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Understanding the Rice Value Chain in South and Southeast Asia:

Opportunities, Challenges, and Way Forward for Rice Fortification

ACKNOWLEDGMENT

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Abbreviations and Notes

ASEAN	Association of Southeast Asian Nations
CLN	National Logistics Center
DFTQC	Department of Food Technology and Quality Control
DoHS	Department of Health Services
DepEd	Department of Education
EXIM	Export Import
FAO	Food and Agriculture Organization
FMTC	Food Management and Trading Company Limited
FOB	Free on board
FR	Fortified Rice
FRK	FR Kernels
GoN	Government of Nepal
GTC	Green Trade Company
HGSFP	Home-Grown School Feeding Programme
IDR	Indonesian Rupiah
INR	Indian rupee
Lao PDR	Lao People's Democratic Republic
LKR	Sri Lankan Rupee
MNDs	Micronutrient Deficiencies
MoH	Ministry of Health
MMT	Million Metric Tons
NPR	Nepalese rupee
PDS	Public Distribution System
PHP	Philippine Peso
RF	Rice Fortification
SAARC	South Asian Association for Regional Cooperation
SBN	SUN Business Network
SOE	State Owned Enterprise
SUN	Scaling Up Nutrition
THB	Thai Baht
ToR	Terms of Reference
UK	United Kingdom
US	United States
USD	United States Dollar
USDA	United State Department of Agriculture
VND	Vietnamese Dong
WFP	World Food Programme

Notes

1. In Phase 1 of the study, we at ValueNotes prepared five country-specific reports under the title Understanding the Rice Value Chain: Defining the Way Forward for Rice Fortification. We created these rice landscape reports for Cambodia, Indonesia, Pakistan, the Philippines, and Sri Lanka. Subsequently, similar reports were created for Lao PDR, Nepal and Timor-Leste.

2. The regional analysis report focuses on these eight countries. Additionally, India, Thailand and Vietnam are the key rice suppliers to many of these countries – and have therefore been included in this regional analysis.

3. Throughout the report, India, Nepal, Pakistan and Sri Lanka are referred to as South Asian countries, while Cambodia, Indonesia, Lao PDR, the Philippines, Thailand, Timor-Leste, and Vietnam are referred to as Southeast Asian countries.

4. Thus, the 11 countries under the scope of this study are: Cambodia, India, Indonesia, Lao PDR, Nepal, Pakistan, the Philippines, Sri Lanka, Thailand, Timor-Leste, and Vietnam.

Executive Summary

Fortifying food, alongside the promotion of a diverse, healthy, and balanced diet, helps reduce the prevalence of micronutrient deficiencies. With daily rice consumption the norm across South and Southeast Asia, fortifying rice is an obvious path toward improved nutritional outcomes for the large percentage of undernourished in the region.

The World Food Programme (WFP) has been promoting rice fortification for more than 10 years in its work with governments, the private sector, and technical partners throughout South and Southeast Asia. WFP provides financial and technical support for initiatives that include large-scale food fortification through commercial channels and social protection programmes, emergency relief, food assistance, and treatment of severe malnutrition in vulnerable populations.

This report considers the state of rice fortification in 11 countries in South and Southeast Asia, with particular attention given to the potential for increased trade within the region in fortified rice and fortified rice kernels (FR/FRK) and the benefits that trade would bring.[1]

More than 90 percent of the population in the countries within the region (Cambodia, India, Indonesia, Lao PDR, Nepal, Pakistan, Philippines, Sri Lanka, Thailand, Timor-Leste and Vietnam) consume rice daily, making rice an appropriate fortification vehicle. Countries under the scope of the study are at differing stages in scaling up their ability to fortify rice, and that constrains the availability of FR/FRK across the region in the near term.

These countries often trade rice with each other, which opens the possibility of regional trade in FR and FRK. This report considers the ways in which large-scale rice fortification across the region could be expedited and suggests actions for WFP in facilitating that result.

The regional analysis considers:

1. The major exporting countries which could act as potential FR/FRK hubs for countries where infrastructure development in rice fortification is at a nascent stage;
2. Potential trading partners for FR/FRK after considering the costs in the rice value chain; and
3. Support needed from WFP to coordinate among various stakeholders involved in the value chain.

The analysis considered parameters including rice export capacity, supply chain efficiency, FR/FRK capability, shipping costs, import tariffs, and landed price.

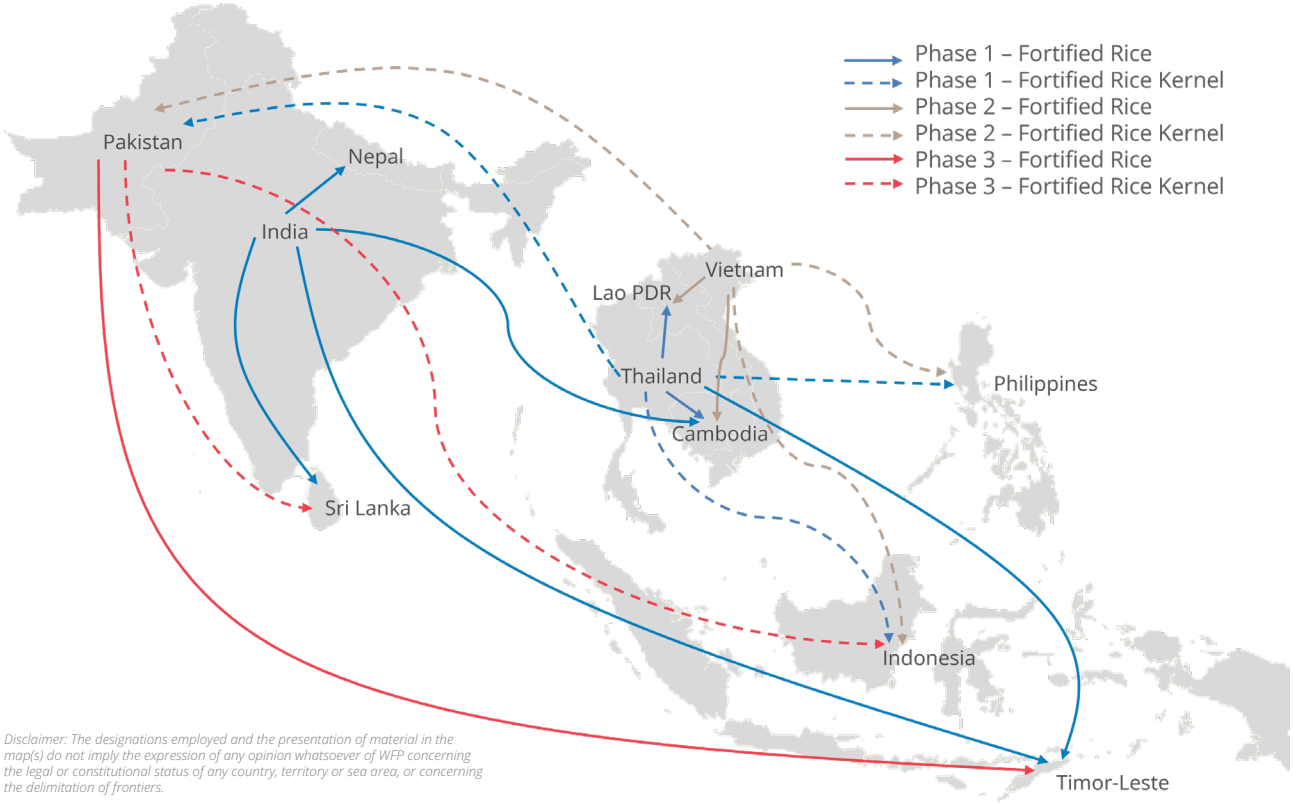
The major findings from the analysis are:

1. India, Vietnam, Thailand, and Pakistan dominate the global rice trade, contributing 62 percent to global trade. Each of these countries has the capability to become a potential FR/FRK export hub but they are at different stages of FR/FRK infrastructure development and will require time to develop as hubs. Hence, the hubs can be developed in a phased manner.

