and Singhal R. (eds.) Sustainable Development Insights from India. India Studies in Business and Economics. Springer, Singapore. https://doi.org/10.1007/978-981-33-4830-1_15

Kotz, S., N. Balakrishnan, and N.L. Johnson. 2000. Continuous Multivariate Distributions, Volume 1: Models and Applications. John Wiley & Sons, Inc.

Kruseman, G., K.A. Mottaleb, K. Tesfaye, S. Bairagi, R. Robertson, D. Mandiaye, A. Frija, S. Gbegbelegbe, A. Alene, and S. Prager. 2020. Rural transformation and the future of cereal-based agri-food systems. Global Food Security, 26. https://doi.org/10.1016/j.gfs.2020.100441

Mahajan G., V. Kumar, and B.S. Chauhan. 2017. Rice Production in India. *In*: Chauhan B., Jabran K., Mahajan G. (eds.) Rice Production Worldwide. Springer, Cham. https://doi.org/10.1007/978-3-319-47516-5_3

Mane, R. and E. Wailes. 2012. Impact of trade liberalization in rice: Assessing alternative proposals. J. Int. Agric. Trade Devel., 8(1):25–41.

Mottaleb, K.A., D.B. Rahut, G. Kruseman, and O. Erenstein. 2018. Evolving food consumption patterns of rural and urban households in developing countries: A Bangladesh case. British Food J. 120(2):392–408. https://doi.org/10.1108/BFJ-12-2016-0620

Pingali, P. 2015. Agricultural policy and nutrition outcomes – getting beyond the preoccupation with staple grains. Food Security, 7(3):583–591. https://doi.org/10.1007/s12571-015-0461-x

Ripley, B. D. 1987. Stochastic simulation. John Wiley & Sons, Inc.

Rubinstein, R.Y. and D.P. Kroese. 2017. Simulation and the monte carlo method. Third Edition. John Wiley & Sons, Inc., Hoboken, New Jersey.

USDA-ERS. (2021). United States Department of Agriculture-Economic Research Service. Rice Outlook: May 2021. RCS-21D; https://www.ers.usda.gov/publications/pub-details/?pubid=101195

USDA-FAS (2022a). United States Department of Agriculture-Foreign Agricultural Service. India Grain and Feed Annual–June 8, 2022. Global Agricultural Information Network Report Number IN2022–0052. https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Update_New%20Delhi_India_IN2022-0052

USDA-FAS. 2022b. United States Department of Agriculture-Foreign Agricultural Service. Production, Supply and Distribution database. https://apps.fas.usda.gov/psdonline/app/index.html#/app/home

USDA-FAS. 2022c. United States Department of Agriculture-Foreign Agricultural Service. China Grain and Feed Annual–April 6, 2022. Global Agricultural Information Network Report Number CH2022–0041. https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Beijing_China%20-%20People%27s%20Republic%20of_CH2022-0041

Van Oort, P.A.J., K. Saito, A. Tanaka, E. Amovin-Assagba, L.G.J. Van Bussel, J. Van Wart, H. De Groot, M.K. Van Ittersum, K.G. Cassman, M.C.S. and Wopereis. 2015. Assessment of rice self-sufficiency in 2025 in eight African countries. Global Food Security, 5:39–49. https://doi.org/10.1016/j.gfs.2015.01.002

Wailes, E., and E. Chavez. 2011. 2011 updated Arkansas Global Rice Model. https://doi.org/10.22004/ag.econ.102650

APPENDIX

Table A1. Country-wise changes in rice production and consumption around the world.

