International Rice Outlook: International Rice Baseline Projections 2023–2033

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AGREP

Arkansas Global Rice Economics Program

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ACKNOWLEDGMENTS

Required citation: Durand-Morat, A. and Mulimbi, W. (2024). International Rice Outlook: International Rice Baseline Projections 2023–2033. The Arkansas Global Rice Economics Program (AGREP), University of Arkansas, Fayetteville, AR.

International Rice Outlook:
International Rice Baseline Projections 2023–2033

Alvaro Durand-Morat and Willy Mulimbi[1]

Highlights

- We project that global rice consumption will exceed global rice production for most of the coming decade, with stocks playing a crucial role in balancing the global market along the projected period.
- The projected growth in production is almost exclusively due to productivity gains.
- The projected global rice consumption is growing, mostly driven by population growth. However, the average global per capita rice consumption is estimated to drop slowly in the coming decade due to per capita consumption decline in Asia, the largest rice-consuming region worldwide.
- The international prices of long-grain and medium-grain rice are 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 in the projected decade. India will remain the largest exporter of rice, while Thailand will consolidate as the second-largest exporter in the coming decade.
- On the rice import side, we project that China, Indonesia, the EU, and Saudi Arabia will lose market share, while the Philippines, Nigeria, Cote d'Ivoire, and Iran will grow their market shares by 2031–2033 relative to the situation in 2020–2022.

Introduction

The increasing rice prices noticed in Asia since 2022 kept trending up in 2023 mainly due to rice export restrictions implemented by the government of India (Fig. 1). The upward trend in global export prices started in September 2022 when India implemented a 20% export tariff on brown and unmilled long-grain (LG) rice, and a complete ban on exports of broken rice, with the goal of reducing rice prices in the domestic market. Fears about the potential negative impact of El Niño on production in 2023 and mounting political pressure to control rice price inflation led India to implement an export ban on non-basmati rice in July 2023, which is still in effect in May 2024. Despite the projection of a very good 2023–2024 crop (estimated at 134 million metric tons (mmt), only slightly below the record-high production of 135.8 mmt in 2022–2023), India still maintains the export ban, but is allowing government-to-government exports.

The export prices out of Thailand, Vietnam, and Uruguay increased respectively by 25%, 31%, and 43% since the implementation of India's export ban, while U.S. LG export prices remained flat, effectively improving the competitiveness of U.S. rice. (Fig. 1). The international price for medium-grain (MG) rice increased sharply in 2022, primarily due to the short production in California and the European Union. The Free on Board (FOB) price of California's MG averaged $1,633/metric ton (mt) in 2022 but has dropped to more normal levels as the new 2023 crop entered the market.

In the first eight months of the current 2023–2024 marketing year, the U.S. negotiated 3.71 mmt (paddy basis) of exports (2.75 mmt of LG and 0.96 mmt of MG), a 56% increase relative to the same period last year (60% and 45% increase for LG and MG, respectively). The U.S. is regaining the Mexican market lost largely to Brazil in 2023. From August 2023 to March 2024, exports of U.S. LG rice to Mexico reached 689 thousand metric tons (tmt) relative to 156 tmt during the same period last year.

The primary goal of this report is to present the main findings of our 2023–2033 baseline projections for the global rice market. The projected period includes the ongoing 2023 marketing year since, at the time of the estimation, a large share of the 2023 rice crop in the northern hemisphere and most of the 2023 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 occurred since January 2024.

Materials and Methods

Arkansas Global Rice Model (AGRM)

The Arkansas Global Rice Model (AGRM) generates a baseline projection of the global rice economy. The AGRM is

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a partial equilibrium economic model that covers over 70 rice-producing, -consuming, and -trading countries worldwide. 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: LG and MG rice. Domestic support and trade policies are embedded in the model equations.

The AGRM can be specified mathematically with the following system of linear equations (1–14; demand, supply, and price transmission). Where the subscripts c, r, and t, respectively, are the country, rice types (LG and MG), 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 to calibrate the AGRM model came from S&P Global, representing the projections as of January 2024. The projections suggest that, globally, the economic growth rate will slow in the next decade (2.6% a year) compared to the last (2.8%). Looking at the top-5 rice-consuming countries, the projections over the next decade point to a decreasing rate of economic growth for China, Bangladesh, India, and

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

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

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

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

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

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

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

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

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

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

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

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

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

$$TD_{c,r,t} = TS_{c,r,t} \quad (14)$$
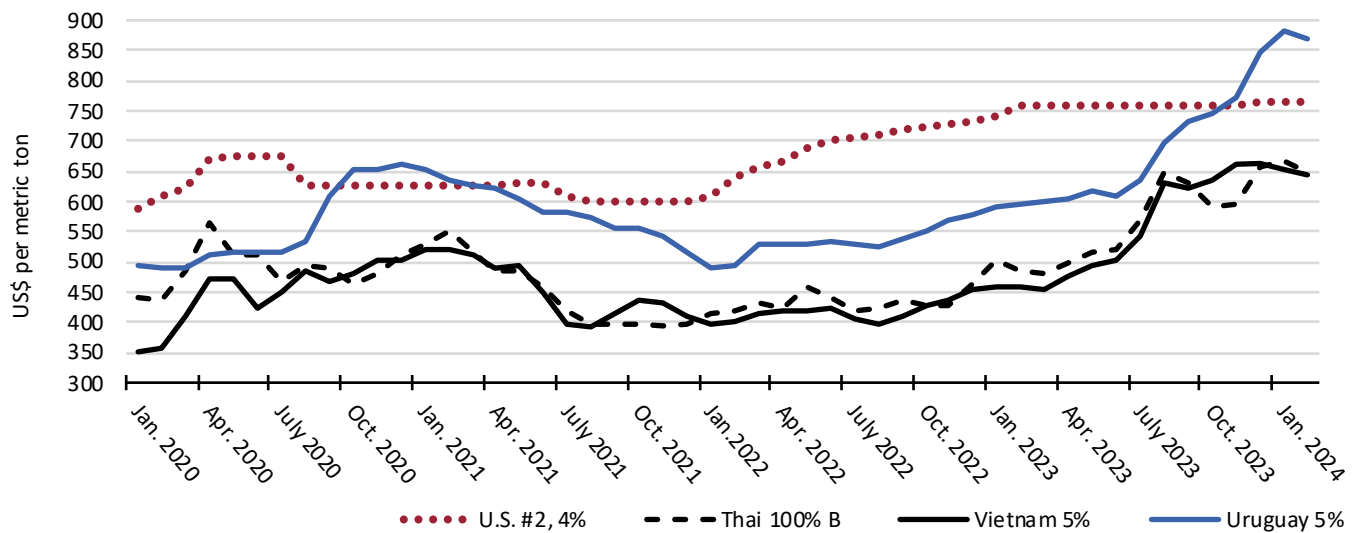
Source: USDA Rice Outlook, FAO Rice Price Update

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

Indonesia and a positive rate of growth for Vietnam (Fig. 2). Looking at the largest rice markets in the Western hemisphere, the projections suggest an increase in the rate of economic growth in Colombia and Peru, small and constant growth in Brazil, and a slowdown in the U.S.economic growth over the next decade.

The global population is projected to grow over the next decade but at a lower rate (0.8% a year) than that observed in the last decade (1.1% a year) and is expected to reach 8.73 billion by 2033. The population growth rate will decline across all regions but most severely among developed countries. For instance, the population growth rate is expected to decrease to 0.24% a year among the Organization for Economic Cooperation and Development (OECD) countries, relative to 0.50% in the last decade. Among developing countries, the population is expected to grow at 1.96% a year in the coming decade, relative to 2.18% 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). Most notoriously is the projected decrease in population in China from 1.426 billion in 2023 to 1.407 billion in 2033.

Stochastic Simulation Method

A stochastic component based on the probabilistic distribution of rice yields has been integrated into the AGRM. The stochastic framework is generated using multivariate empirical distributions (MVE) of the deterministic yields. Yield is chosen as the stochastic variable because it varies by year and country and is very sensitive to seasonal changes, weather conditions, and water availability—factors that are critical for rice production. The stochastic rice yields are simulated using @Risk© (Palisade, Ithaca, N.Y.) based on historical rice yield data from 1993 to 2022. For each country, the distribution of