1 Paddy rice is the rice in the husk which is either gathered or still in the field.
Fortified rice kernels (FRK) are either coated rice kernels or extruded rice-shaped kernels prepared with a mix of vitamins and minerals.
Fortified rice (FR) is the process of adding vital vitamins and minerals to the regular rice by blending FRK, which increases its nutritional value.

Phases	Stage of FR/FRK infrastructure development	Hubs
Phase 1: Short term	Countries where the infrastructure is already developed	India Thailand
Phase 2: Medium term	Countries where the infrastructure is partially developed	Vietnam
Phase 3: Long term	Countries where there is no existing infrastructure	Pakistan

2. Based on the classification of phases, the potential trade flows are mapped below.



The potential trade flows are classified in various categories and the flows are shown through arrows from source country to destination country. The classification has been done as follows:

Phase 1: India and Thailand have an established FR ecosystem and could start exporting in the short term. India has the lowest cost of production in the region and could serve as a major FR/FRK export hub, especially to South Asian countries. Thailand could be developed as an export hub for Southeast Asia.

Phase 2: Vietnam has built the necessary infrastructure to export FR, but FRK infrastructure still needs to be developed. Once this is done, Vietnam could be a strong export hub in the Southeast Asia region. The cost competitiveness of Vietnam vis-à-vis Thailand might make Vietnam FR exports more attractive to Southeast Asian importers.

Phase 3: Pakistan has recently begun exploring the development of its domestic FR/FRK infrastructure. Even though its rice milling infrastructure is good, the FR/FRK ecosystem in Pakistan is underdeveloped and constrained by a lack of awareness among consumers and industry stakeholders and lack of a suitable regulatory environment. Efforts to develop the FR/FRK ecosystem face strong headwinds due to the current economic crisis in Pakistan. However, given its robust rice industry, Pakistan could emerge as an export hub for FR/FRK in the long run.

Therefore, the recommendations for WFP to ensure the successful commercialization of FR/FRK within the region are as follows:

1. Engage with government decision makers to facilitate the development of harmonized rice fortification standards and to design a robust monitoring system.

2. Advocate with government entities and regional trade blocs to reduce taxes and import duties on FR/FRK trade to lower the final cost of FR to consumers.

3. Conduct periodic meetings/workshops with:

    - importers, to increase their awareness of the economic and health benefits of consuming FR; and

    - exporters, to inform them about the health benefits of consuming FR, rice fortification standards, and the business opportunities in FR trade with the importing countries.

4. For regional trade to succeed, importers need to be aware of FR/FRK exporters and vice versa. To connect importers and exporters and generate awareness about rice fortification, WFP should organize frequent seminars/conferences and organize trade delegations and promote South-South Cooperation between countries to promote the accessibility, availability and affordability of fortified rice. WFP can also engage with relevant stakeholders to facilitate partnership between large exporters and the private sector in importing countries by facilitating joint ventures, business partnerships, and setting up subsidiaries through active engagement of the SUN Business Network.

5. Approach development partners to fund the development of the FR/FRK export hubs.

WFP could use the hubs to facilitate market access for FR/FRK to other regions with a high prevalence of micronutrient deficiencies, such as Africa, and create additional demand for exporters. This would improve the commercial returns/viability for those who invest in developing of FR/FRK capacity.

Effective coordination and a long-term commitment among all stakeholders are essential factors for successful regional trade in FR/FRK. In the long run, a combination of government backing and growing public acceptance will contribute to the creation of a sustainable ecosystem that will considerably reduce micronutrient deficiencies in the region.

Introduction

Background

1. Status of micronutrient deficiencies

South and Southeast Asian[2] countries are weighed down by the triple burden of malnutrition — high stunting and wasting rates, growing incidence of obesity, and widespread micronutrient deficiencies. The populations of Cambodia, Indonesia, Lao PDR, Nepal, Pakistan, the Philippines, Sri Lanka, and Timor-Leste face high levels of food insecurity due to the prevalence of hunger and malnutrition. High rates of anemia and stunting affect the most vulnerable groups of the population. The prevalence of micronutrient deficiencies indicates the insufficient micronutrient intake of the population (WFP 2021).

The prevalence of undernourishment across countries under the scope is provided below:

Figure 1: Prevalence of undernourishment (%) in the population (2021)

Country	Population (m)	Prevalence (%)
Timor-Leste	1	26%
Pakistan	221	13%
Philippines	111	9%
Indonesia	274	9%
Sri Lanka	22	7%
Cambodia	17	6%
Lao PDR	7	5%
Nepal	30	5%

Source: World Bank, ValueNotes analysis

A diversified, healthy, and balanced diet is the best way to tackle micronutrient deficiencies. Such a diet is difficult in most of the countries in the report due to social, economic, and food security reasons. The current global food crisis, due to the effects of COVID-19 and geopolitical tensions, has exacerbated the economic constraints on better nutrition across the region.

Enhancing ongoing nutrition initiatives such as those of the SUN Business Networks (SBN), WFP, and other development partners would be one of the most affordable and effective way to improve the nutritional health of the population and address the food crisis. The streamlining of the ongoing Food Systems Initiative and the food fortification initiatives (particularly rice and wheat) in several countries would be an appropriate medium to address the current distress created by the food crises in the region.

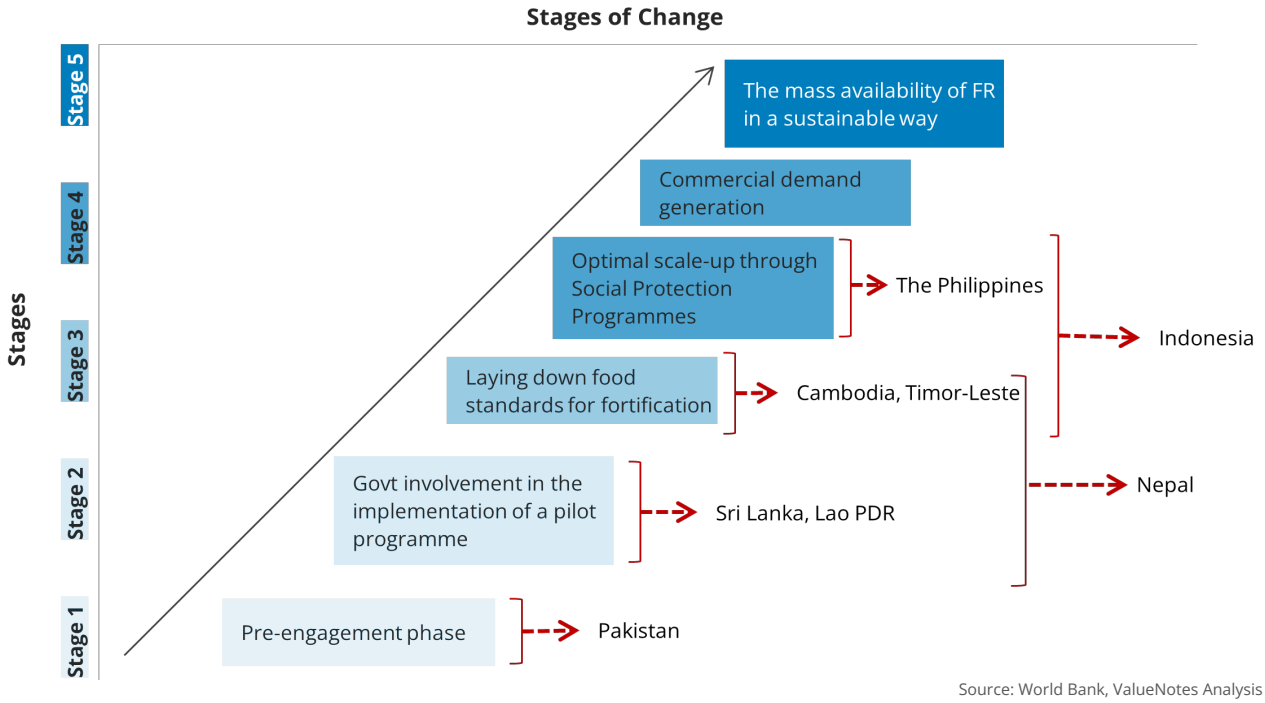
2. Status of rice fortification in South and Southeast Asia

Rice is the most appropriate food vehicle for fortification as more than 90 percent of the population in South and Southeast Asia consumes it daily. WFP initiated a rice landscape study to understand the opportunity for commercial scale-up and potential for rice fortification in eight countries.

