

Feasibility and Potential for Rice Fortification in Africa

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Key Messages

- The fortification of rice in Africa offers a significant opportunity to improve intakes of essential vitamins and minerals among at least 146 million people, spread across 12 countries, who are considered potential beneficiaries of the intervention.
- Domestic milling capacity to implement rice fortification is not yet feasible in any of the countries studied. Imported rice remains the dominant opportunity for feasible rice fortification.
- Efforts on a single country-by-country basis will not lead to sufficient demand for fortified rice to justify private-sector investment in fortified kernel production. Rice fortification at scale will require a regional effort for mandatory rice fortification and/or a significant leverage of publicly funded food programs (e.g., food distribution, school meals).
- Sustainable rice fortification will depend on the successful navigation of politically sensitive rice policies, opportunities to use food distribution programs, and effective regulatory monitoring.
- Several countries considering opportunities for rice fortification already have mandatory fortification of other foods – e.g., wheat flour, oil, salt. For those countries it would be beneficial to evaluate the compliance, coverage, and nutrition contribution from existing fortified foods.

Background

Why rice in Africa?

Outside of Asia, the largest per capita rice consumption is in Africa, where 19 countries have more than 75 grams per capita per day (g/c/d) of rice available on average for human consumption (**Table 1**).¹ The World Health Organization considers prevalence of anemia exceeding 40% in a population as being of “severe” public health significance.² For every single one of these countries, anemia is categorized as “severe” for children under 5; in 12 out of these 19 countries anemia is of “severe” public health significance for non-pregnant women. For further information about vitamin and mineral deficiencies in the region, see article Overview of Evidence and Recommendations for Effective Large-scale Rice Fortification on page 55. This suggests that rice fortification in Africa is a potential opportunity to improve vitamin and mineral intakes across the population, as well as to rapidly increase the volumes of rice fortified globally.

Large stocks of rice held in port warehouses by private importers are a key aspect of food security in Liberia and other countries of West Africa



TABLE 1: African countries with over 75 g/c/d of rice available (FAO 2013)

WEST AFRICA	OUTSIDE OF WEST AFRICA
Benin	Comoros ^a
Cape Verde	Djibouti
Côte d'Ivoire	Egypt
The Gambia	Gabon
Ghana	Madagascar
Guinea	Mauritius
Guinea-Bissau	
Liberia	
Mali	
Mauritania	
Nigeria	
São Tomé and Príncipe ^b	
Sierra Leone	

^a FAO's Food Balance Sheets do not have data for Comoros; however, field interviews in Comoros suggest rice availability in Comoros meets this criterion.

^b At time of work, only FAO 2011 food availability was available; at that time, rice availability for Sao Tome and Principe was under 75 g/c/d and the country was not included in the original report. The data presented here have been updated to include 2013 FAO data, but a country profile for São Tomé and Príncipe was not added as its population and total rice volume would not significantly impact the results of the analysis.

However, national-level availability and consumption alone do not describe the entire picture. To ensure feasibility and describe potential for impact, we need to understand consumption patterns among specific populations (e.g., women of reproductive age, rural populations) and the overlap with other fortified/fortifiable food vehicles (e.g., maize and wheat flour). A third consideration is the rice supply chain for both imports and domestic production; that is the focus of this assessment. The Food Fortification Initiative (FFI) and the Global Alliance for Improved Nutrition (GAIN) used primary and secondary data to identify opportunities to use rice fortification in Africa as a way to improve nutrition and to identify priorities for establishing the intervention in Africa.

Rice fortification at scale

Fortifying rice requires a different process than fortifying flour. Rice is commonly eaten in its milled grain form rather than as flour and rice fortification requires creating a fortified kernel. Consequently, the cost of fortifying rice is reportedly seven times the cost of fortifying flour.³ For basics on rice fortification technology, see Peiman Milani's article on page 48.

Another economic factor is that rice fortification is not yet practiced on a global scale. For an overview of current rice fortification status worldwide, see Becky L. Tsang's article on page 68. Today, fortified kernel manufacturers run at low utili-

zation to supply fortified kernels for small volumes of rice used in pilot projects and targeted food distribution programs. Fortifying the estimated 23.8 million metric tons of rice available for food in African countries⁴ could increase global production of fortified kernels, improve the industry's economies of scale and catalyze lower prices for fortified rice. But how much of that 23.8 million metric tons is a feasible fortification opportunity, and of that quantity, who would benefit?