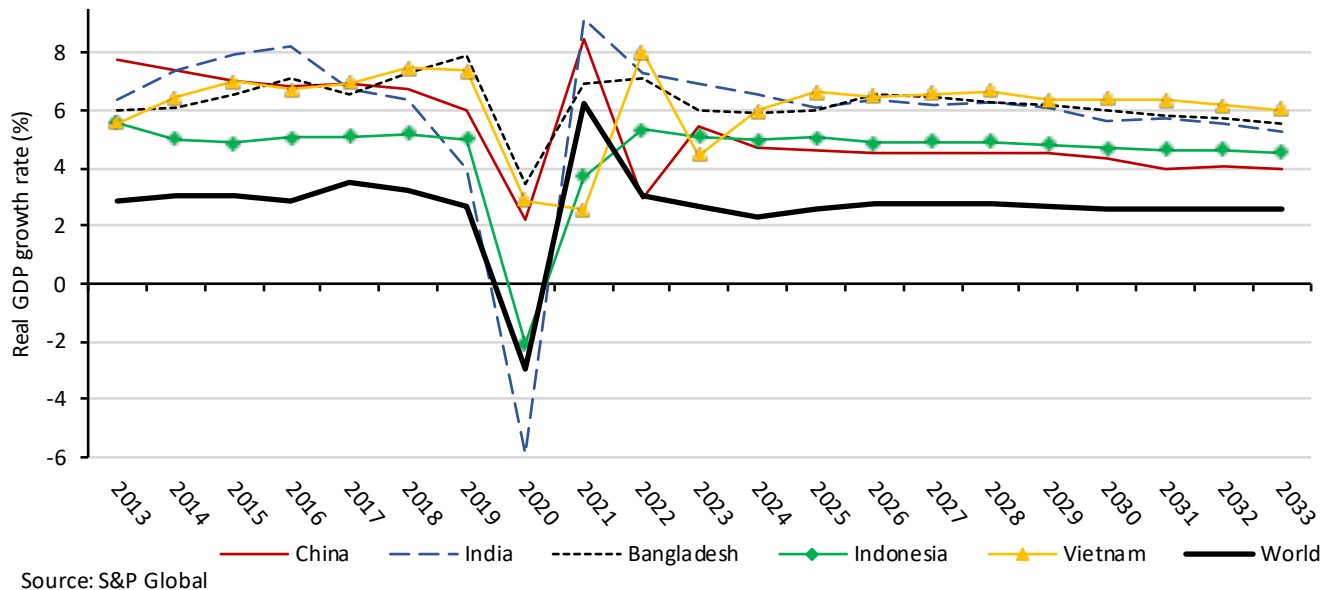
Source: S&P Global

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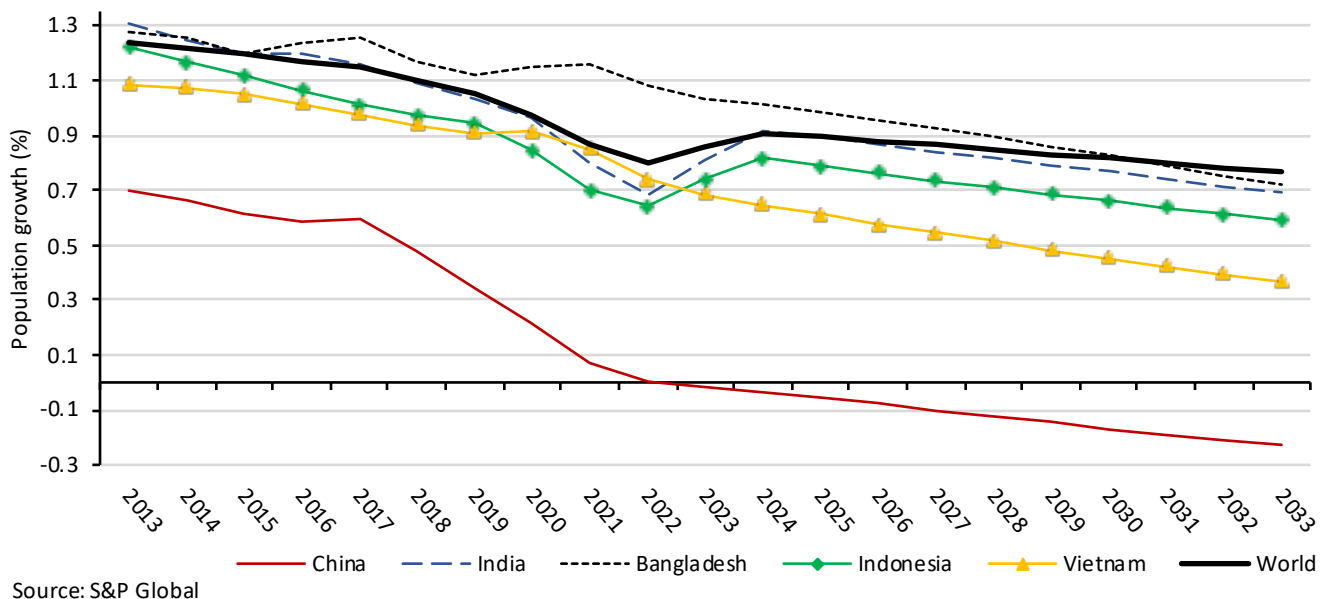

Source: S&P Global

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

detrended residuals is estimated and used to simulate yield variability in the next decade, accounting for yield correlation across countries. Finally, 100 random yield observations are drawn to generate stochastic results.

Results and Discussion

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

The current and projected global rice supply and utilization are presented in Table 1. Since 2021, and after more than a decade of surpluses, global consumption has outpaced global production by an average of 5 mmt a year, and we project the deficit situation to continue over the next decade. Production is projected to reach 547.9 mmt a year in 2031–2033, that is, a 7.09% increase from the average 2020–2022 level, based mainly on rice yield gains. Global consumption is projected to grow by 8.08% over the next decade and reach 552.5 mmt a year on average in 2031–2033, driven mostly by increases in per-capita consumption. The stock-to-use ratio reached its highest value (37.7%) in 2020 and decreased thereafter to 33.8% in 2022, averaging 35.7% in 2020–2022. We project the stock-to-use ratio will decrease steadily and reach 22.7% in 2031–2033, driven primarily by a decrease in rice stocks in China.

Despite the growth in rice trade relative to supply observed over the last two decades, rice remains thinly traded, with only 10.6% of the production traded internationally in 2020–2022, compared to 16% for corn and 26.7% 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 countries where rice is the staple food. We project that the share of rice production that is traded internationally will grow marginally to 11.0% by 2031–2033 as consumption continues to grow and outpace production in many importing regions, including Africa and the Middle East.

Despite the high global stock levels, rice prices have trended upward since 2015, which may reflect that most rice stocks are not readily available for trade but play an important food security role in some markets. China and India held 81% of the global rice stocks in 2020–2022. Excluding India, the stocks held by the top five rice exporters (Thailand, Vietnam, Pakistan, and the U.S.), which may be deemed as readily tradable, amounted to 5.2% of the global rice stocks in 2020–2022, down from 11.2% in 2013–2015.

The international price of 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 1.37% from its 2020–2022 level, reaching an average of $530/mt in 2031–2033, while the price of U.S. LG (#2 LG Gulf) will decrease by 1.01% a year from its 2020–2022 level and reach $604/mt by 2031–2033 (Fig. 4). The price gap between LG rice from Asia and the Western Hemisphere is expected to narrow down over the next decade, which assumes that Asian rice will increase its presence in core markets in the Western Hemisphere and, thus, compete more directly with U.S. and Mercosur rice. Following its highest value in the 2022 crop year, the international nominal price of MG rice, represented by the U.S. #2 MG (FOB California), is projected to decline more markedly in the short run (from 2023 to 2027) and flatten at around $930–950/mt thereafter. In real terms (adjusting for inflation), the international price of LG (Thai LG 100% B) and MG rice (U.S. #2 MG California) are projected to drop over the next decade.

At the regional level, Asia is projected to account for the bulk (27 mmt out of the 36.3 mmt increase, or 74.5%) of the growth in rice production in the next decade, followed by Africa with 7 mmt or 19.4% of the growth, and America with 1.7 mmt or 4.6% of the growth (Fig. 5). Africa's share of total production is expected to expand, and Asia's share is expected to decline by 2031–2033 relative to 2020–2022. Africa will experience the largest growth in production from 23.9 mmt a year in 2020–2022 to 30.9 mmt a year in 2031–2033. The efforts to bolster production in Africa following the rice crisis of 2007–2008 manifested in an impressive 4.94% average annual growth in the last fifteen years. We project that rice production in Africa will continue to grow in the coming decade but at a slower pace than that shown last decade.

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

Attributes	2020–2022 Average	2031–2033 Average	Nominal Change	% Change
Area Harvested (1000 ha)	165,476	168,984	3,508	2.12%
Yield (kg/ha)	3.09	3.24	0.15	4.87%
Production	511,619	547,914	36,296	7.09%
Beginning Stocks	184,264	126,461	-57,803	-31.37%
Domestic Supply	695,883	674,375	-21,507	-3.09%
Consumption	511,218	552,525	41,307	8.08%
Ending Stocks	182,299	125,316	-56,983	-31.26%
Total Exports	54,172	60,355	6,183	11.41%
Stock-to-use Ratio[a] (%)	35.66	22.68	-12.98	-36.40%

[a] Globally, the stock-to-use ratio is estimated as ending stocks over consumption.

Source: USDA; AGREP

Thai LG 100% B ······ U.S. #2 LG Gulf – – – U.S. #2 MG CA ———

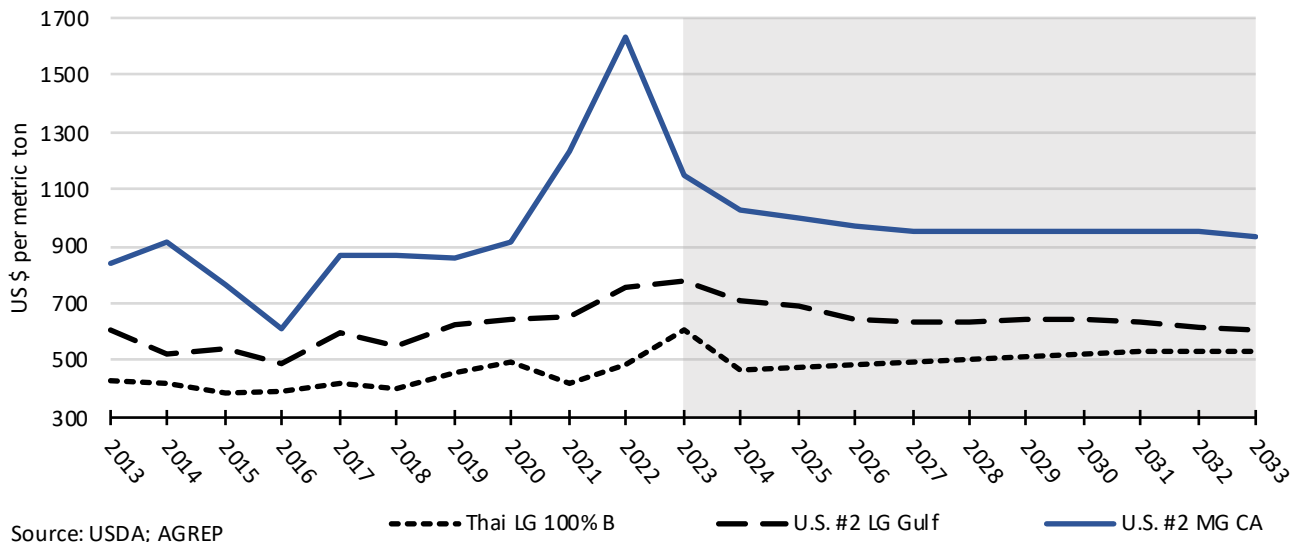**Fig. 4. The nominal international price of long-grain (LG) and medium-grain (MG) rice. The gray-shaded area represents the projected period between 2023 and 2033.**
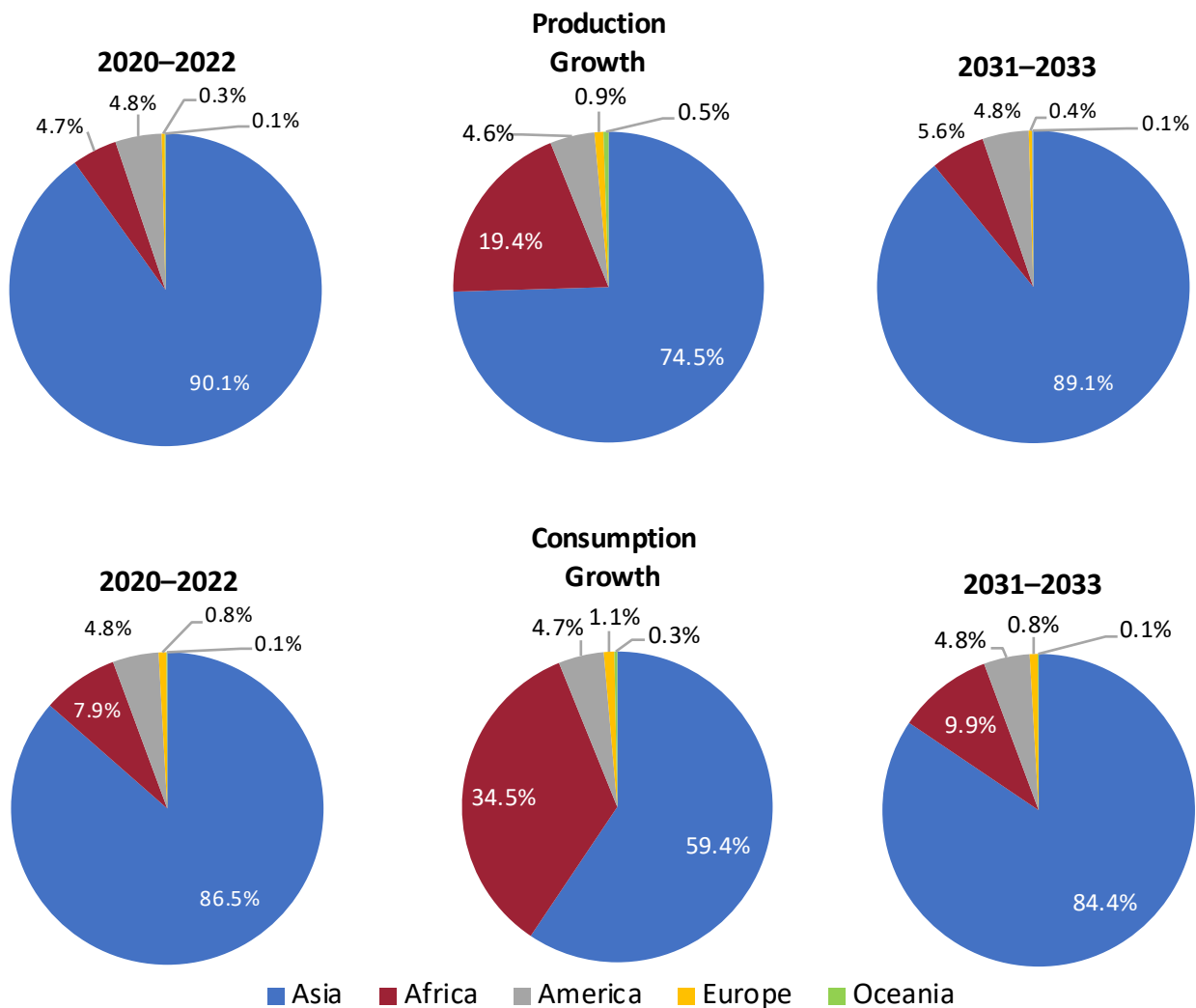

Production Growth

2020–2022

2031–2033

Consumption Growth

2020–2022

2031–2033

Asia   Africa   America   Europe   Oceania

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

On the consumption side, the projections are broadly consistent with those on the production side. Asia is projected to account for the largest nominal growth in consumption (59.4%, or 24.5 mmt out of the 41.3 mmt). Africa will experience the second largest growth in consumption in nominal terms, with 14.2 mmt or 34.5% of the projected growth (Fig. 5). Africa is expected to maintain an impressive growth in consumption over the next decade, increasing rice consumption from 40.3 mmt in 2020–2022 to 54.5 mmt in 2031–2033, a 35.3% increase. In the last decade, rice consumption in Africa grew 54.4% due to rapid growth in per capita consumption and population. We project that growth will slow down but still remain strong in the coming decade. Africa's share of global consumption is projected to increase over the next decade and reach 9.9% of global rice consumption in 2031–2033 (Fig. 5).