Phase 1 of the study focused on five country-specific reports titled Understanding the Rice Value Chain: Defining the Way Forward for Rice Fortification. These reports were created for Cambodia, Indonesia, Pakistan, the Philippines, and Sri Lanka. Subsequently, similar reports were created for Lao PDR, Nepal, and Timor-Leste in Phase 2. The figure below provides a schematic view of the current stages of rice fortification across countries under the scope.

2 The regional analysis report focuses on the following countries: Cambodia, India, Indonesia, Lao PDR, Nepal, Pakistan, Sri Lanka, Thailand, the Philippines, Timor-Leste and Vietnam. Throughout the report, India, Nepal, Pakistan and Sri Lanka are referred to as South Asian countries, while the remaining are referred to as Southeast Asian countries.

Figure 2: Countries at different stages of rice fortification scale up



Source: World Bank, ValueNotes Analysis

The early adopters of rice fortification are ahead of the curve but many countries are far behind in the scale-up process. The slow progress of FR adoption can be attributed to various structural, technical, financial, and awareness-related barriers. The country reports primarily focused on the feasibility of making FR available to the most vulnerable groups in these countries. The reports focused on understanding these barriers in detail and providing actionable insights for a sustainable commercial scale-up of rice fortification. A brief on the progress of rice fortification scale-up with the support of WFP and government entities is mentioned in the next section.

3. WFP Initiatives in Rice Fortification

For more than a decade, WFP has been working with governments, private sector and technical partners across the Asia-Pacific region, to provide technical assistance on policy and regulatory frameworks, advocacy, analysis and evidence generation, programming, and consumer awareness about rice fortification.

The table below provides a snapshot of various initiatives taken by WFP towards rice fortification in countries under the scope of this study.

Table 1: Initiatives undertaken by WFP in the countries

Country	Year	Description
Cambodia	2010	• Acceptability trial for fortified rice by WFP and Institut de Recherche pour le Développement
	2012-2013	• Fortified Rice for Schoolchildren in Cambodia (FORISCA) trial undertaken by the Royal Government of Cambodia, WFP, Programme for Appropriate Technology in Health, Institut de Recherche pour le Développement, and DSM
	2016-2018	• Pilot-scale distribution of FR to ~57,000 students, under the Home-Grown School Feeding Programme, in partnership with the Ministry of Education, Youth and Sports
	2019	• Executed the blending of FRK with regular rice with the help of Green Trade Company for the first time in the country
	2021	• Supported SUN Business Network in the development of the five-year strategy to promote nutrition awareness and the consumption of fortified food items
	2022	• Technical training workshops planned for 15 private rice millers to support the development of domestic blending capabilities
Indonesia	2021	• Completed the Rice Fortification Landscape Analysis in collaboration with the Ministry of National Development Planning • In the process of finalizing digital nutrition education materials to promote healthy diets among school-aged children in a hybrid (online-offline) learning context
Lao PDR	2017	• Conducted a landscape analysis of rice fortification in association with the Government of Lao PDR • Assisted the Technical Working group and the National Nutrition Committee Secretariat on Food Fortification in launching the Food Fortification Strategic Action Plan for Lao PDR
	2018	• Assisted the Technical Working group and the National Nutrition Committee Secretariat on Food Fortification in launching the Food Fortification Strategic Action Plan for Lao PDR
	2021	• Introduced FR as a part of a school meal programme, targeted to reach 63,000 school children
	2022	• Conducted an orientation meeting for the National Food Fortification Technical Working Group to set the rice fortification standards • In the process of engaging with large millers to spread awareness about rice fortification and its benefits • Currently discussing with selected millers the feasibility of producing FR and FRK commercially
Nepal	2016	• Technical assistance provided to Government of Nepal for commissioning a landscape analysis of rice fortification
	2017	• First national conference on rice fortification, convened in Kathmandu by Department of Health Services, Department of Food Technology and Quality Control, and Food Management and Trading Company Limited in association with WFP
	2019-2020	• Memorandum of Understanding signed between WFP and Government of Nepal to introduce FR under existing school feeding programme, and distribute FR to remote/food insecure districts at subsidized prices through Food Management and Trading Company Limited • National standards for rice fortification developed and shared with the Government of Nepal
	2020-2021	• Fortification equipment installed in one of the mills owned by Food Management and Trading Company Limited in Rajapur, for a trial run of the rice fortification process
	2021-2022	• Establishment of Fair Price Shops, crucial for the distribution of FR, in remote districts of the country
Pakistan	2021	• Completed the landscape analysis for rice fortification

Philippines	2021	•	Served FR to 23,000 schoolchildren in 69 schools in Maguindanao, in collaboration with the Department of Education
Sri Lanka	2016	•	An acceptability trial was conducted by the Faculty of Agriculture of Peradeniya University supported by WFP
	2017	•	Held a National Food Fortification Workshop for Rice and Wheat Flour along with the Ministry of Health
	2019-2020	•	Implemented rice fortification pilot programme in Anuradhapura district
	2021	•	Conducted a multi-scenario costing analyses to inform advocacy efforts for rice fortification
Timor-Leste	2008	•	WFP signed a MoU with Govt. of Timor-Leste on food fortification
	2017	•	WFP conducted rice landscape analysis to understand the viability of launching rice fortification
	2019	•	Assisted the Government of Timor-Leste in conducting pilot-scale rice fortification acceptability trials
	2020	•	Distributed fortified rice donated by USDA for school feeding programme under the McGovern-Dole Food for Education Program
	2021	•	Installed a blending machinery at a National Logistics Center warehouse in Tibar to facilitate local production of fortified rice
	2022	•	Submitted the final version of the Food Fortification Decree-Law to Ministry of Tourism, Commerce and Industry. The law mandates all rice in the country to be fortified • A batch of fortified rice produced and distributed by National Logistics Center, leveraging the blending machinery installed by WFP • In the process of introducing mineral and vitamin-rich FR as part of the school meals programme

4. Regional Rice Trade Analysis

The findings of the landscape reports showed that while some have well-developed rice markets and have invested in FR/FRK infrastructure, others lag far behind. The reports also highlighted that the region contains both rice exporters, such as Cambodia and Pakistan, and importers, such as Nepal, the Philippines, and Timor-Leste.

Exploring options for increased regional trade to enhance adoption of fortified rice across the region is essential given the disparity in rice and FR/FRK production capabilities and infrastructure. While some of the countries listed above trade rice with each other, the major rice exporters in the region are India, Thailand, and Vietnam. These countries have therefore been included in this analysis, to take advantage of existing supply chains in the region and minimize eventual consumer costs.

This report aims to assess the potential for regional trade in FR/FRK, and determine the most suitable trade partners for each country. While each country builds its own infrastructure, the varying pace of development can be addressed in the near term by regional trade. This regional trade will initially be more cost-efficient and can act as a catalyst for further domestic efforts.

A regional approach can help address the challenges posed by the significant levels of malnutrition in these countries and will also help WFP and development partners to better engage with the private sector and the governments in the region.

1. Rice Value Chain in South and Southeast Asia

Rice plays a major role in international trade. Rice exports, which amounted to 48.271 million metric tons (MMT) in 2020, bring foreign currency revenues to exporters and food to countries that need it. According to the Food and Agricultural Organization of the United Nations (FAO), global rice demand will increase by 30 percent by 2050.