Country	Production			Consumption		
	2018–2020	2029–2031	% Change	2018–2020	2029–2031	% Change
	1000 metric tons					
East Asia & Pacific						
Australia	138	619	16.2%	330	433	2.7%
Brunei	1	1	0.0%	25	36	3.8%
Cambodia	5755	6882	1.8%	4317	5017	1.5%
China	147840	143542	-0.3%	146243	145096	-0.1%
Hong Kong				307	385	2.3%
Indonesia	34733	36805	0.6%	36033	37731	0.5%
Japan	7614	7323	-0.4%	8333	7639	-0.9%
Laos	1727	2604	4.2%	1850	2137	1.5%
Malaysia	1817	2095	1.4%	2850	2971	0.4%
Myanmar	12817	14611	1.3%	10400	11532	1.0%
Philippines	12025	13301	1.0%	14283	16015	1.2%
Singapore				362	318	-1.3%
Korea, South	3706	3523	-0.5%	4224	3715	-1.3%
Taiwan	1282	1144	-1.1%	1173	1170	0.0%
Thailand	18953	21751	1.4%	12267	12919	0.5%
Vietnam	27275	29621	0.8%	21300	22529	0.6%
South Asia						
Bangladesh	35120	37616	0.7%	35733	38734	0.8%
India	119207	130373	0.9%	100372	108334	0.8%
Pakistan	7600	8767	1.4%	3433	4640	3.1%
Sri Lanka	3243	3586	1.0%	3100	3467	1.1%
Middle East & North Africa						
Egypt	3700	4142	1.1%	4267	4939	1.5%
Iran	1995	2247	1.2%	3167	4018	2.4%
Iraq	222	333	4.2%	1352	1862	3.3%
Saudi Arabia				1350	1756	2.7%
Sub-Saharan Africa						
Cameroon	202	334	5.1%	761	1347	5.9%
Ivory Coast	1164	1536	2.8%	2483	3808	4.4%
ECOWAS-7[a]	813	977	1.9%	2995	5258	5.8%
Ghana	580	772	2.9%	1467	2154	3.9%
Guinea	1680	2395	3.6%	2267	3148	3.3%
Kenya	86	97	1.2%	693	1314	6.6%
Liberia	168	252	4.2%	490	727	4.0%
Madagascar	2665	2735	0.3%	3099	3948	2.5%
Malawi	83	81	-0.2%	98	140	3.7%
Mali	2032	2252	1.0%	2333	3553	4.3%
Mozambique	239	378	4.7%	846	1465	5.6%
Nigeria	4823	5853	2.0%	6850	9565	3.4%
Rwanda	58	96	5.1%	98	350	13.6%
Senegal	842	943	1.1%	1875	2685	3.7%

Continued

Table A1. Country-wise changes in rice production and consumption around the world, *continued.*

Country	Production			Consumption		
	2018–2020	2029–2031	% Change	2018–2020	2029–2031	% Change
	1000 metric tons					
Sub-Saharan Africa, *continued*						
Sierra Leone	942	1375	3.9%	1342	1711	2.5%
South Africa				898	988	1.0%
Tanzania	2286	3442	4.2%	2442	3724	4.3%
Uganda	144	173	1.8%	214	412	6.8%
Zambia	30	39	2.6%	40	55	3.2%
Latin America & Caribbean						
Argentina	803	1072	2.9%	508	610	1.8%
Brazil	7581	7562	0.0%	7367	7276	-0.1%
Chile	105	154	4.0%	268	326	2.0%
Colombia	1814	1999	1.0%	1893	2170	1.4%
Costa Rica	98	118	1.9%	237	246	0.4%
Cuba	252	236	-0.7%	706	787	1.1%
Dominican Republic	623	682	0.9%	623	718	1.4%
Guatemala	19	43	8.2%	133	205	4.5%
Guyana	666	885	2.9%	192	249	2.7%
Haiti	70	83	1.7%	572	691	1.9%
Honduras	60	104	5.7%	198	269	3.1%
Mexico	188	226	1.9%	943	1125	1.8%
Nicaragua	274	349	2.4%	380	445	1.6%
Panama	230	285	2.1%	325	402	2.2%
Paraguay	707	1003	3.6%	60	82	3.2%
Peru	2277	2689	1.7%	2508	3175	2.4%
Uruguay	867	971	1.1%	40	57	3.6%
Venezuela	153	245	4.8%	673	968	3.7%
North America						
Canada				424	461	0.8%
United States	6736	7128	0.6%	4670	5106	0.9%
Europe & Central Asia						
Turkey	604	667	1.0%	805	822	0.2%
EU27+UK	1969	2167	1.0%	3347	4265	2.5%
The rest of the world	9605	9879	0.3%	16805	21885	2.7%
World	501304	533163	0.6%	492039	536089	0.9%