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 59.8% of the growth in imports in the next decade. On the export side, Asia accounts for the bulk (89.3%) of the growth projected in the coming decade, thanks to the good export performance of India and, to a lesser extent, Thailand and Vietnam (Fig. 6).

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

Rice Consumption. In several developing countries, the food basket is expected to 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). As such, 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).

In the next decade, rice consumption in Asia will increase purely based on population growth as the regional per-capita consumption is expected to decline. Total consumption is projected to increase in most Asian countries except Japan, South Korea, and Indonesia (Fig. 7). Total rice consumption
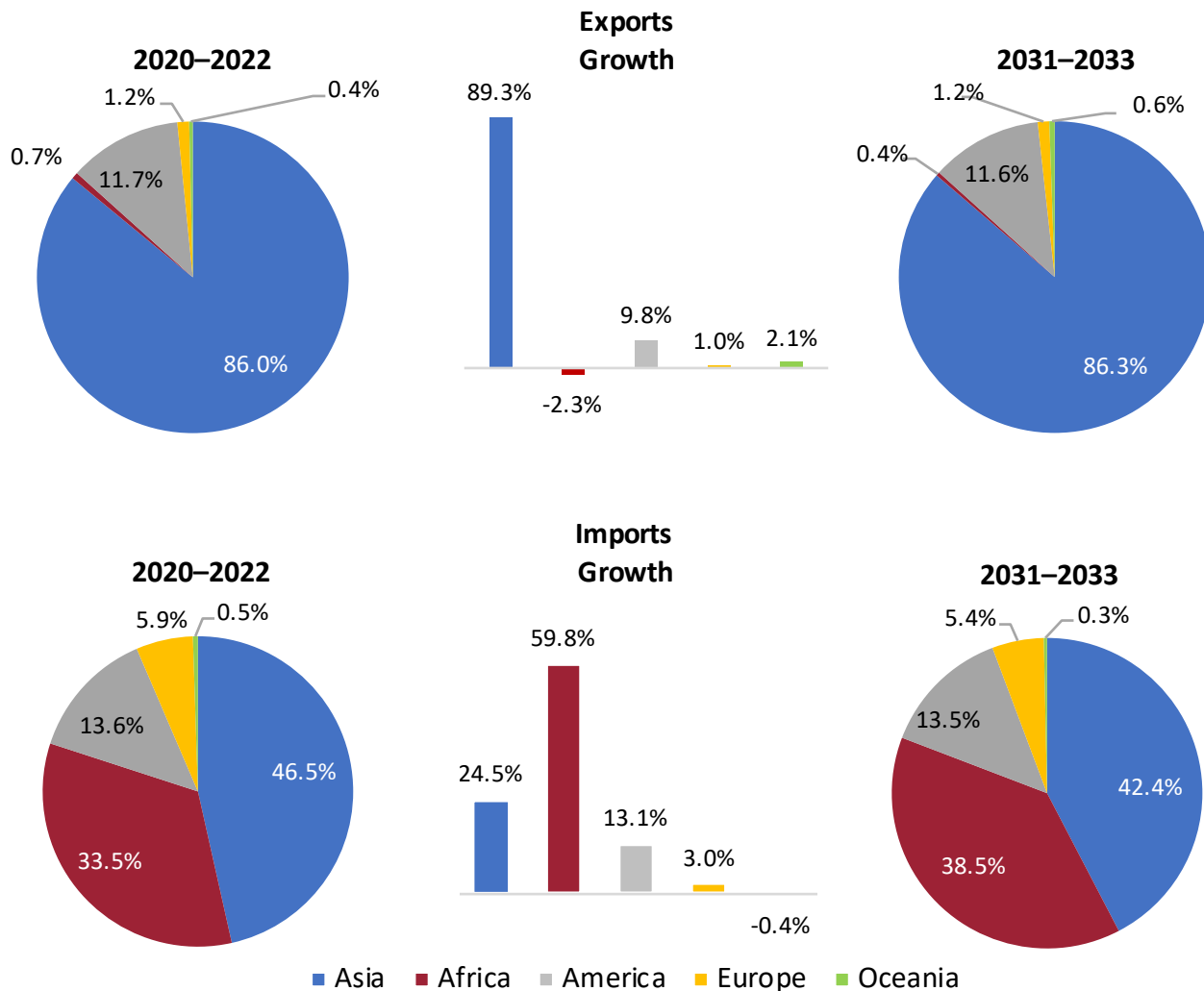

Fig. 6. The projected trend of regional rice export and import shares over the next decade.

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is projected to increase strongly across most African countries based on higher per capita consumption (supported partly by growing income levels in some countries where rice is a normal good) and strong population growth (Van Oort et al., 2015). For instance, looking at the largest rice markets in the continent, we project that total consumption in Tanzania will grow by 69% over the next decade, driven by an increase in population and per-capita consumption. Rice consumption in Nigeria, Madagascar, and Egypt is expected to grow 24.7%, 23.7%, and 9.3%, respectively, over the next decade. Finally, rice demand is projected to grow in all Latin American countries except Brazil, the largest rice market outside Asia, where a 10.9% decline in per capita consumption will drive a 6.2% decline in total rice consumption by 2031–2033. 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 increase slightly by 3.3% over the next decade based solely on yield gains as the area har-

vested is expected to decline marginally (Fig. 8). On the other hand, we project that production in India will continue to grow at 0.85% annually supported by yield and area gains. The future path of rice yields in India remains a key variable that could greatly impact the global rice market in the coming decade. In Nigeria, Africa's largest rice producer, we project rice area and yield to continue growing, increasing production by 16.7% by the end of the next decade. In Tanzania, we project a 69% increase in rice production, driven by yield improvements and an increase in area. 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. Brazilian rainfed rice area stood at an average of 25% of the total area in 2015–2020, relative to 38% in the 1990s. We project the rice area will decrease by 17.6% and rice yields increase by 11.75% by the end of the next decade, leading to a 7.9% decrease in rice production. In Peru, the second-largest rice producer in Latin America, we project rice area and yields to grow, leading to a 12% increase in production by the
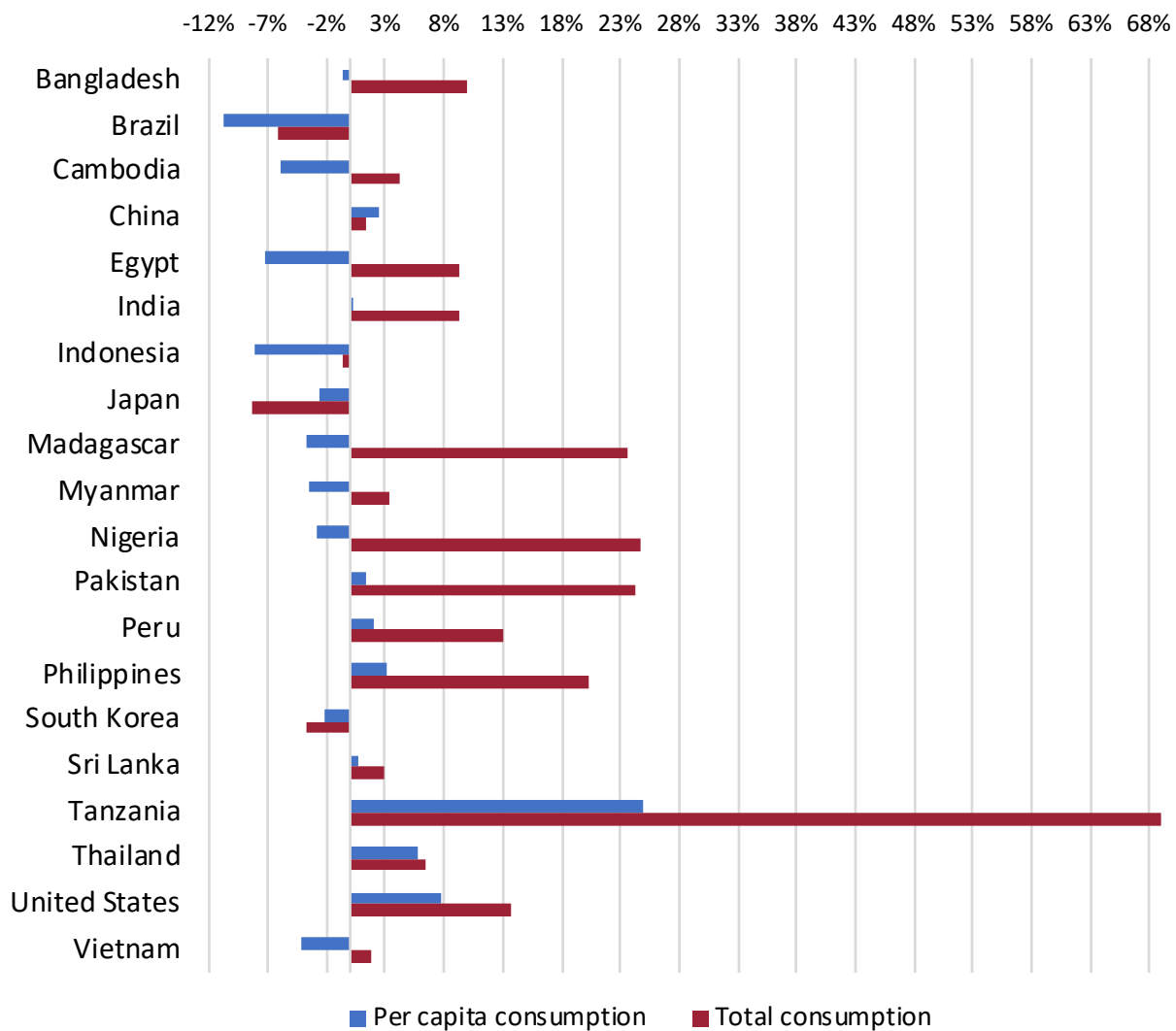

Fig. 7. Projected changes in per-capita and total rice consumption among the 20 largest rice markets in 2031–2033 compared to 2020–2022.

end of the next decade. For the projected changes in production in other countries, see Appendix Table A1.