The South and Southeast Asia region plays a crucial role in ensuring global rice supply. As a whole, the region is a major global producer with a high level of domestic consumption (Yuan 2022). More than 90 percent of the population in South and Southeast Asia consume rice daily, making rice an appropriate fortification vehicle.

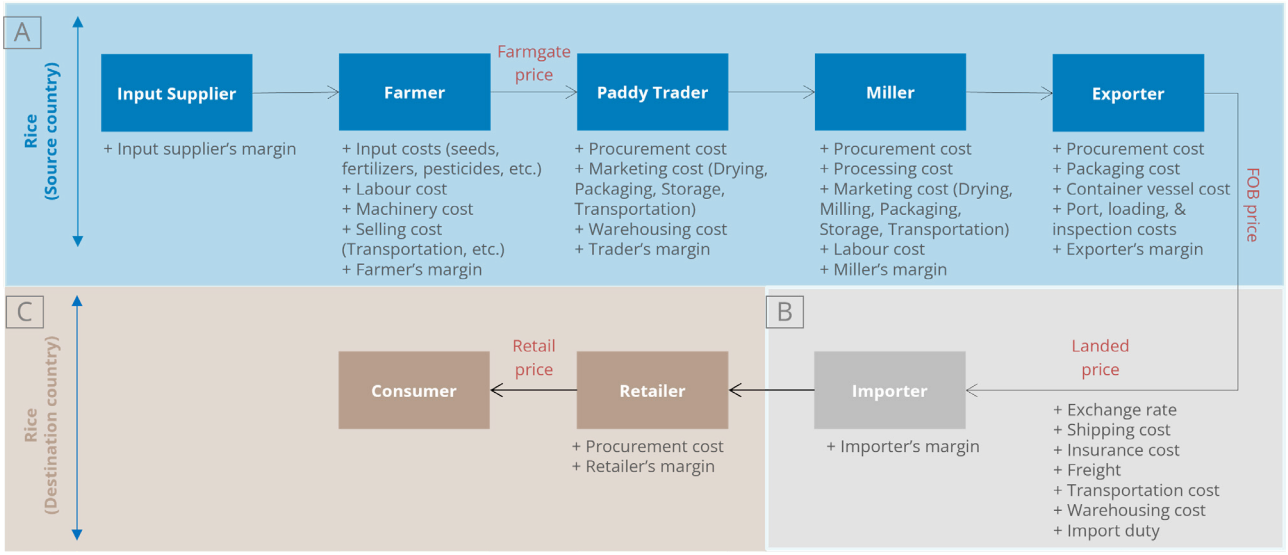
However, there is a wide variance in both rice production capabilities and fortification efforts. Reducing costs of FR/FRK will improve consumer acceptance and to do that, scale-up efforts must include the synergies provided by regional trade. Since countries within the region already trade rice with each other, promoting regional FR/FRK trade is easier in some cases than it would have been otherwise.

A regional analysis aimed at optimizing existing value chains throws light on the best way to hasten rice fortification scale-up. But first the rice value chain in the respective countries needs to be analyzed.

1.1 Value Chain Participants and Associated Costs

The rice value chain shows the trade flows for rice, starting in the source (exporting) country and ending with the final consumer in the destination (importing) country. The chain starts with inputs for paddy production, then aggregation and transportation of paddy to rice mills, then rice processing in the source country. The rice in the source country is then exported to the destination country, wherein the imported rice is marketed and delivered to consumers.

The figure below describes the rice value chain, including the value chain participants and the various cost components incurred at each point of the chain until it reaches the final consumer.



Source: (Maneechansook 2011), (Pavithra, et. al. 2017), (Christophe Alliot 2018), ValueNotes Analysis

Note: The grey text indicates the cost components and margins added by the participant in the value chain. The red text indicates the selling price of paddy/rice.
The figure has been divided into three parts (A, B, and C):
A. Value chain from the farmer to the exporter in the source country
B. Value chain from the exporter in the source country to the importer in the destination country
C. Value chain from the importer to the consumer in the destination country
A more detailed analysis of value added at different stages of the value chain is provided in chapter 3.

1.2 Role of Participants

The rice value chain begins with the farmer, the key actor in paddy production. The farmer sells the paddy to the paddy trader, who engages solely in paddy aggregation. This is followed by the processing of rice by millers. The rice is then sold to exporters, who sell to importers in the destination country. Finally, the rice is sold to retailers, who sell it in the domestic market.

The roles of various entities involved in the rice value chain are mentioned below in detail:

Table 2: Rice value chain participants and their role

SN	Key players	Steps involved in
1	Input suppliers	• Supply inputs such as seeds, fertilizers, crop protection chemicals, pesticides, irrigation systems, etc. to farmers. They also provide technical advice on application methods.
2	Farmers	• Farmers are the paddy producers and they are classified as: 1. Large land-holding farmers: Organize paddy production on a large scale. Supply paddy to millers either directly or through intermediaries such as paddy traders and wholesalers. 2. Small land-holding farmers: Own small farms and sell paddy to the millers in the village marketplace via auction through paddy traders or commission agents.
3	Paddy traders	• Sell the paddy procured from farmers to millers directly or through intermediaries such as wholesalers.
4	Millers	• Perform processes such as paddy collection, cleaning, de-husking, polishing, grading, packaging, and labeling. • Process milled rice and sell it in domestic and export markets directly or through wholesalers, traders/ importers (Rice Value Chain: Food Loss Analysis 2017)
5	Exporters	• Large millers usually perform both milling and exporting and supply rice to international markets. • Some exporters do not mill rice but buy rice from mills for export.
6	Importers	• Includes governments, importing companies, traders or wholesalers.
7	Retailers	• Buy rice from importers and wholesalers and sell at traditional grocery stores or in modern supermarkets.
8	Consumers	• Buy rice from multiple channels such as traditional grocery stores, e-commerce websites, retail stores, etc.

The value chain for fortified rice and fortified rice kernels will need to be built on the existing rice value chain. The roles of millers, exporters, importers, and retailers will include additional functions such as those involving producing FRK, blending FRK into rice, and packaging of fortified rice brands.

The fortified rice value chain will require the support of WFP and other development and technical partners which play a significant role in coordination among government entities, rice associations, millers, importers, exporters, and other relevant stakeholders. This role is crucial in providing technical assistance to millers in the production of FRK and blending of FRK into rice.

At the regional level, WFP's role will be substantial. WFP could help coordination among the trade associations, importers, and exporters between countries to facilitate trade of fortified rice and FRK. WFP, government entities, and rice and trade associations will also be crucial in creating awareness among value chain participants.

1.3 Value Addition

There are many participants in the export rice value chain, each adding value to the product at different stages. The selling price of a participant includes the addition of all costs and margin (Maneechansook 2011). The costs, margins, and selling prices of paddy/rice involved in the rice value chain are mentioned below in detail:

Table 3: Costs, margins, and selling prices involved in the rice value chain

Player	Costs & Margin	Description
Input Supplier	Input Supplier's Margin	The difference between the price at which inputs (seeds, fertilizers, equipment, etc.) are sold and the cost of procuring or producing the inputs.
Farmer	+ Input costs	The cost incurred by farmers to procure inputs such as seeds, fertilizers, pesticides, etc.
	+ Labour costs	Includes the wages that are paid to workers for sowing, tending, and harvesting rice at the farm.
	+ Machinery costs	Includes the costs borne by farmers to purchase and maintain agricultural machines such as tractors, harvesters, threshers, etc. Includes any interest, rent, or operation costs for machinery.
	+ Selling costs	Includes transportation and other selling expenses incurred by the farmer to dispatch the goods to the paddy trader
	+ Farmer's margin	The income difference between the price at which paddy is sold to traders or millers, and costs of producing paddy.
Farmer (Farmgate price) / Paddy trader procurement cost		The price received by farmers for their produce at the farm location. If the produce is sold at another location, the costs of transporting from the farm gate to the nearest market and market charges (if any) for selling the produce is not included in the farmgate price. The farmgate price is equal to the procurement cost for the paddy trader.
Paddy Trade	+ Marketing cost	Includes costs of drying, packaging, storage, and transportation of paddy to millers.
	+ Warehousing cost	The cost to store paddy. Includes rent, labour cost, insurance etc.
	+ Trader's margin	The difference between the costs incurred by the paddy trader and the price at which paddy is sold to millers.
Trader's selling price / Miller's procurement cost		The price at which rice is sold by the traders to the millers. This price is equal to the procurement cost for the miller.