Opportunities for rice fortification in Africa

Methods

Using a combination of field interviews and desk reviews, we assessed the rice supply chain in 19 African countries. Secondary data sources included United Nations Comtrade for bilateral rice trade data; both the Food and Agriculture Organization and the United States Department of Agriculture for rice availability and import (as aggregated by IndexMundi), production, and consumption in each country; USDA Foreign Agricultural Service Feed Grains Yearbooks; the USAID 2009 West Africa Value Chain Analysis; and The World Factbook for population and urbanization estimates and trends.

Results

An overview of the rice market and industry for West African countries is given in the Country Profiles section at the end of this article.

Preferences for rice types and quality

Fortified kernels (coated or extruded) can be produced to match most rice shapes and sizes; understanding rice prefer-

Broken rice is preferred in many West African countries for its affordability and texture in local dishes

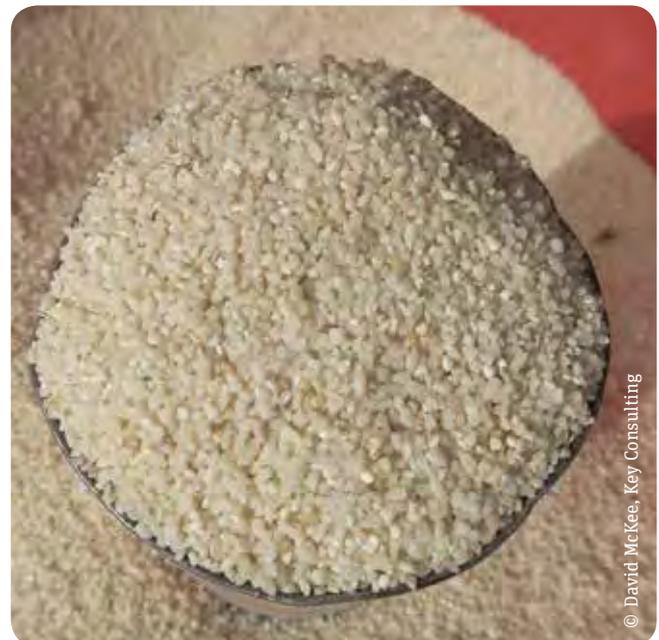


TABLE 2: Rice, wheat flour and maize flour availability and % industrially milled by country (data in bold indicate mandatory fortification of the relevant cereal grain, FAO 2013)¹⁰

	Rice			Wheat flour		Maize flour	
	g/c/d	% industrially milled	% imported	g/c/d	% industrially milled	g/c/d	% industrially milled
WEST AFRICA							
Benin	146	20%	66%	36	100%	110	Unknown
Cape Verde	134	0%	123%	106	100%	102	Unknown
Côte d'Ivoire	174	8%	58%	57	98%	60	Unknown
The Gambia	169	0%	56%	104	100%	48	Unknown
Ghana	88	11%–23%	62%	40	100%	70	Unknown
Guinea	266	0%	13%	51	100%	26	Unknown
Guinea-Bissau	269	0%	41%	31	100%	28	Unknown
Liberia	260	<6%	33%	30	100%	0	Unknown
Mali	156	<6%	12%	34	100%	97	Unknown
Mauritania	133	Unknown	83%	276	95%	10	Unknown
Nigeria	77	12%–24%	40%	57	100%	90	Unknown
Senegal	198	38%–44%	105%	102	100%	51	Unknown
Sierra Leone	283	<7%	31%	24	100%	14	Unknown
OUTSIDE OF WEST AFRICA							
Comoros	281	0%	100%	Unknown	100%	Unknown	Unknown
Djibouti	122	0%	129%	326	100%	3	Unknown
Egypt	108	100%	3%	402	100%	173	Unknown
Gabon	94	0%	106%	172	100%	45	Unknown
Madagascar	281	1%	16%	25	100%	49	Unknown
Mauritius	142	Unknown	84%	312	95%	8	Unknown

g/c/d: grams per capita per day.

ences in a population is key to ensuring fortified rice is accepted by consumers. **Table 3** details market preferences for rice by country.