Rice Trade. Global rice trade grew 42% in the last decade (from 38.2 mmt in 2010–2012 to 54.2 mmt in 2020–2022), and we project it will continue to grow but at a slower pace, reaching 60.4 mmt by 2031–2033, that is, a cumulative 11.4% growth from its 2020–2022 level. Rice trade is highly concentrated on the export side, with five countries (India, Thailand, Vietnam, Pakistan, and the U.S.) accounting for 78% of the total volume of exports in 2020–2022. We project that the U.S. will secure the 5th place out of the top-five rice exporters, and Cambodia and China will become, respectively, the 6th and 7th largest rice exporters in 2031–2033. 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 21% export share in 2010–2012 to more than one-third (38.5%) in 2020–2022 (Fig. 9). We project that India will sustain its dominance as the largest exporter of rice in the coming decade, accounting for 39% of the global rice exports

in 2031–2033. Thailand is regaining the market share lost in 2021 and 2022 due to a series of weather-related production shocks that have tightened the market and undermined its competitiveness. We project that in 2031–2033, Thailand's exports will decrease very marginally compared to 2020–2022, but the country will remain the second largest exporter after India. Cambodia, Pakistan, and the U.S. are expected to grow their export market share, while China, Myanmar, and Vietnam are expected to lose market share in the coming decade.

The import side of the global rice market is much less concentrated than the export side, with the top five importers accounting for 27% of global imports in 2020–2022. We project that the Philippines will surpass China as the largest rice importer in 2031–2033. Cote d'Ivoire, Nigeria, and Iran will also increase their share (Fig. 10). For the projected changes in exports and imports in other countries, see Appendix Table A2.

U.S. Rice Market. Table 2 presents the U.S. rice supply and utilization by types (namely, LG and MG, where MG includes
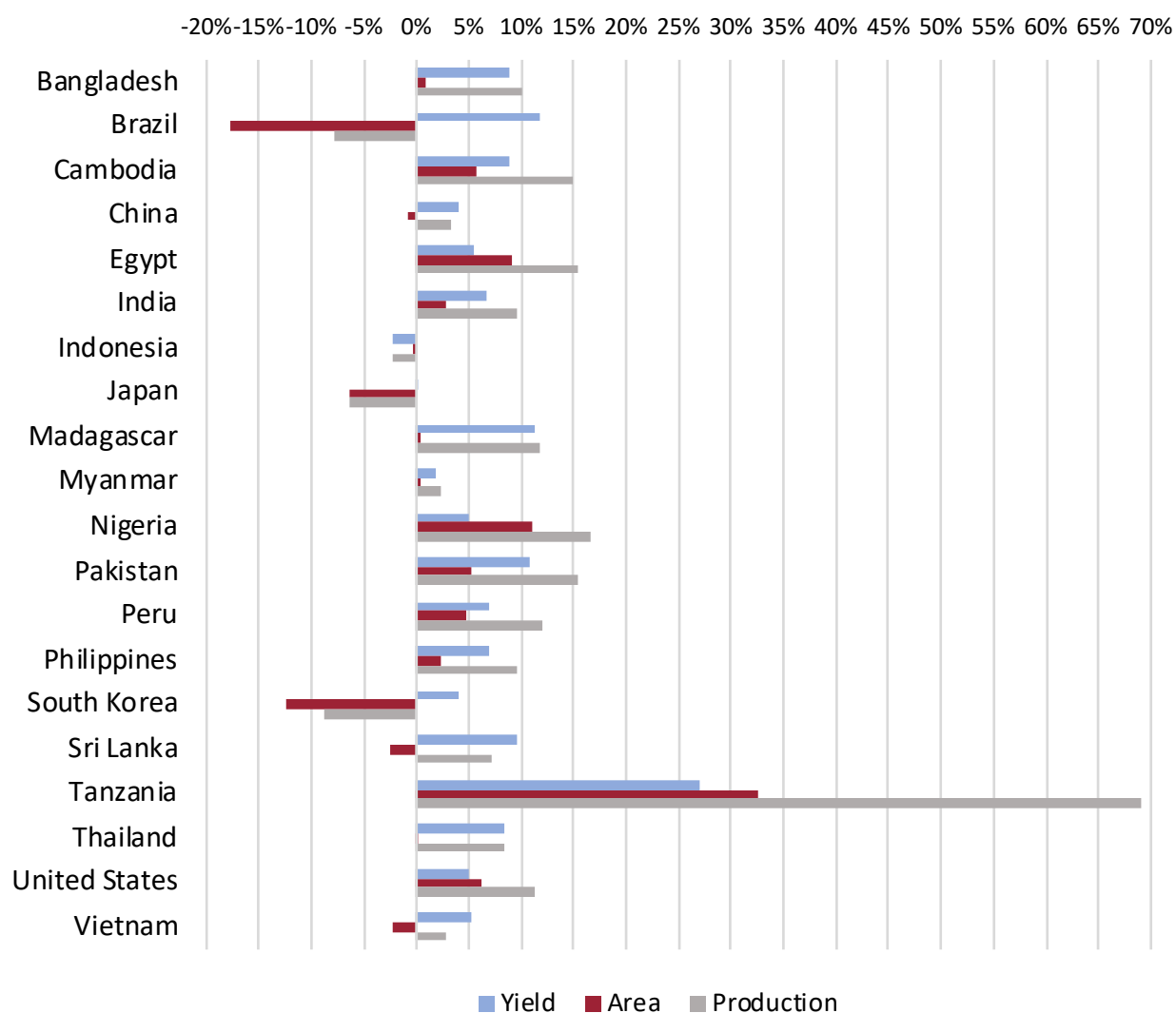

Fig. 8. Projected changes in rice yields, area, and total production among the 20 largest rice producers in 2031–2033 compared to 2020–2022.

both medium- and short-grain rice). We project that the production of LG rice will grow from 147.8 million hundredweight (cwt) in 2020–2022 to 163 million cwt by 2031–2033. To put these numbers in perspective, we project the LG rice crop in 2031–2033 to be smaller than the most recent highest production of 2016 (166.7 million cwt) and 2020 (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 2024 relative to 2023 and slightly increase after 2026 as regional trade integration with CAFTA-DR (Central America-Dominican Republic Free Trade Agreement) and TPA (U.S.-Colombia Trade Promo-

tion Agreement) is fully implemented. We project the volume of LG exports will reach 69.7 million cwt by 2031–2033 (Fig. 11). The U.S. is expected to 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 steadily over the next decade but at a slower pace (0.51% a year) in the coming decade relative to 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 that imports will continue growing steadily at 1.39% a year between 2023–2033.

Looking at the MG segment of the market (Fig. 12), we project that the production of MG rice will decrease significantly in 2024, driven mainly by a decrease in planted acres as reflected in USDA's 2024 Prospective Plantings (USDA-NASS,
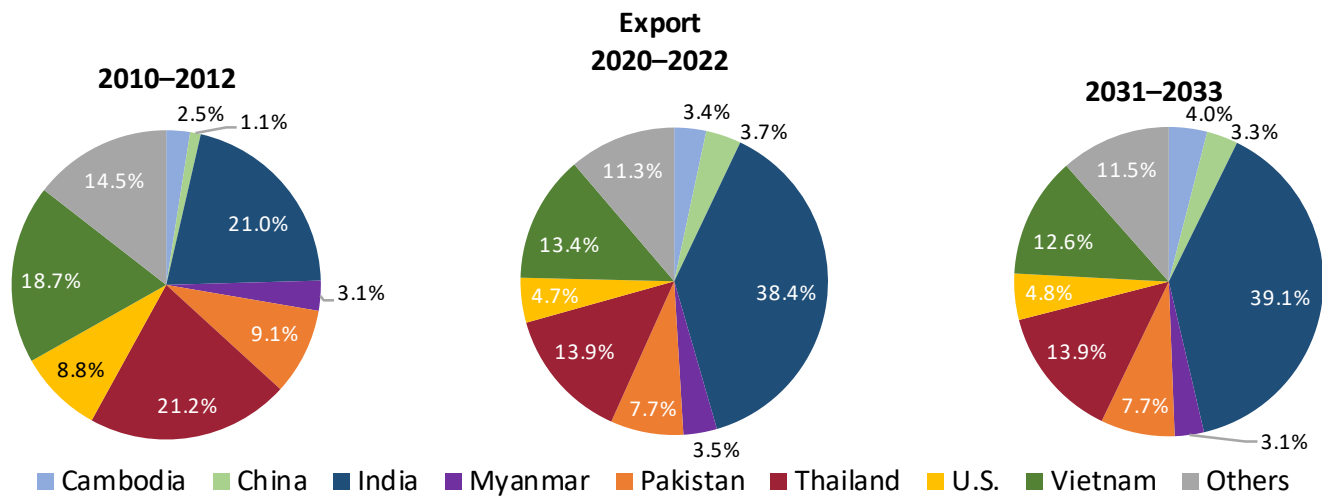

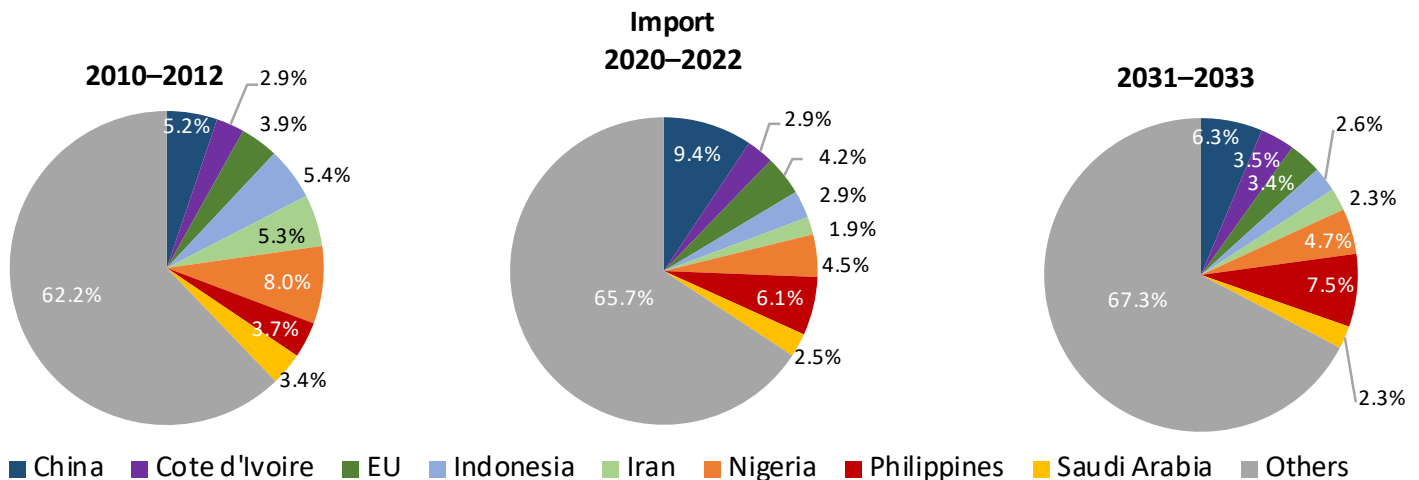**Fig. 9. Historical and projected export shares by the top rice exporters.**

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

2024). We project production to stabilize in 2025 and 2026 and decline slowly thereafter to reach 51.2 million cwt by 2031–2033. To put these numbers in perspective, we project a volume of production in 2031–2033 similar to the 2017 crop. Exports of MG rice are expected to decrease by 0.08% from 21.5 million cwt in 2020–2022 to 21.7 million cwt in 2031–2033. In reality, California Calrose MG rice and mid-South MG rice serve very different markets and attract different prices, even though we consider MG to be a single commodity. California MG rice is exported primarily to markets in Northeast Asia (e.g., Japan, South Korea, Taiwan) and within the World Trade Organization (WTO)-negotiated schedules, which are expected to remain 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 in the coming decade. We project that domestic use (consumption plus residual) will grow marginally in the coming decade relative to the 2020–2022 level, reaching 36.6 million cwt in 2031–2033.