Miller	+ Processing cost	The cost of procuring and milling paddy to produce rice. Includes costs of using machinery, electricity etc.
	+ Marketing cost	The costs of drying, packaging, storage and transportation of rice to retailers and exporters.
	+ Labour cost	The wages paid to labour for processing of rice.
	+ Miller's Margin	The difference between the costs incurred by the miller and price at which milled rice is sold.
Miller's selling price / Exporter's procurement cost		The price at which rice is sold by the millers to the exporters. This price is equal to the procurement cost for the exporter.
Exporter	+ Packaging cost	Cost of packaging rice to ensure there is no damages during transportation.
	+ Container vessel cost	Cost of the container to carry rice onboard ships, which depend on the size and weight of the container vessel and current international shipping rates.
	+ Port, loading, & inspection costs	The cost of inspection of rice at the port conducted by customs authority and the cost of loading the rice onto the ship.
	+ Exporter's margin	The difference between costs incurred by exporters and the price at which rice is sold to importers.
Free on board (FOB) Price		FOB price indicates that the liability and ownership of the goods have been transferred from a seller to a buyer, which means that if the goods are damaged or destroyed during shipping, the seller is not liable.
Exchange rate conversion to importer's local currency		
Importer	+ Shipping cost	All costs of shipping, handling, and other similar costs and expenses incurred with transportation of rice at the FOB price.
	+ Insurance cost	Charges paid to procure insurance against the buyer's risk or loss to the goods during transportation.
	+ Freight	Charges and fees paid to the shipping company to transport rice from the port of origin to its destination.
	+ Transportation Cost	Cost of transporting rice from the port to a warehouse or retailers. Calculated on the basis of weight of rice and distance traveled.
	+ Warehousing cost	The cost to store rice. Includes rent, labour cost, insurance etc.
	+ Import duty	Paid by the importer to the county's customs office.
Landed Price / Importer's procurement cost		Landed price is the total cost incurred while transporting rice from the rice exporter to the importer in the destination country. This cost includes the product's price and any other expenses incurred directly in obtaining the product, including the shipping, insurance, and freight charges.
Importer	+ Importer's margin	The difference between costs incurred to importers and the price at which rice is sold to retailers.
Importer's selling price / Retailer's procurement cost		The price at which rice is sold by the importers to the retailers. This price is equal to the procurement cost for the retailer in the destination country.
Retailer	+ Retailer's margin	The differential of retail rice price minus costs of procurement.
Retail Price		The final price at which rice is sold in the destination country.

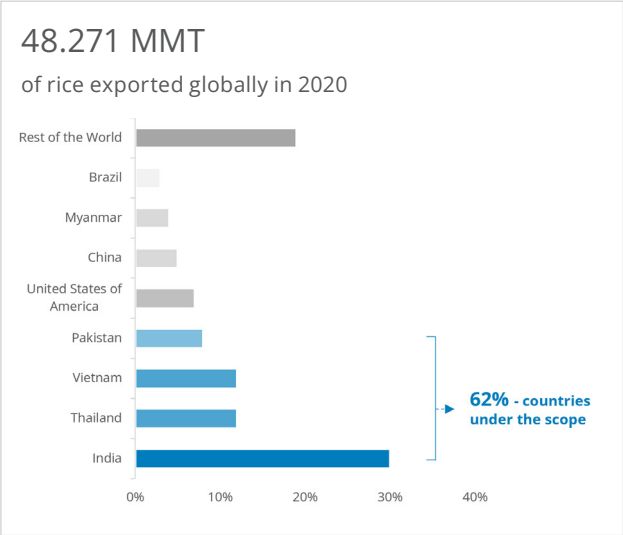
Source: (A. R. Durga 2018), (Economic Times n.d.), (Ortiz 2022)

Rice industry stakeholders in South and Southeast Asian countries are an integral part of the regional rice trade. Given the high level of trade between the countries under the scope of this report, it is essential to map the existing rice trade between the key importers and exporters in the region.

2. Regional Trade Analysis

Globally, rice exports amounted to 48.271 million metric tons (MMT) in 2020. India, Pakistan, Thailand, and Vietnam are the top four rice exporting countries, together contributing 62 percent of exports to global trade. As these countries are also involved in the regional rice trade, it is important to include these countries in the regional analysis for rice trade and scale up of rice fortification. The figure below shows the segregation of global rice exports as per the share of rice exports by the top eight countries globally.

Figure 4: Global rice exports (2020)



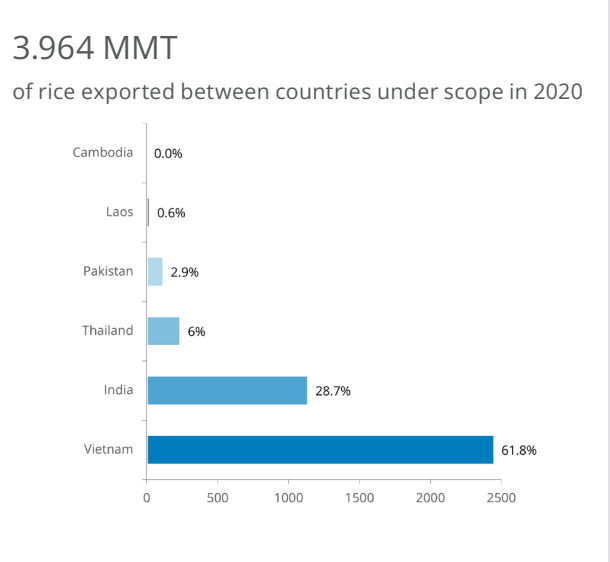
Source: UN Comtrade, Trademap, ValueNotes Analysis

2.1 Source (Exporting) Countries

India, Thailand, and Vietnam together supply more than 95 percent of the rice to the importing countries under the scope.

Figure 5 provides the percentage share of rice exports between the countries in the study.

Figure 5: Share of rice exports for countries under scope (2020)



Source: USDA, UN Comtrade, Trademap, ValueNotes Analysis

The export flows of India, Pakistan, Thailand, and Vietnam are explained in the subsequent sections. The export capability of Cambodia has not been analyzed further for two important reasons:

1. The amount of rice exports to the relevant region is insignificant.
2. The country only exports paddy to Vietnam due to limited processing facilities and the high cost of processing within Cambodia. The processed rice is then imported to Vietnam and sold in the domestic market.

Similarly, the export capability of Lao PDR has not been analyzed further as the volume of exports is insignificant. Moreover, it is a net importer.