[a] ECOWAS-7 = Benin, Burkina, Gambia, Guinea-Bissau, Niger, Togo, and Cape Verde.

Table A2. Country-wise changes in rice trade.

Country	2018–2020	2029–2031	Nominal Change	Country	2018–2020	2029–2031	Nominal Change
			1000 metric tons				
Exporters							
India	14,368	21,779	7,411	EU 28	492	491	-0.3
Thailand	6,389	9,196	2,807	Australia	84	378	294
Vietnam	6,333	7,581	1,249	Peru	75	22	-53
Pakistan	4,063	4,362	299	Guinea	77	30	-47
United States	2,977	3,164	187	Cote d'Ivoire	58	25	-33
Myanmar	2,317	3,076	760	Egypt	15	20	5
China	2,531	2,670	139	Japan	60	70	10
Cambodia	1,517	1,893	376	Turkey	213	220	7
Brazil	949	900	-49	Tanzania	30	30	0
Uruguay	824	914	90	Venezuela	0	0	0
Paraguay	704	927	223	Senegal	30	60	30
Guyana	477	633	156	Sri Lanka	7	5	-2
Argentina	354	472	118	Laos	-117	-50	67
				Rest of world	1124	1430	306
Total Exports					**45,950**	**60,299**	**14,349**
Importers							
China	3,433	4,032	599	Canada	439	461	22
Nigeria	1,733	3,716	1,983	Sierra Leone	400	338	-62
ECOWAS-7[a]	2,183	4,285	2,102	Egypt	447	766	319
Philippines	2,750	3,112	362	Liberia	323	476	153
EU 28	1,863	2,524	661	Sri Lanka	19	-109	-129
Cote d'Ivoire	1,227	2,333	1,107	Hong Kong	307	385	79
Saudi Arabia	1,413	1,758	345	Peru	280	475	196
Iran	1,117	1,801	685	Singapore	362	318	-44
Bangladesh	607	1,123	516	Turkey	461	373	-88
Iraq	1,188	1,540	352	Tanzania	187	315	128
Senegal	1,100	1,817	717	Thailand	233	225	-8
South Africa	1,007	1,104	97	Mali	300	1305	1005
Indonesia	583	926	343	Australia	230	175	-55
Malaysia	1,107	957	-150	Chile	171	174	3
United States	1,063	1,168	105	Costa Rica	149	128	-21
Mexico	795	923	128	Colombia	187	200	12
Ghana	920	1,389	469	Honduras	138	169	31
Guinea	690	786	96	Uganda	80	249	169
Japan	674	682	8	Taiwan	109	100	-9
Brazil	777	615	-162	Guatemala	113	163	50
Kenya	598	1,232	633	Nicaragua	108	103	-5
Mozambique	607	1,088	482	Panama	77	118	41
Cameroon	558	1,015	457	Brunei	24	35	11
Cuba	454	553	98	Rwanda	40	256	216
Haiti	498	609	111	Dominican Rep.	28	46	18
Vietnam	900	500	-400	Malawi	15	59	44
Venezuela	535	726	192	Zambia	10	17	7
South Korea	391	411	20	Pakistan	7	7	0
Madagascar	434	1,216	782	Paraguay	2	2	0
				Rest of world	9499	9028	-471
Total Imports					**45,950**	**60,299**	**14,349**

[a] ECOWAS-7 = Benin, Burkina, Gambia, Guinea-Bissau, Niger, Togo, and Cape Verde.

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