The dynamics of U.S. rice farm prices are illustrated in Fig. 13. The price of LG rice is projected to decrease in 2023 and 2024 from the high price records reached in 2022 and remain between $14/cwt and $15/cwt thereafter. The price of MG from California is projected to decrease significantly in 2023 from the record-high prices observed in 2022 and slowly but steadily decrease thereafter, hovering around $24/cwt by the end of the projected period. We project 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 the stochastic projections for a few selected variables here. All other stochastic results are available from the authors upon request.

Table 3 shows the stochastic results, represented by the mean, 5th, and 95th percentile values for the international reference price of LG rice (represented by Thai 100% B), as well as the global levels of production, consumption, and exports. Fig. 14 shows the stochastic projected behavior of the export price of Thai LG 100% B rice, the reference price that clears the international LG market.

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

Variables	All Rice			Long-grain			Medium- and Short-grain		
	2020–2022	2031–2033	Annual Growth	2020–2022	2031–2033	Annual Growth	2020–2022	2031–2033	Annual Growth
Planted area (1000 acres)	2547.7	2695.6	0.57%	2003.3	2087.4	0.41%	544.3	608.2	1.12%
Yield (lb/ac)	7570.8	7956.5	0.50%	7372.4	7808.7	0.58%	8308.0	8463.7	0.19%
Production (million cwt)	193.2	214.5	1.05%	147.8	163.0	0.98%	45.3	51.5	1.28%
Beginning stocks (million cwt)	35.5	44.8	2.36%	23.8	32.2	3.08%	11.7	12.6	0.73%
Imports (million cwt)	37.3	47.5	2.45%	30.0	40.6	3.09%	7.3	6.8	-0.64%
Supply (million cwt)	265.9	306.8	1.44%	201.6	235.8	1.58%	64.3	70.9	0.98%
Domestic use (million cwt)	149.4	169.4	1.26%	117.4	132.7	1.23%	32.0	36.6	1.36%
Exports (million cwt)	80.4	91.8	1.33%	59.0	70.2	1.75%	21.5	21.7	0.08%
Ending stocks (million cwt)	35.6	45.6	2.50%	25.2	32.9	2.72%	10.4	12.6	1.94%
Demand (million cwt)	229.9	261.2	1.28%	201.6	235.8	1.58%	63.9	70.9	1.05%
Farm price ($/cwt)	16.6	15.9	-0.45%	14.3	14.7	0.22%	30.2	24.1	-2.24%

The gray-shaded area marks the range of variability between the 5th and 95th percentile. We project that the export price of Thai LG 100% B will be highly volatile in the short term, with a 90% confidence that the price will be between $509.7/mt and $710.4/mt in 2023. By the end of the projected period, we estimate the Thai LG 100% B to range between $484.1/mt and $556.8/mt. The U.S. #2 LG Gulf is expected to be highly volatile in the short term, with the 90% confidence interval between $685/mt and $873/mt in 2023, and a narrower interval between $565.1/mt and $625.9/mt by 2033 (Fig. 15). Finally, the U.S. #2 MG California price (Fig. 16) is expected to be less volatile than the international and U.S. LG export prices, with a 90% confidence interval between $1,020.6/mt and $1316.7/mt in 2023 and between $851.8/mt and $964.7/mt in 2033.

The stochastic projection of global production (Fig. 17) and consumption (Fig. 18) show a low variability under this

study's assumptions. With 90% confidence, we project that production will be between 546 and 557.5 mmt and consumption between 553 and 558 mmt by 2033. Global rice exports will keep increasing to reach between 57 and 67 mmt in 2033 (Fig. 19). Finally, global rice ending stocks are expected to be highly volatile over the next decade, with a 90% confidence interval ranging from 87.1 and 167.5 mmt in 2033 (Fig. 20).

Key Market Variables to Watch

China's Rice Stocks

As of today, China has a record level of stocks, estimated at an average of 112 mmt in 2020–2022. The current stock level represents nearly 72.86% of China's annual rice consumption. The stock buildup that started in the late 2000s was supported by a sustained level of production facilitated by favorable domestic
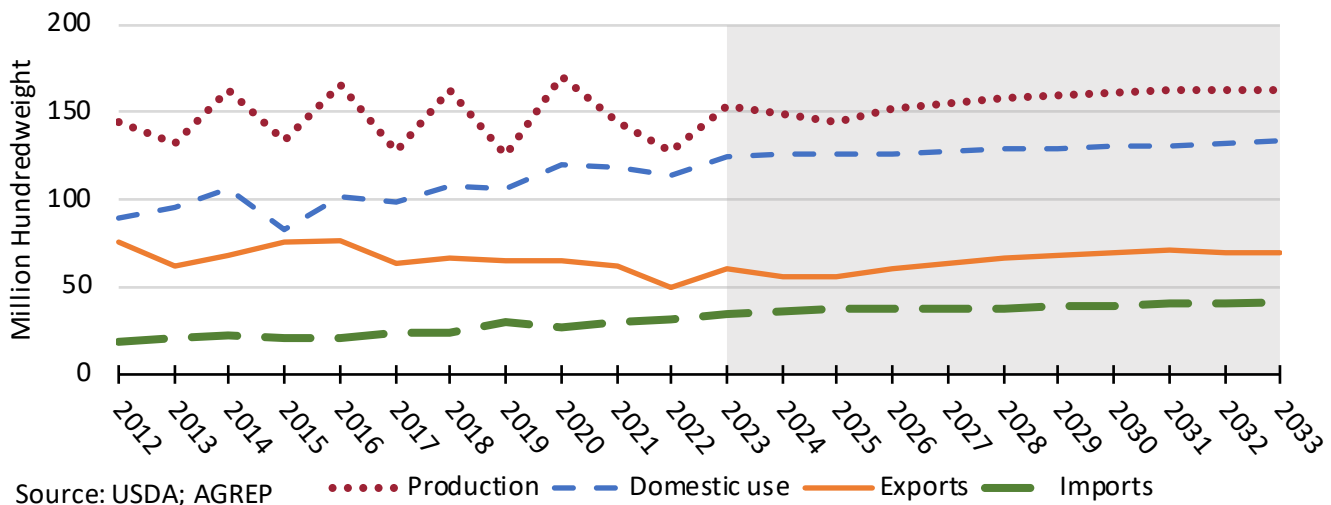

Fig. 11. Historical and projected behavior of selected U.S. long-grain rice market variables. The gray-shaded area represents the projected period between 2023 and 2033
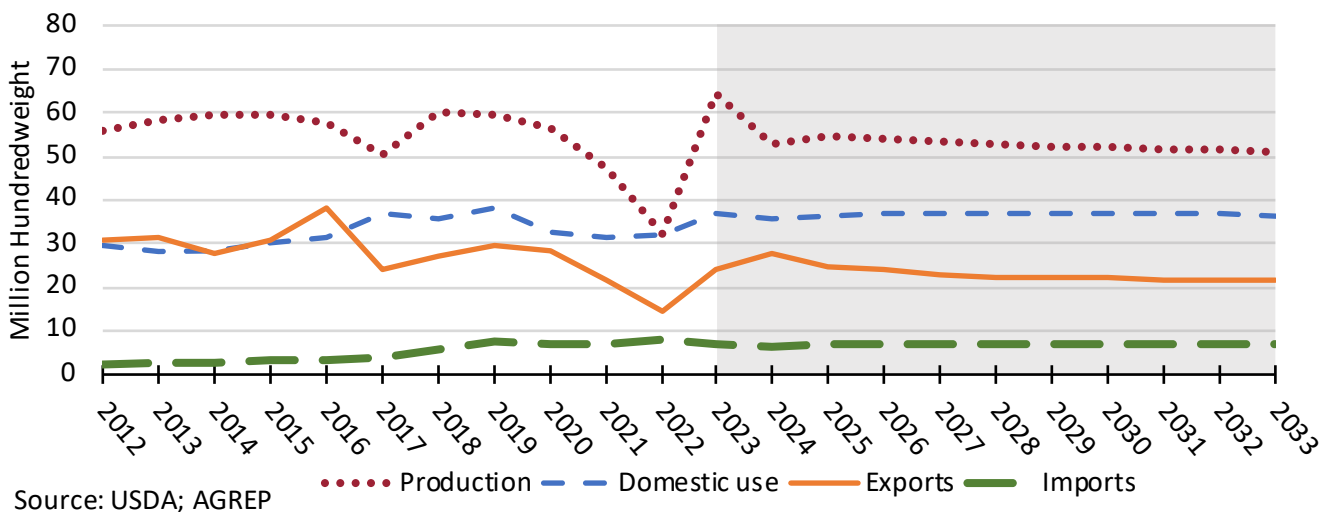

Fig. 12. Historical and projected behavior of selected U.S. medium-grain rice market variables. The gray-shaded area represents the projected period between 2023 and 2033.
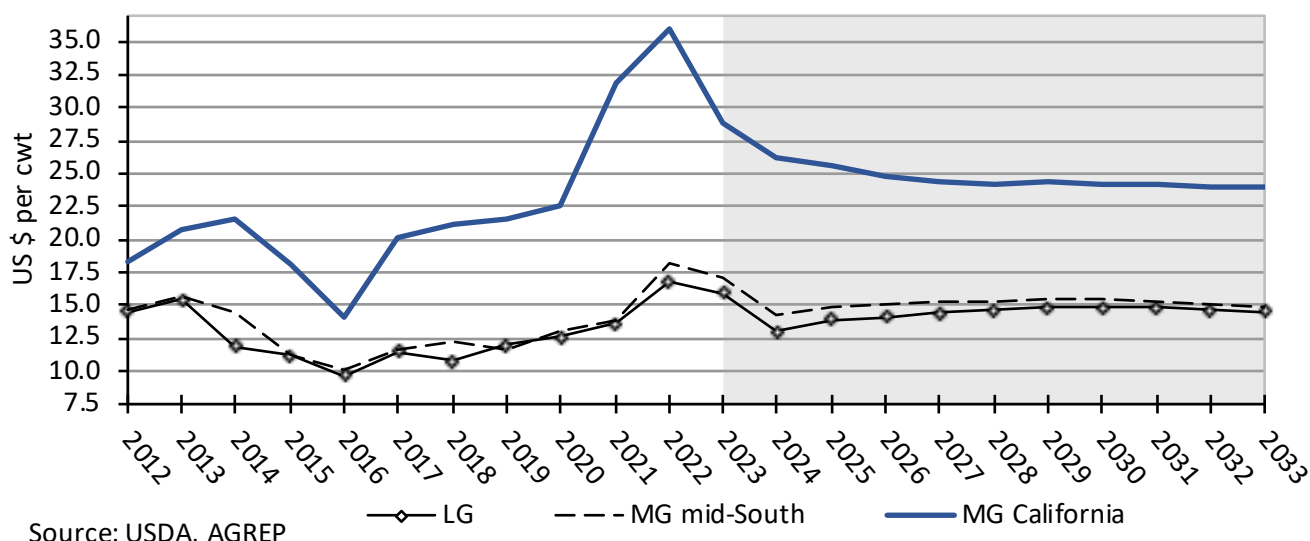
Source: USDA, AGREP

Fig. 13. Historical and projected behavior of U.S. rice prices by type, in nominal U.S. dollars. The gray-shaded area represents the projected period between 2023 and 2033.