Generally, the more price-sensitive the consumer, the greater the market for rice with a high percentage of broken kernels. In The Gambia, Guinea-Bissau, Liberia, Mauritania, Senegal and Sierra Leone, the preference is for 100% broken rice, likely due to both low price and common use in traditional dishes. Although parboiled rice is consumed by sub-populations in most countries, Nigeria is the only country that exclusively prefers parboiled rice. Both broken kernels and parboiled rice can be fortified.

Opportunities for fortifying domestically grown rice

Fifteen of the 19 countries produce rice domestically. The feasibility of fortifying domestic rice depends on the structure of the local milling industry. Rice fortification at small mills (defined at less than five metric tons per hour)⁵ is cost-prohibitive compared to fortification at large mills. Larger mills can take advantage of economies of scale and are more likely to have greater resources to implement fortification. Enforcing fortification by

government agencies is also difficult due to the high numbers of small mills in existence.⁶

Of the countries reviewed, only Egypt has a large domestic rice-milling capacity. Nearly all the domestic rice produced in Egypt is milled industrially due to the country's role as a key regional rice exporter (**Table 2**). Hand-pounding of rice in remote areas or toll milling in village mills is still overwhelmingly the practice for domestic rice grown in other countries assessed. Estimating the total volume of domestically grown rice that is industrially milled suggests that only 860,000 metric tons of rice could be fortified across 12 countries identified as opportunities for rice fortification (**Table 4**).

“Africa’s large volume of rice imports is a great opportunity”

Opportunities for fortifying imported rice

On the other hand, Africa's large volume of rice imports is a great opportunity. Fortifying the 5.7 million metric tons of rice

TABLE 3: Market preferences for rice varieties and quality, by country¹¹**WEST AFRICA**

Benin	<ul style="list-style-type: none"> › Primarily an importer of high-quality white rice, brokens ranging from 5% to 25%. › High-quality white and aromatic rice is preferred in urban areas. › Some consumers also prefer parboiled rice, especially in rural areas. › Imported parboiled rice likely re-exported to Nigeria.
Cape Verde	› Market preference for medium-grain white rice from Thailand, proportion of brokens unknown. No rice grown in Cape Verde.
Côte d'Ivoire	<ul style="list-style-type: none"> › The overall market is dominated by 15% broken white rice, followed by 50% brokens. › High-quality 5% aromatic rice is considered only 2% of the market. › About half of rice imports are aromatic, from Thailand and Vietnam. › Local rice is mostly consumed in rural areas. › Limited local parboiling near the border with Guinea.
The Gambia	<ul style="list-style-type: none"> › Price-conscious market; consumer preference is for 100% broken rice. › Some 25% broken white rice is imported as well. › Local rice is considered premium and is more expensive than imported.
Ghana	<ul style="list-style-type: none"> › Rice is not an essential staple food. Consumer preference is for high-quality white and aromatic rice (5% brokens). › Aromatic rice is considered 80% of the market and sold at a premium, and Ghana is Africa's largest importer of aromatic rice. › There is ~10% demand for 100% broken rice used specifically for traditional dishes. › Rural households parboil rice, particularly in the north. › Imported parboiled rice serves the Muslim population, ~1% of the market.
Guinea	<ul style="list-style-type: none"> › Imports are at least 50% low-quality 100% broken rice, but parboiled and 25% broken rice is also consumed in the urban market. › Rural consumers prefer locally parboiled rice. › Some varieties of local rice are popular and sold at a premium over imported rice.
Guinea-Bissau	› Market preference for 100% broken rice.
Liberia	<ul style="list-style-type: none"> › Domestic rice parboiled at household or village level. › Market dominated by 100% brokens and 50% brokens, with some 5% broken demand from middle-high income consumers. › Past reports¹² of 80% preference for round-grain Chinese rice and low-quality parboiled rice.
Mali	<ul style="list-style-type: none"> › Primarily domestic rice consumed; local rice is ~40% broken due to poor milling. › Premium varieties of local rice (e.g., Gambiaka) more expensive than imported rice. › Imports include 100% brokens as well as high-quality aromatic rice.
Mauritania	› Consumer preference is for 100% broken rice, both aromatic and white.
Nigeria	› In northern Nigeria the preference is for rice flour (97% share) as opposed to grain. In the south the preference is for high-quality parboiled, mostly imported, rice.
Senegal	<ul style="list-style-type: none"> › Consumer preference is for 100% broken rice, both white and aromatic, but there is approximately a 30% market for rice with 50% or less brokens. › In rice production areas, local rice is preferred. In urban areas, consumers prefer imported rice; aromatic 100% broken rice is preferred in Dakar.
Sierra Leone	› Price-conscious market; importers report that 75% of market is now 100% brokens.