2.1.1 Vietnam

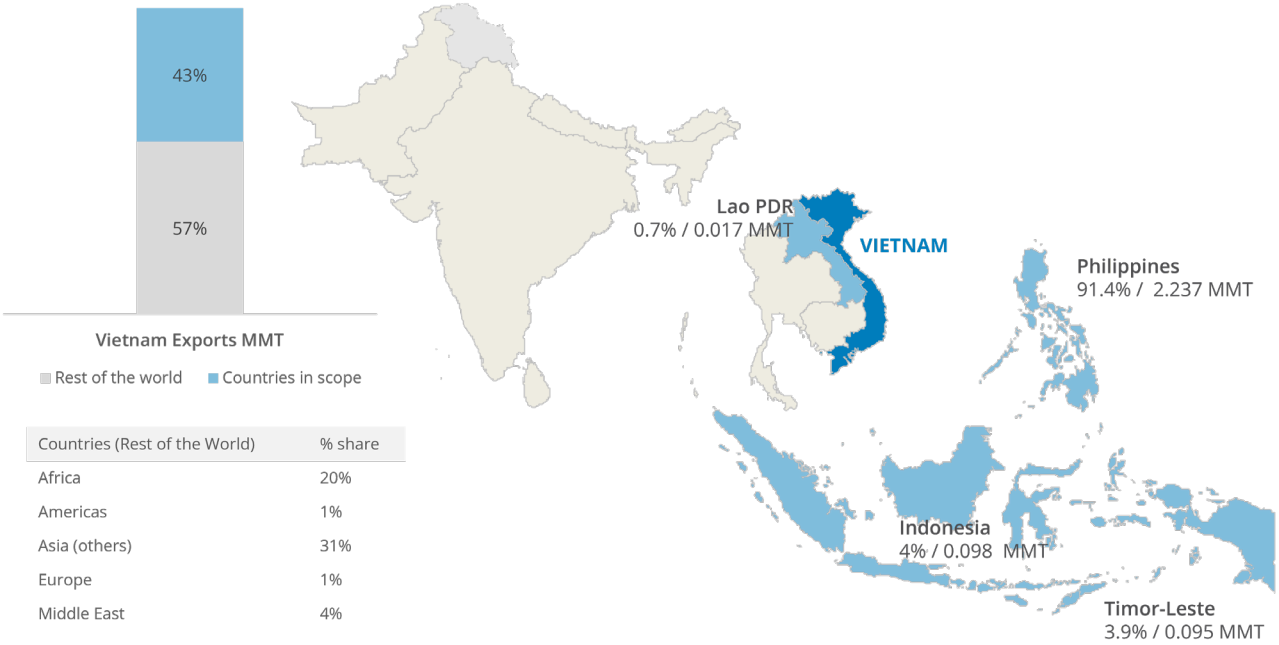
Forty-three percent of Vietnam rice exports in 2020 went to the countries under scope. This amounts to approximately 2.449 MMT of rice.

The Philippines was the largest importer of Vietnamese rice, amounting to more than 90 percent of its exports in the region.

The map below showcases the volume and percentage of exports from Vietnam to the Philippines, Indonesia, Timor-Leste, and Lao PDR.

Figure 6: Rice exports from Vietnam to importing countries under the scope

Source: Trademap, ValueNotes Analysis[3]



Countries (Rest of the World)	% share
Africa	20%
Americas	1%
Asia (others)	31%
Europe	1%
Middle East	4%

Disclaimer: The designations employed and the presentation of material in the map(s) do not imply the expression of any opinion whatsoever of WFP concerning the legal or constitutional status of any country, territory or sea area, or concerning the delimitation of frontiers.

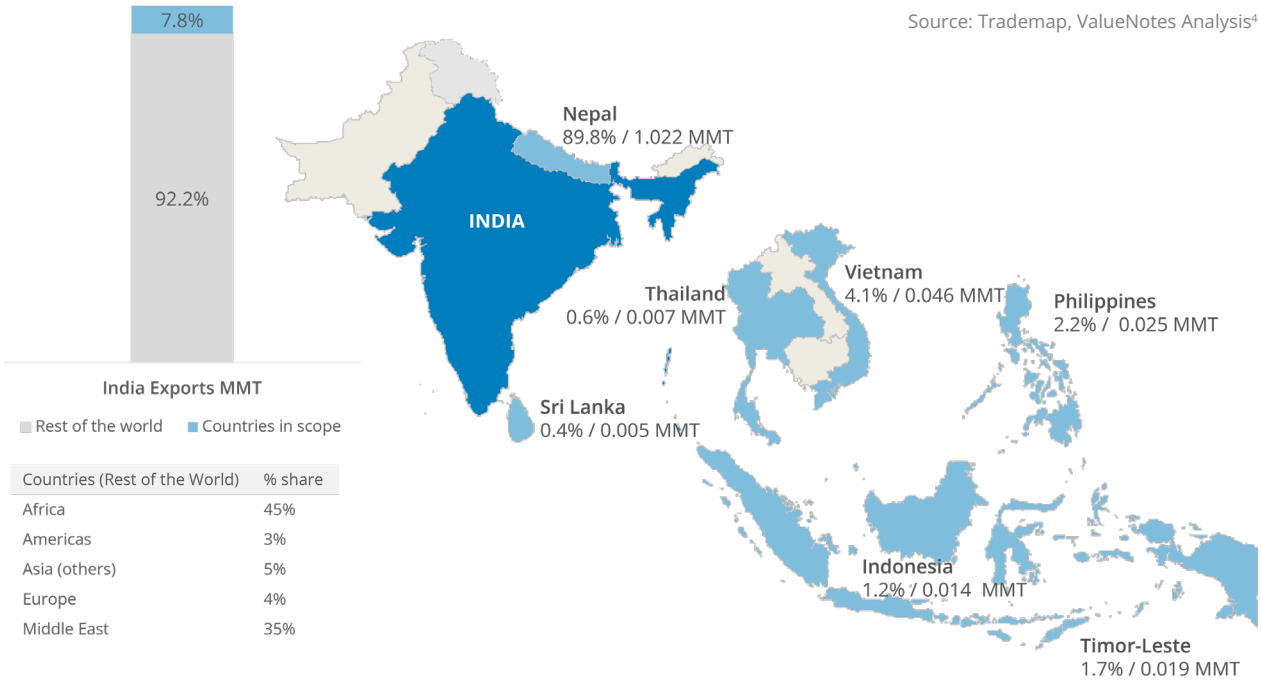
3 Asia (others) includes all Asian counties except for the 11 countries under the scope. Countries included in Middle East are Iraq, United Arab Emirates, Saudi Arabia, Qatar, Israel, Kuwait, Angola, Türkiye, Cyprus, Iran, Yemen, Oman, Jordan, Bahrain, Syrian Arab Republic, and Lebanon.

2.1.2 India

India exported 1.138 MMT of rice in 2020 to the countries concerned, which was 8 percent of its total global exports. The top importer for India is Nepal, which imported 1.022 MMT of rice from India in 2020.

The map below showcases the volume and percentage of exports from India to the countries under the scope.

Figure 7: Rice exports from India to importing countries under the scope



Source: Trademap, ValueNotes Analysis[4]

Countries (Rest of the World)	% share
Africa	45%
Americas	3%
Asia (others)	5%
Europe	4%
Middle East	35%

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4 Asia (others) includes all Asian counties except for the 11 countries under the scope. Countries included in Middle East are Iraq, United Arab Emirates, Saudi Arabia, Qatar, Israel, Kuwait, Angola, Türkiye, Cyprus, Iran, Yemen, Oman, Jordan, Bahrain, Syrian Arab Republic, and Lebanon.

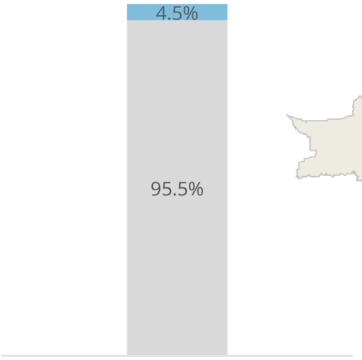
2.1.3 Thailand

Thailand exported 0.238 MMT of rice in 2020 to the countries under the scope, only 4 percent of its global exports.

The map below showcases the volume and percentage of exports from Thailand to the countries under the scope.

Figure 8: Rice exports from Thailand to importing countries under the scope

Source: Trademap, ValueNotes Analysis[5]



Countries (Rest of the World)	% share
Africa	47%
Americas	15%
Asia (others)	22%
Europe	6%
Middle East	5%

Disclaimer: The designations employed and the presentation of material in the map(s) do not imply the expression of any opinion whatsoever of WFP concerning the legal or constitutional status of any country, territory or sea area, or concerning the delimitation of frontiers.