Table 3. Stochastic projections (5th and 95th percentile) of the international reference price (Thai 100% B), global production, consumption, and exports.

Year	Thai 100% B ($/mt)			Production (mmt)			Consumption (mmt)			Exports (mmt)		
	5th	Mean	95th	5th	Mean	95th	5th	Mean	95th	5th	Mean	95th
2012		565.0			476.1			462.2			39.4	
2013		428.0			481.3			472.2			43.3	
2014		420.0			482.9			473.3			43.9	
2015		386.0			476.7			467.7			40.7	
2016		394.0			492.1			478.4			47.9	
2017		418.0			494.7			481.5			47.9	
2018		399.0			498.2			485.4			44.2	
2019		457.0			498.2			492.4			43.4	
2020		490.5			508.8			497.9			51.2	
2021		416.0			513.1			515.2			56.9	
2022		480.8			513.0			520.6			54.4	
2023	509.7	600.8	710.4	506.0	512.7	522.4	518.0	522.2	526.7	50.9	53.8	57.9
2024	392.2	458.6	529.7	512.9	519.4	528.3	523.7	527.7	532.3	48.5	52.3	57.9
2025	410.1	471.8	535.1	517.6	523.8	532.2	527.7	531.0	535.1	49.2	53.3	59.4
2026	418.4	478.1	533.5	521.3	527.3	535.4	531.4	534.2	537.9	50.2	54.3	60.5
2027	429.9	489.0	540.2	524.9	530.7	538.6	534.8	537.4	540.8	51.5	55.6	61.8
2028	442.5	499.9	547.7	528.6	534.3	541.9	538.1	540.5	543.7	52.6	56.6	62.9
2029	455.4	510.7	555.1	532.3	537.9	545.2	541.4	543.7	546.7	53.6	57.7	63.9
2030	468.4	521.9	563.0	536.0	541.5	548.6	544.6	546.7	549.5	54.6	58.6	64.8
2031	475.3	526.1	563.7	539.6	544.9	551.8	547.8	549.7	552.3	55.5	59.4	65.6
2032	480.2	527.5	561.1	542.8	547.9	554.6	550.9	552.6	555.1	56.2	60.2	66.2
2033	484.1	527.5	556.8	546.0	551.1	557.5	554.3	555.8	558.0	57.1	60.9	66.7

policies, a steady volume of imports under the auspice of the WTO, and a slowdown in total rice consumption. However, since 2019, we have seen an upward shift in consumption, which has surpassed production ever since, thus contributing to a decrease in ending stocks despite net imports, which averaged 2.8 mmt in 2020–2022 (Fig. 21). Our projections suggest that total consumption will exceed total production by 8.6 mmt in 2023 and that the deficit will narrow down but remain throughout the projected period (Fig. 21). The stock-to-use ratio will average 44% in 2031–2033, significantly down from the 73% averaged in 2020–2022, but still above the 30% reached in the mid-2000s.

In the previous reports, we have stated that "a key question looming over the rice market is what China will do with its rice stocks," primarily because we were projecting high ending stocks that could force China to sell large volumes in the international market. Given the current projections, it seems reasonable to expect a lower risk of a surge in rice exports out of China. However, we still consider China's ending stocks as a key variable to observe going forward.

India's Rice Yields and Production

In the last 20 years, India's production performance has remained remarkable. From 88.5 mmt in 2003, India reached a new record high of 135.8 mmt in 2022. This trend in production translates to an average growth rate of 2.16% a year, almost double the global average rate (1.35%) over the same period. The production gain came exclusively from yield improvements since the area harvested grew only 0.58% annually from 2003 to 2022. Average rice yields grew 1.57% a year from 2.08 metric tons per hectare in 2003 to 2.84 metric tons per hectare in 2022 (Fig. 22). 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 in the coming decade. We hypothesized 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
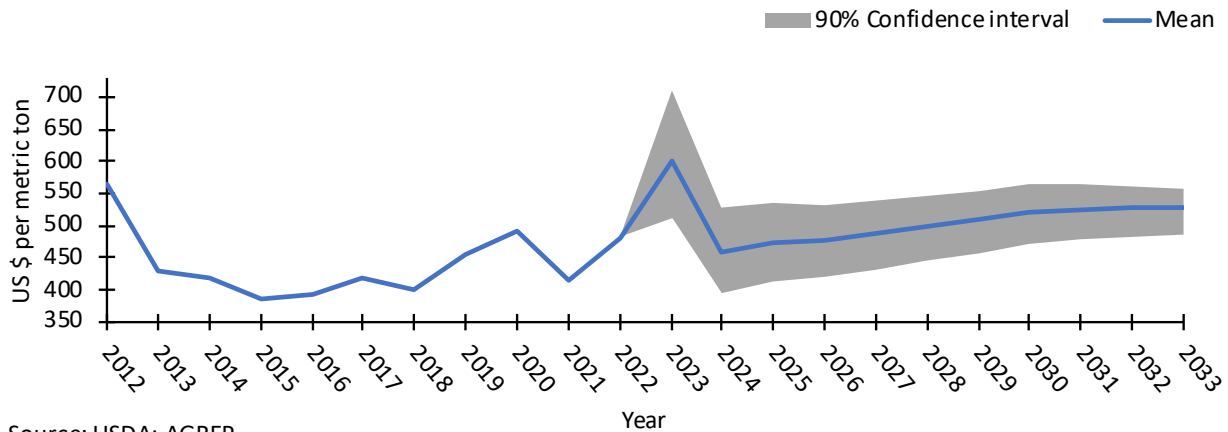
Fig. 14. Stochastic projection of the export price of Thai long-grain 100% B rice in the next decade. The gray-shaded area indicates the 90% confidence interval area based on stochastic projections for the period between 2023 and 2033.
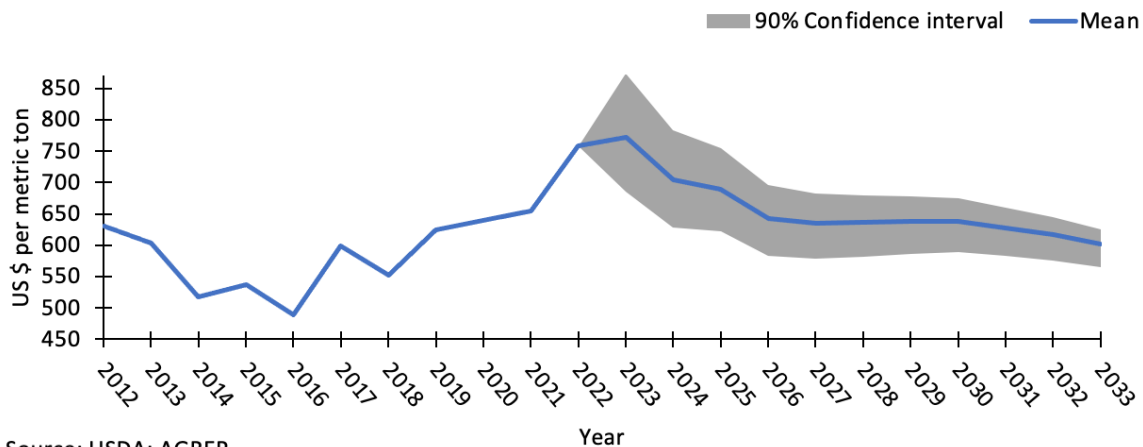
Fig. 15. Stochastic projection of the export price of US #2 long-grain Gulf in the next decade. The gray-shaded area indicates the 90% confidence interval area based on stochastic projections for the period between 2023 and 2033.
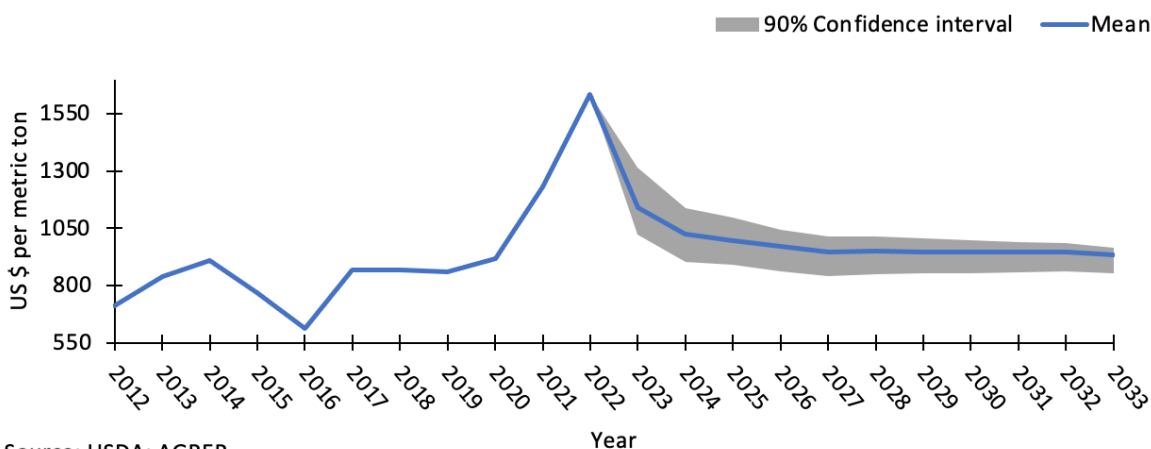
Source: USDA; AGREP

Fig. 16. Stochastic projection of the export price of U.S. #2 medium-grain California in the next decade. The gray-shaded area indicates the 90% confidence interval area based on stochastic projections for the period between 2023 and 2033.

Source: USDA; AGREP

Fig. 17. Stochastic projection of global rice production in the next decade. The gray-shaded area indicates the 90% confidence interval area based on stochastic projections for the period between 2023 and 2033.

Source: USDA; AGREP

Fig. 18. Stochastic projection of global rice consumption in the next decade. The gray-shaded area indicates the 90% confidence interval area based on stochastic projections for the period between 2023 and 2033.

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a decreasing rate. We project that the rice yield will grow 0.75% a year, which, together with a slight increase in area, will sustain a 1.01% average annual increase in production over the next decade. Despite this projected slowdown in production growth, India is expected 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 improving irrigation), we expect that the international rice market will find an equilibrium at much lower prices than our projections suggest.

Price Gaps Between Asian and Western Hemisphere Rice

The LG rice exports from the Western Hemisphere (e.g., the U.S. and Mercosur) have been historically priced higher than most LG rice originating from Asia. To illustrate, Fig. 23 shows that the nominal and relative premium for U.S. LG rice versus Thai 100% B rice has varied widely but remained broadly positive from 1983

until the rice market crisis of 2007/2008 when the international market price of Thai 100% B rice tripled from $335/mt to over $1,000/mt (Dawe and Slayton, 2010). The price premium was nearly zero and even reversed in 2011 when Thailand launched its ambitious rice-pledging program, resulting in higher Thai 100% B rice prices and lower export competitiveness. Since then, the price premium for U.S. LG rice has increased significantly, reaching a record $277/mt in 2022. We project that the gap will decrease gradually in the next decade to reach $74/mt in 2033.