OUTSIDE OF WEST AFRICA

Comoros	<ul style="list-style-type: none"> › Rice imported by government agency (Onicor), so availability and price of government-to-government bids may overrule market preference for rice. Current contract is for Pakistani rice with 15% brokens but past reports of Vietnamese rice. › Higher-income households purchase Pakistani basmati rice.
Djibouti	› White milled rice and red Belem rice; unknown broken percentage.
Egypt	› Domestically grown rice is medium-grain Japonica varieties.
Gabon	› White milled rice, unknown broken percentage or varieties.
Madagascar	<ul style="list-style-type: none"> › Domestic rice is the main share of national consumption. Several varieties of rice unique to Madagascar are grown. › Imported rice is white milled rice from India and Pakistan.
Mauritius	› Primary market is for white milled rice, with a smaller demand for brokens (~22%).



Imported rice is moved around the region through sometimes informal mechanisms. If fortified rice is mandated, regulatory monitoring at land borders will need to be considered.

exported annually to 12 countries in Africa, primarily in West Africa, would immediately bring rice fortification to scale globally (Table 5).

Fortifying imported rice is the only rice fortification option in Senegal, Cape Verde, Comoros, Djibouti, and Gabon, where close to 100% of the rice supply is imported. On the other hand, fortifying imported rice is unlikely to be a great opportunity where imported rice is not a significant source of the rice supply (less than 25%) – e.g., Mali, Egypt, and Madagascar (Table 2).

Estimating potential population coverage

Understanding the coverage of a fortified food identifies which populations are most likely to benefit. In Table 4, the countries shaded green are where fortified rice could be expected to provide a public health impact in certain populations. However, green does not guarantee easy implementation. Issues that could compromise rice fortification are discussed below.

In countries where nearly 100% of rice is imported, it is assumed that the entire population could benefit from rice fortification.⁷ This may be an overestimation if rice consumption is not distributed evenly across the population. In nine countries, fortified rice imports are expected to primarily reach the urban populations that consume imported over domestically grown rice. Collectively, the reach of these opportunity countries (highlighted green) is 146 million people (Table 4).

Imported rice sources

In 2014–2015, 80 countries exported rice to the 12 African countries considered opportunities. India and Thailand tied as the major sources of imported rice at 2.1 million metric tons of rice. Table 5 shows the rice origins for each country exporting at least 11,000 metric tons to African countries.

Options for points of fortification

Rice imported to Africa can be fortified in two locations:

1. Country of rice origin
2. Destination (i.e., after arrival into a country)

Each option has advantages and disadvantages. This analysis suggests that fortification at country of origin is better suited for West African imports.

“This analysis suggests that fortification at country of origin is better suited for West African imports”

Fortifying rice in countries of origin would result in private-sector investment in high-quality fortified kernel production, thus bringing costs down exponentially. Of Africa’s rice imports,

TABLE 4: Population coverage of potential rice fortification opportunities

	Population	% Urban	Population coverage	
			Imported	Domestic
WEST AFRICA				
Benin	10,320,000	44	4,540,800	138,488
Cape Verde	490,000	66	490,000	–
Côte d'Ivoire	20,320,000	54	11,013,440	–
The Gambia	1,840,000	60	1,104,000	397,702
Ghana	25,900,000	54	13,986,000	2,255,902
Guinea	11,750,000	37	–	–
Guinea-Bissau	1,700,000	49	838,100	–
Liberia	4,290,000	50	2,132,130	–
Mali	15,300,000	40	–	–
Mauritania	3,890,000	60	–	–
Nigeria	173,600,000	48	86,800,000	5,636,008
Senegal	14,130,000	44	6,174,810	8,217,475
Sierra Leone	6,090,000	40	–	–
OUTSIDE OF WEST AFRICA				
Comoros	735,000	28	735,000	–
Djibouti	872,000	77	872,000	–
Egypt	82,060,000	43	–	–
Gabon	1,672,000	87	1,457,984	–
Madagascar	22,920,000	35	–	–
Mauritius	1,296,000	40	–	–
TOTAL POPULATION	399,175,000	Coverage	130,144,264	16,645,574

Green: Considered opportunities for rice fortification

Violet: Unknown, and further information necessary

Orange: Unlikely that large volumes of rice could be fortified to benefit a broad segment of the population

the great majority is handled by a few multinational traders, which will facilitate implementation and enforcement of adequately fortified rice.