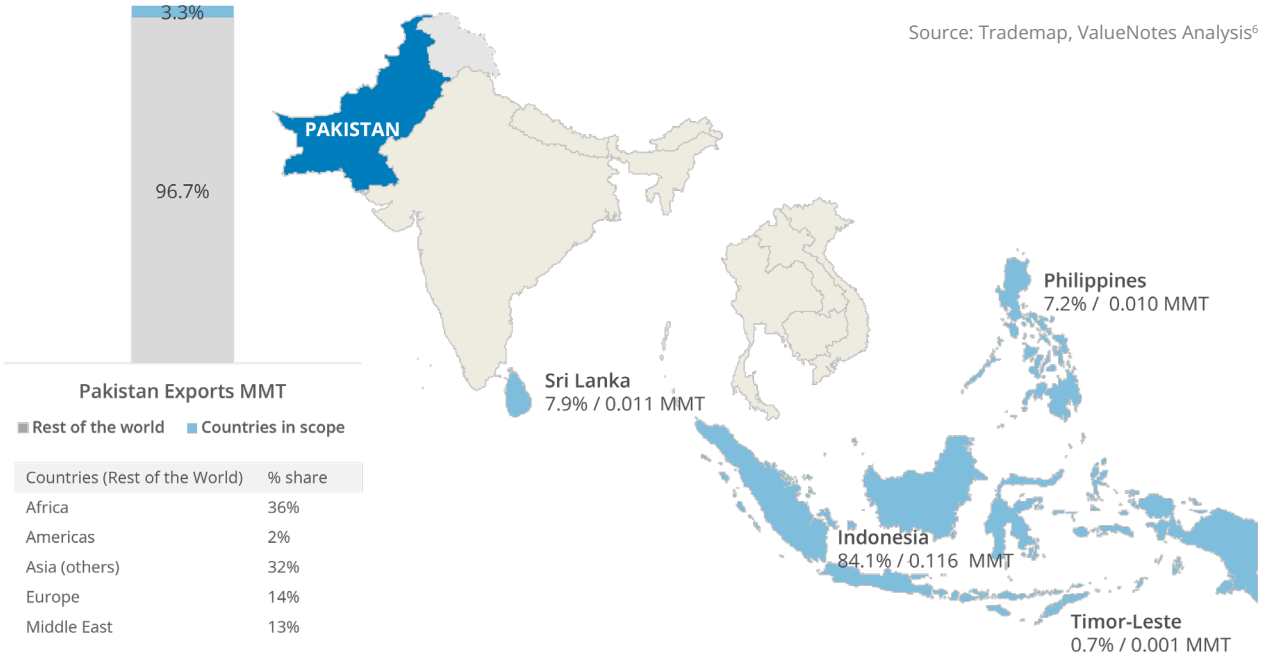
5 Asia (others) includes all Asian counties except for the 11 countries under the scope. Countries included in Middle East are Iraq, United Arab Emirates, Saudi Arabia, Qatar, Israel, Kuwait, Angola, Türkiye, Cyprus, Iran, Yemen, Oman, Jordan, Bahrain, Syrian Arab Republic, and Lebanon.

2.1.4 Pakistan

Pakistan exported 0.138 MMT of rice in 2020 to the countries under the scope, only 3.3 percent of its total global exports. In South & Southeast Asia, Indonesia is the key importer for the country.

The map below showcases the volume and percentage of exports from Pakistan to the countries under the scope.

Figure 9: Rice exports from Pakistan to importing countries under the scope



Countries (Rest of the World)	% share
Africa	36%
Americas	2%
Asia (others)	32%
Europe	14%
Middle East	13%

Source: Trademap, ValueNotes Analysis[6]

Disclaimer: The designations employed and the presentation of material in the map(s) do not imply the expression of any opinion whatsoever of WFP concerning the legal or constitutional status of any country, territory or sea area, or concerning the delimitation of frontiers.

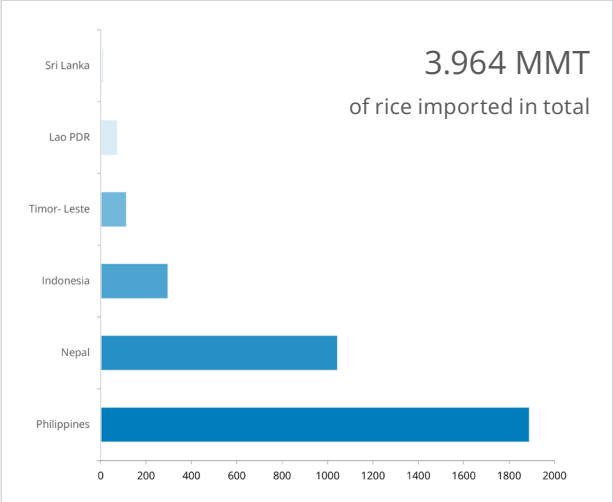
6 Asia (others) includes all Asian counties except for the 11 countries under the scope. Countries included in Middle East are Iraq, United Arab Emirates, Saudi Arabia, Qatar, Israel, Kuwait, Angola, Türkiye, Cyprus, Iran, Yemen, Oman, Jordan, Bahrain, Syrian Arab Republic, and Lebanon.

India, Pakistan Thailand, and Vietnam contribute significantly to the global rice trade. They have the potential to produce and trade fortified rice and FRK to countries outside the scope of the study. Thus, focusing on developing these countries as the hubs for fortified rice and FRK will benefit in the global expansion and acceptance of fortified rice.

2.2 Destination (Importing) Countries

The Philippines, Nepal, and Indonesia are the largest importers in the region, accounting for more than 94 percent of imports.

Figure 10: Share of countries in regional rice imports



Source: USDA UN Comtrade. Trademap, ValueNotes Analysis[6]

Note: The export and import data do not match due to unavailability of data. The import data only adds up to 3.443 MMT. To ensure consistency, we have considered the volume of exports and that of imports to be equal.

The table below provides further details of rice imports by countries in our scope. It elaborates the following details:

1. Share of imports in total consumption
2. Exporting country's share in total imports of the importing country
3. Key port/city used by the exporting country
4. Volume of imports (MMT)
5. Key rice variety imported

Table 4: Major trading partners for rice-importing countries

Importing Country	Share of Imports in total consump-tion (2020)	Exporting country's share in total imports	Major port/city of exporting country	Volumes (thousand Metric Tons) (2020)	Key rice variety imported
Philippines	19%	Vietnam (95.1%)	Cat Lai, My Thoi	2,237.40	5% broken white rice
		Thailand (3.4%)	Bangkok, Laem Chabang, Nakhon Pathom, Nakhon Phanom	79.60	5% broken white rice
		India (1.0%)	Hyderabad (Air), Kolkata, Nhava Sheva	24.70	Swarna white non-basmati rice
		Pakistan (0.4%)	Qasim (Karachi)	10.00	-
		Cambodia (0.01%)	Phnom Penh, Sihanoukville	0.30	-
Nepal	29%	India (100%)	Raxaul, Jogbani, Nepalgunj Road	1,022.00	Broken non-basmati white rice
Indonesia	<1%	Pakistan (36.7%)	Qasim (Karachi)	116.50	IRRI white rice
		Vietnam (30.9%)	Cat Lai	98.20	Japonica rice
		Thailand (28.1%)	Laem Chabang	89.40	100% broken white glutinous rice
		India (4.3%)	Nhava Sheva, Vizag, Kakinada	13.70	100% broken white rice
Timor-Leste	~70%	Vietnam (70.9 %)	My Thoi	95.80	5% broken white rice
		India (14.2 %)	Kakinada, Kolkata	19.20	25% broken non-bas-mati white rice
		Thailand (14.2%)	Bangkok, Laem Chabang, Nakhon Pathom, Nakhon Phanom	19.25	-
		Pakistan (0.7%)	Qasim (Karachi)	1.00	-
Lao PDR	4%	Thailand (76.7%)	Bangkok, Laem Chabang, Nakhon Pathom, Nakhon Phanom	58.40	-
		Vietnam (23.3%)	Cau Treo Painting, Ha Tinh	17.80	5% broken white rice
Sri Lanka	23%	Pakistan (70.4%)	Qasim (Karachi)	11.00	-
		India (29.1%)	Chennai, Tuticorin	4.54	Samba non-basmati rice

7 Sri Lanka is self-sufficient in rice production, however, 2020 was an exceptional year due to an ongoing economic and agrarian crisis. Usually, imports are less than 1% of domestic consumption, as seen from 2018 to 2020.