One of the main reasons supporting the price gap between Western Hemisphere and Asian rice is the level of trade integration in the former and the fact that most rice trade remains regional and benefits from a preferential trade policy treatment. Another reason for the price gap 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

Source: USDA; AGREP

Fig. 19. Stochastic projection of global rice ending stocks in the next decade. The gray-shaded area indicates the 90% confidence interval area based on stochastic projections for the period between 2023 and 2033.
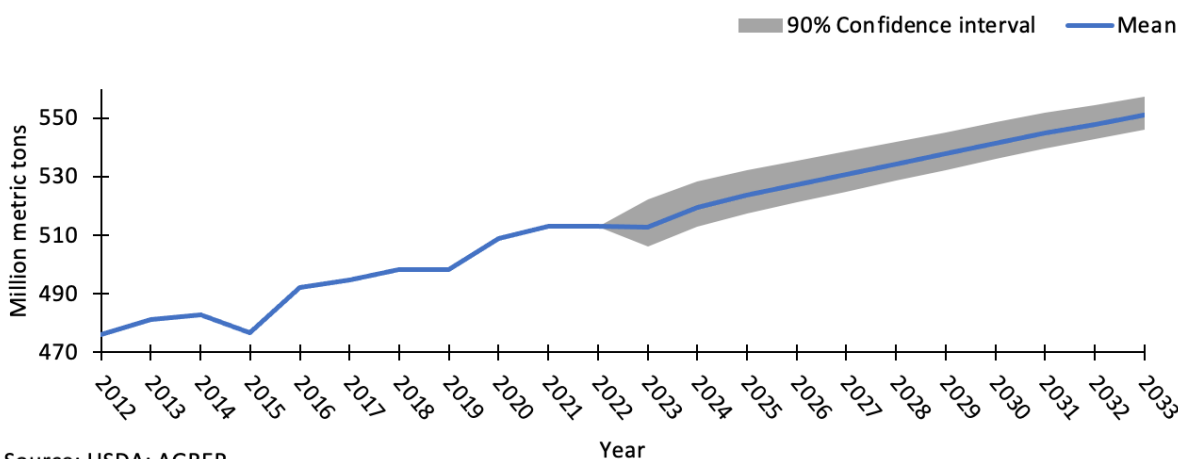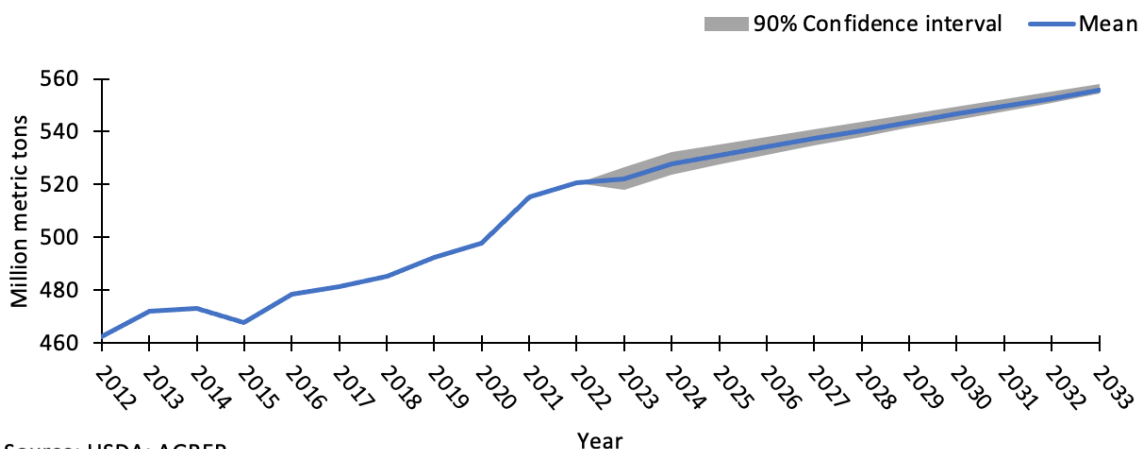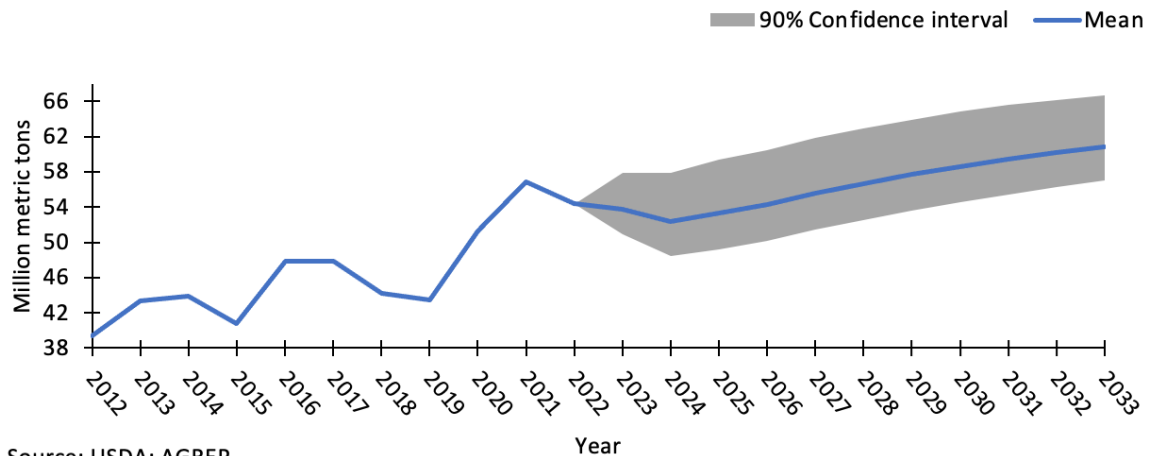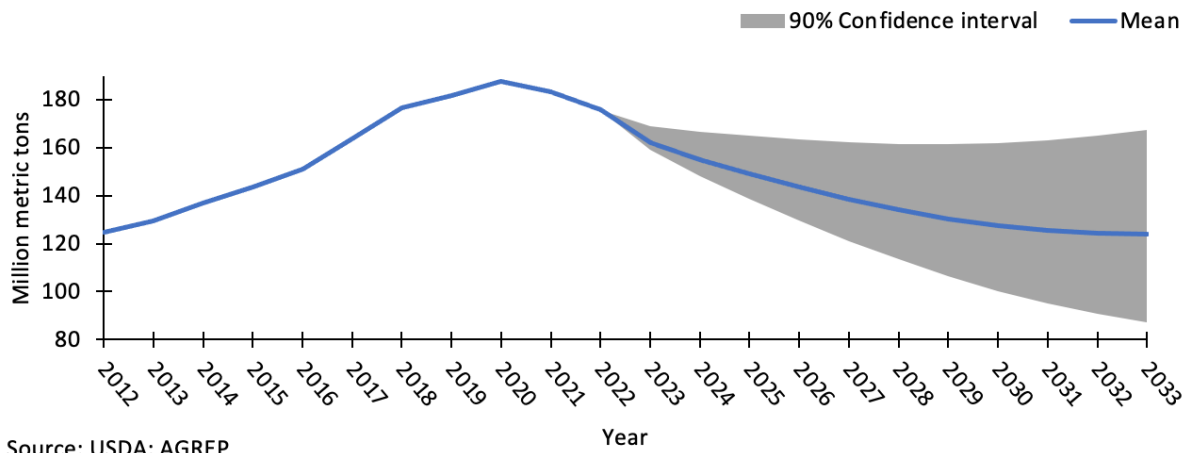

Source: USDA; AGREP

Fig. 20. Stochastic projection of global rice exports in the next decade. The gray-shaded area indicates the 90% confidence interval area based on stochastic projections for the period between 2023 and 2033.

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, resulting in high-quality rice that can compete well in the most demanding markets.

Summary and Conclusion

Rice is a crucial global staple and the cornerstone of food security programs worldwide, and it remains one of the most regulated global staple foods. Hence, understanding the future behavior of the global rice market is of 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 worldwide. This report outlines the main findings from the

2023–2033 baseline projections of the global rice market outlook developed by the Arkansas Global Rice Economics Program.

Based on the results from model simulations, the overall rice story is that global production and consumption will continue to grow strong over the next decade, with a continuous deficit that will be offset by stocks over the projected period. As such, the global ending stocks are projected to keep declining during 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 and, following Asia, will be the second largest rice importer in 2031–2033.

At the country level, rice production is projected to decrease in Brazil, Japan, and South Korea and grow the most in Tanzania, Nigeria, Egypt, Pakistan, and Cambodia relative to the production
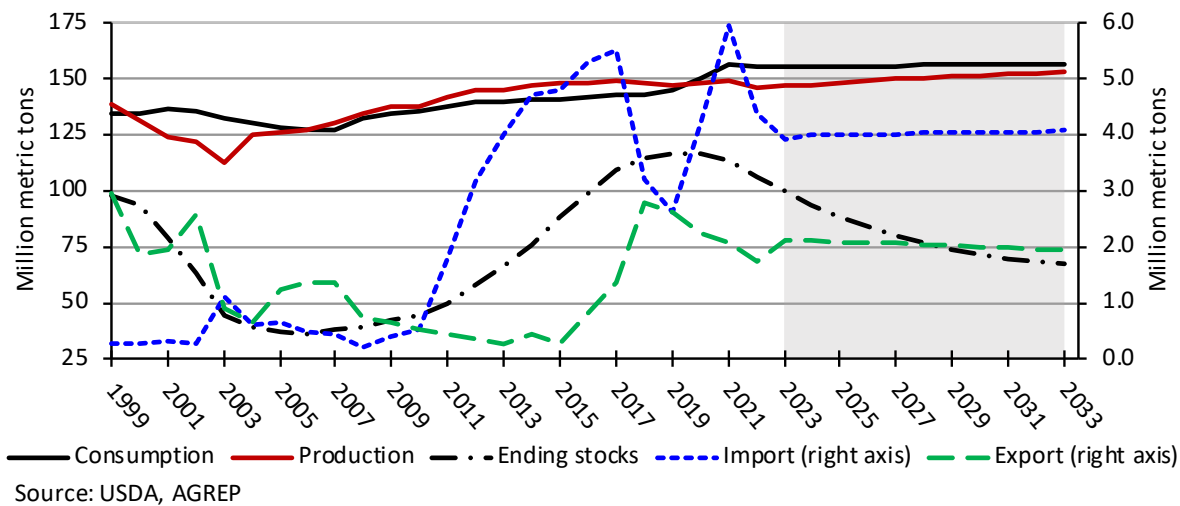

Fig. 21. China rice supply and utilization. The gray-shaded area represents the projected period between 2023 and 2033.
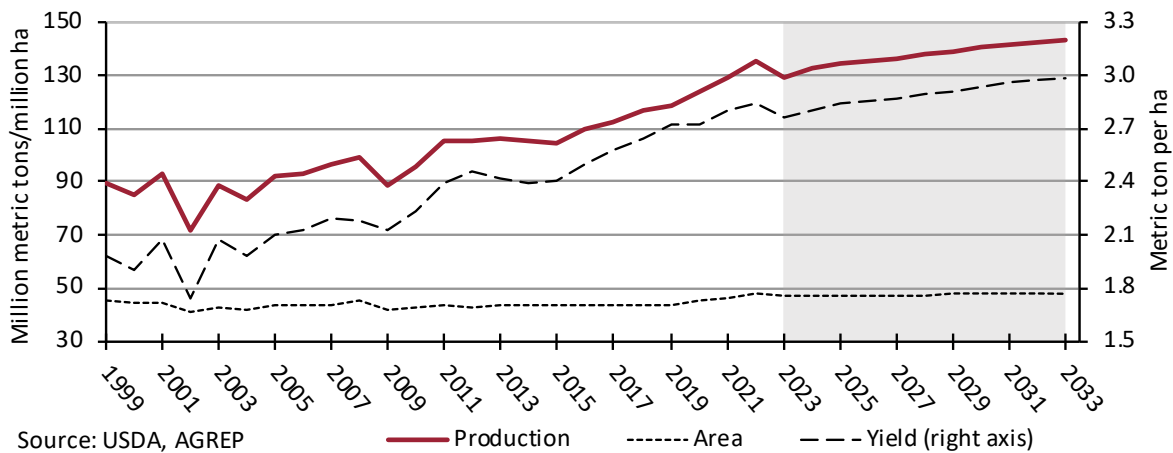

Fig. 22. India's historical and projected rice area, yield, and volume of production. The gray-shaded area represents the projected period between 2023 and 2033.