On the other hand, fortifying rice after importation (using imported or domestically produced kernels) could be very costly. Rice is imported via several modes of transportation, from bulk

shipments to bags in containers and bulk holds. Where rice is imported already bagged for retail, blending after importation and repackaging could be cost-prohibitive. Another disadvantage is that domestic blending of fortified rice will require greater regulatory resources from local government compared to monitoring imported rice at a centralized location such as the port.

Justification

Fortification of imported rice potentially feasible; could reach the urban population (44% of population).

Fortification of imported rice is potentially feasible; because no rice is grown or milled domestically and rice is the primary staple grain; fortification would reach the entire population.

Fortification of imported rice is potentially feasible and would reach the urban population (44% of population).

Fortification of imported rice is potentially feasible and would reach the urban population (60% of population).

Fortification of imported rice is potentially feasible and would reach the urban population (54% of population). There may be limited coverage in rural areas that consume imported rice.

No. Only 37% of the population is urbanized, and this population also consumes both imported and domestically grown rice. Domestic rice is hand pounded and accounts for the majority of rice consumption.

Fortification of imported rice is potentially feasible and would reach the urban population (49% of population). Rice imports are closely tied to the cashew export industry on a barter basis which may complicate the costs of fortification. Some coverage in rural areas that consume imported rice.

Fortification of imported rice is potentially feasible and would reach the urban population (50% of population).

No. Only 40% of the population is urbanized and this population also consumes both imported and domestically grown rice. Domestic rice is small milled and accounts for the majority of consumption.

Domestic milling information required for a conclusion, but expected low impact of rice fortification. Imported rice and domestically produced rice are approximately equal shares and wheat flour is the primary staple.

Success of rice fortification is highly dependent on the ability to regulate cross-border trade. If all imports were fortified (including illegal imports), fortified rice could reach the urban population (48% of population). Domestic rice milling capacity is growing but 30% of rice at most is industrially milled.

Fortification of imported rice is potentially feasible and would reach the urban population (44% of population). There may be limited coverage in rural areas that consume imported rice. Fortification of domestic rice production could be possible in the short-term future, as the milling industry is growing quickly.

No. Small imported rice quantities. Domestic rice is small-milled and accounts for the majority of consumption.

Fortification of imported rice is potentially feasible. Because almost no rice is grown or milled domestically and rice is the primary staple grain, fortification would reach the entire population.

Fortification of imported rice is potentially feasible since no rice is grown domestically. However, wheat flour is the primary staple.

Additional information necessary for a conclusion. Rice fortification depends on the domestic rice-milling industry, which reportedly accounts for 100% of industrial milling; imported rice is a small proportion of rice consumed. Wheat flour is the primary staple.

Fortification of imported rice is potentially feasible and would reach the urban population (87% of population).

No. Only 35% of the population is urbanized, and this population also consumes both imported and domestically grown rice. Domestic rice is small-milled and accounts for the majority of consumption.

Additional information necessary for a conclusion. Rice is primarily imported and may be an opportunity but wheat flour is the primary staple.

Total potential population coverage through fortified rice: **146,789,838**

Barriers to rice fortification

The opportunities for rice fortification are accompanied by important implementation barriers that must be addressed prior to considering a mandatory rice fortification policy.

Regulatory monitoring at porous land borders and seaports

Rice is an essential commodity for food security and stability, and African rice policies are constantly in flux: duties are raised or lowered depending on global rice prices or expected short-

ages in the domestic rice crop. These policies result in opportunistic rice trade that can quickly change with the rice policy.