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level observed in 2020–2022. On the other hand, total rice consumption is projected to decline in Brazil, Japan, and South Korea and increase strongly in Tanzania, Madagascar, and Nigeria, as well as in Pakistan, the Philippines, and the U.S. relative to 2020–2022.

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 rice exporter. Rice exports will continue to be highly concentrated among the top-5 largest exporters (India, Thailand, Vietnam, Pakistan, and the U.S.).

Many factors could alter the projected path of the global rice market. 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 performance coupled with their rice policy, and (3) the price gap between Asian and American LG rice. In the short term, the behavior of the rice market and the entire global economy would be influenced by India's rice export policies and still depends on the evolution of the conflict in Ukraine.

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Source: USDA; AGREP
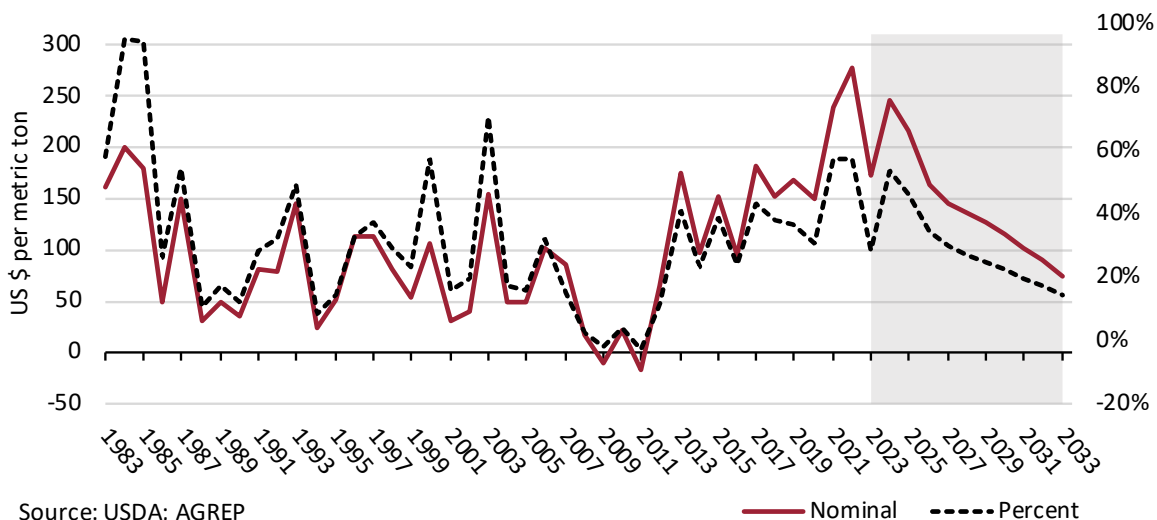
Fig. 23. Price gap between Thai 100%B and U.S. #2 long grain rice (percent = price gap/price Thai 100%B). The gray-shaded area represents the projected period between 2023 and 2033.

APPENDIX

Table A1. Projected production and consumption by country.

Country	Production			Consumption		
	2020–2022	2031–2033	Change	2020–2022	2031–2033	Change
	------------------------------------1000 metric tons------------------------------------					
East Asia & Pacific						
Australia	392	585	4.1%	363	468	2.6%
Brunei	1	1	0.0%	27	30	1.0%
Cambodia	5,814	6,693	1.4%	4,150	4,327	0.4%
China	147,745	152,687	0.3%	153,882	155,973	0.1%
Hong Kong				296	302	0.2%
Indonesia	34,300	33,537	-0.2%	35,433	35,191	-0.1%
Japan	7,562	7,091	-0.6%	8,183	7,490	-0.9%
Laos	1,933	2,809	3.8%	1,875	2,206	1.6%
Malaysia	1,726	1,798	0.4%	2,900	3,035	0.5%
Myanmar	12,267	12,546	0.2%	10,367	10,703	0.3%
Philippines	12,527	13,733	0.9%	15,400	18,494	1.8%
Singapore				392	337	-1.5%
South Korea	3,718	3,392	-0.9%	3,967	3,815	-0.4%
Taiwan	1,141	1,198	0.5%	1,117	1,166	0.4%
Thailand	19,883	21,574	0.8%	12,467	13,267	0.6%
Vietnam	26,997	27,867	0.3%	21,383	21,758	0.2%
South Asia						
Bangladesh	35,600	38,854	0.9%	36,700	40,339	0.9%
India	129,865	142,389	0.9%	108,669	118,787	0.9%
Pakistan	7,748	8,983	1.5%	3,633	4,512	2.2%
Sri Lanka	2,986	3,199	0.7%	3,233	3,323	0.3%
Middle East & North Africa						
Egypt	3,500	4,044	1.5%	4,117	4,497	0.9%
Iran	1,967	2,139	0.8%	3,050	3,603	1.7%
Iraq	199	346	5.7%	1,783	2,277	2.5%
Saudi Arabia				1,317	1,497	1.3%
Sub-Saharan Africa						
Cameroon	221	507	8.6%	803	1,203	4.1%
Cote d'Ivoire	1,049	1,659	4.7%	2,517	3,866	4.4%
ECOWAS-7[a]	948	1,192	2.3%	3,135	4,609	3.9%
Ghana	717	909	2.4%	1,600	2,184	3.2%
Guinea	1,641	2,580	4.6%	2,342	3,169	3.1%
Kenya	122	133	0.8%	808	1,251	4.5%
Liberia	169	266	4.6%	500	635	2.4%

Continued

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Table A1. Projected production and consumption by country, *continued*.

Country	Production			Consumption		
	2020–2022	2031–2033	Change	2020–2022	2031–2033	Change
	--------------------------------1000 metric tons--------------------------------					
Madagascar	2,778	3,105	1.1%	3,391	4,196	2.2%
Mali	1,801	2,481	3.3%	2,217	3,265	3.9%
Mozambique	112	438	14.6%	820	1,379	5.3%
Nigeria	5,253	6,129	1.6%	7,333	9,143	2.2%
Senegal	939	1,115	1.7%	2,067	2,935	3.6%
Sierra Leone	966	1,355	3.4%	1,404	1,786	2.4%
South Africa				918	989	0.7%
Tanzania	1,996	3,382	5.4%	2,032	3,430	5.4%
Uganda	161	184	1.3%	201	395	7.0%
Latin America & Caribbean						
Argentina	832	789	-0.5%	480	492	0.2%
Brazil	7,447	6,754	-1.0%	7,167	6,722	-0.6%
Chile	77	154	7.2%	269	350	2.7%
Colombia	1,887	2,088	1.0%	2,017	2,205	0.9%
Costa Rica	89	95	0.6%	240	244	0.2%
Cuba	152	234	4.4%	597	664	1.1%
Dominican Republic	665	718	0.8%	647	737	1.3%
Guatemala	18	45	9.8%	139	220	4.7%
Guyana	619	834	3.0%	167	216	2.6%
Haiti	67	78	1.6%	553	701	2.4%
Honduras	59	51	-1.5%	198	314	4.7%
Mexico	175	204	1.5%	968	1,117	1.4%
Nicaragua	279	335	1.9%	382	495	2.6%
Panama	237	289	2.0%	332	413	2.2%
Paraguay	771	1,066	3.3%	62	47	-2.7%
Peru	2,419	2,707	1.1%	2,586	2,921	1.2%
Uruguay	952	1,111	1.6%	30	36	1.9%
Venezuela	190	282	4.1%	717	917	2.5%
North America						
Canada				426	451	0.6%
United States	6,118	6,810	1.1%	4,730	5,372	1.3%
Europe & Central Asia						
Türkiye	577	590	0.2%	792	921	1.5%
EU-27 & UK[b]	1,631	1,967	1.9%	3,417	3,647	0.7%
Rest of the world	9,604	9,805	0.2%	17,511	21,492	2.1%
World	511,619	547,914	0.7%	511,218	552,525	0.8%

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

Table A2. Projected volumes of trade by country.

Country	2020–2022	2031–2033	Nominal Change	Country	2020–2022	2031–2033	Nominal Change
--				1000 metric tons	--		
Exporters							
Argentina	386	302	-83	Paraguay	757	1,025	267
Australia	198	329	131	China	2,012	1,971	-41
Brazil	1,181	900	-281	Peru	33	31	-2
Cambodia	1,817	2,417	601	Senegal	75	60	-15
Cote d'Ivoire	28	30	2	Sri Lanka	7	8	1
Egypt	5	5	0	Tanzania	173	50	-123
EU-27 & UK*	416	463	47	Thailand	7,555	8,372	817
Guinea	80	80	0	Türkiye	234	250	16
Guyana	439	618	179	United States	2,554	2,916	362
India	20,829	23,580	2751	Uruguay	899	1,075	176
Japan	115	120	5	Vietnam	7,242	7,625	383
Laos	67	647	580	Malaysia	115	125	10
Myanmar	1,912	1,844	-68	Mexico	13	10	-3
Pakistan	4,153	4,676	523	Rest of World	878	827	-51
Total Exports					**54,172**	**60,355**	**6,183**
Importers							
Argentina	3	5	2	Laos	50	50	0
Australia	225	175	-50	Liberia	337	370	33
Bangladesh	1,325	1,460	135	Madagascar	613	1,092	479
Brazil	856	867	11	Malaysia	1,233	1,364	131
Brunei	26	29	3	Mali	342	786	444
Cambodia	50	50	0	Mexico	777	928	151
Cameroon	582	695	114	Mozambique	708	942	234
Canada	444	451	7	Nicaragua	100	161	61
Chile	189	197	7	Nigeria	2,308	2,993	685
China	4,849	4,048	-801	Pakistan	6	6	0
Hong Kong	296	302	6	Panama	74	125	51
Colombia	141	184	43	Peru	201	237	36
Costa Rica	188	149	-39	Philippines	3,183	4,791	1607
Cote d'Ivoire	1,490	2,265	775	Saudi Arabia	1,294	1,498	204
Cuba	445	430	-15	Senegal	1,333	1,895	561

Continued

Table A2. Projected volumes of trade by country, *continued*.

Country	2020–2022	2031–2033	Nominal Change	Country	2020–2022	2031–2033	Nominal Change
			----1000 metric tons----				
Dominican Republic	22	28	6	Sierra Leone	438	430	-8
ECOWAS-7[a]	2,172	3,421	1249	Singapore	392	337	-55
Egypt	411	458	47	South Africa	1,054	1,140	86
EU-27 & UK[b]	2,165	2,158	-7	South Korea	376	421	45
Ghana	860	1,281	421	Sri Lanka	320	134	-186
Guatemala	121	175	54	Taiwan	107	100	-7
Guinea	885	671	-214	Tanzania	210	98	-112
Haiti	470	625	155	Thailand	100	75	-25
Honduras	140	264	124	Türkiye	413	626	213
Indonesia	1,497	1,631	135	Uganda	50	222	172
Iran	965	1,479	514	United States	1,183	1,502	320
Iraq	1,725	1,943	218	Venezuela	533	635	102
Japan	666	685	19	Vietnam	1,767	1,500	-267
Kenya	773	1,128	355	Rest of World	8,322	12,100	3779
Total Imports					**51,420**	**63,395**	**11,975**

[a] ECOWAS = Benin, Burkina, Gambia, Guinea-Bissau, Niger, Togo, Cape Verde.
[b] European Union and United Kingdom.