For example, an estimated 70% of the rice imported into Benin's Port of Cotonou in 2014 was illegally destined for Nigeria, due to more favorable rice import duties in Benin. Fortification of rice in Nigeria directly impacts Benin and vice versa. Coordinated efforts are required to ensure that all imports are properly fortified regardless of their final destination.

All countries planning to introduce imported rice fortification, particularly in Africa, have to take regulatory monitoring

TABLE 5: Bilateral rice imports to opportunity countries, by rice import origin, metric tons (2014/2015) ^{1,13}

COUNTRY	India	Thailand	Pakistan	Vietnam	Brazil
Benin	589,558	614,914	17,718	26,908	13,860
Cape Verde	20	18,361	24	1,820	6,816
Comoros	0	0	80,000	0	0
Côte d'Ivoire	207,531	356,776	65,697	225,525	0
Djibouti	148,575	285	31,255	0	0
Gabon	383	68,408	0	0	0
The Gambia	38,374	31,390	27,611	0	22,796
Ghana	62,063	126,630	8,351	334,555	-
Guinea-Bissau	4,595	11,625	37,785	0	375
Liberia	260,368	1,622	337	0	0
Nigeria	127,210	644,131	27	0	11,072
Senegal	685,482	240,113	11,174	545	50,082
TOTAL	2,124,158	2,114,255	279,978	589,352	105,002

at points of entry seriously. Sources in Madagascar estimate that as much as 30% of rice imports records are falsified to take advantage of the 0% duty on rice imports.⁸ Without strong regulatory monitoring of sea and land borders, mandatory rice fortification in one country could lead to smuggling of cheaper, non-fortified rice from a neighboring country.

Government interventions: rice self-sufficiency policies and price interventions

After the 2008 global rice crisis,⁹ several countries in Africa (particularly Senegal, Benin, Mali, Côte d'Ivoire, Nigeria and Sierra Leone) created national rice self-sufficiency and price intervention policies intended to reduce the national dependence on imported rice. Mandatory fortification of imported rice may seem to be a direct contrast to self-sufficiency priorities. Instead, policies should consider how rice fortification will apply to both the imported and domestic rice industries. Rice fortification can be phased into domestic rice milling as the industry modernizes.

“Regional action will have the greatest likelihood of bringing fortified rice to the tables of 146 million people living in Africa”

Conclusion

Regional activity required for scale

Rice fortification in one or two countries in Africa will likely not significantly change the economics of rice fortification. For impactful rice fortification at scale and to address the porous

borders in this region, regional action will have the greatest likelihood of bringing fortified rice to the tables of 146 million people living in Africa. At the same time, rice fortification does not exist in a vacuum. In opportunity countries, evaluating the compliance, coverage and nutrient contribution from existing mandatory fortification efforts of other staple foods (e.g., wheat flour, oil and salt) would be beneficial to understand the potential implications of rice fortification.

To create sufficient demand for fortified rice in Africa, a collective strategy is necessary – individual country action will fail to achieve the scale necessary for rice fortification to succeed as a public health intervention.

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USA	Uruguay	Senegal	Myanmar	Others	TOTAL
–	8,100	251	0	126,463	1,397,771
3	2,597	4	0	631	30,275
0	0	0	0	0	80,000
14,210	0	0	74,298	8,564	952,601
68	0	0	0	118	180,301
0	0	0	0	56	68,847
67	9,627	66	0	9,938	139,871
106,248	0	0	3,126	3,362	644,334
0	4,950	7,662	0	999	67,991
5,285	0	0	0	3,511	271,123
75	0	0	0	583	783,098
18,445	14,422	0	0	91,095	1,111,357
144,402	39,696	7,983	77,424	245,319	5,727,569

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13. UN Comtrade 2014 import quantities were triangulated with FAO, USDA, and Key Consulting estimates (via importer interviews). Where UN Comtrade aligned with both FAO and USDA, UN Comtrade quantities were used because by-origin-country quantities were available. If UN Comtrade import quantities were not available for a given country then reported export quantities from UN Comtrade 2015 were used instead (Djibouti, Egypt, Gabon, Guinea, Guinea-Bissau, Liberia, Mali, Nigeria, Sierra Leone). For Ghana, UN Comtrade 2013 was the most recent data available. Only countries representing 1% or greater of total rice exports are presented. Abbreviations: MT, metric ton; USA, United States of America.