Analysis of the rice trade in the region suggests that the distance between countries plays a significant role in deciding where exports go. For instance, in addition to excellent bilateral ties, Nepal imports from India because of the minimal distance between the two countries, which results in low transportation costs. This distance factor must be considered in the framework for identifying potential trade partners in the region. Furthermore, the rice varieties traded in the region must be taken into account. For instance, most countries import white rice (5 percent broken) from the supplying nations. Particularly, Indonesia imports high volumes of 100 percent broken rice and Japonica rice (a fragrant variety).

An analysis of the value chain between source and destination countries will help in evaluating options to ultimately reduce the final price of rice, and optimize trading partners.

3. Rice Value Chain Analysis

The rice value chain analysis explains the cost differentials at each step of the value chain, the margins added by each participant, and the final landed price of rice in each country for each step in the chain:

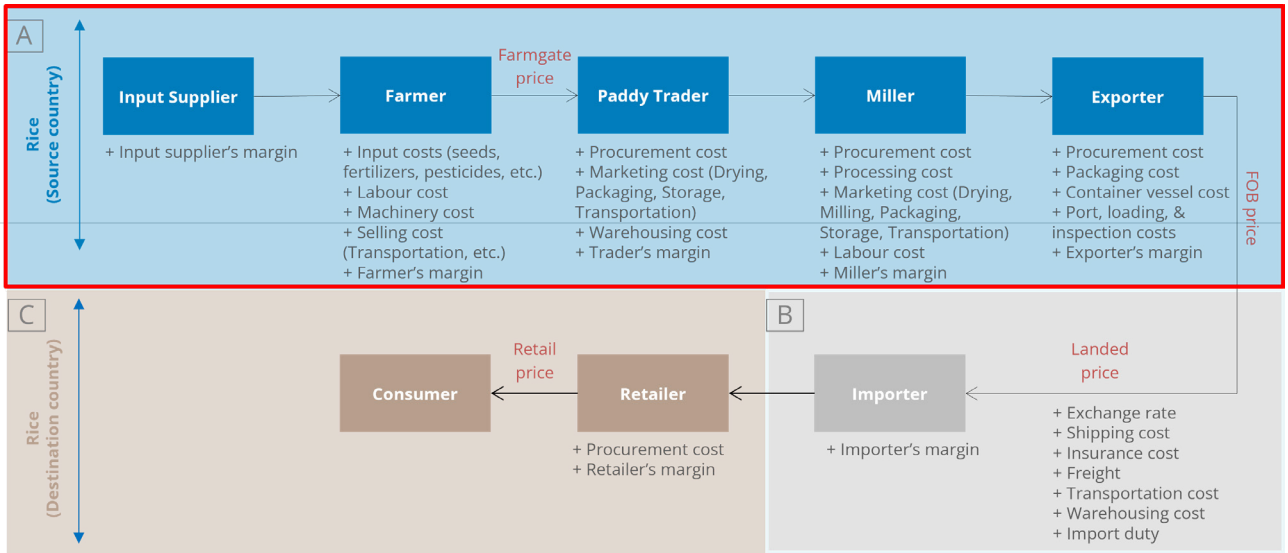
1. From farmer to exporter

2. From exporter to importer

3. From importer to retailer

Farmer to Exporter (FOB price)

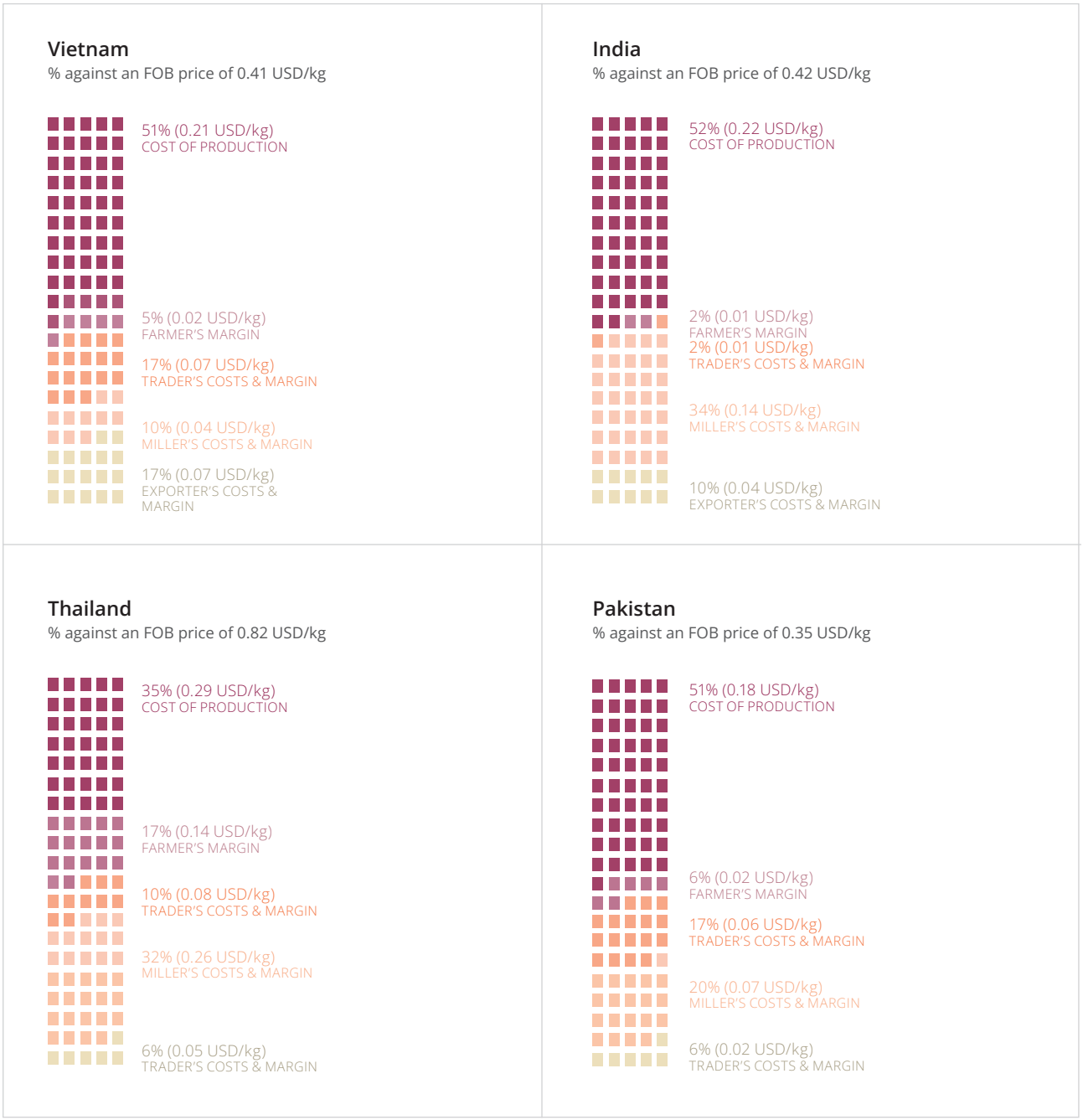
As discussed in section 1.1, Part A of the value chain concerns the value added by the farmer to the exporter in the source country.



The value addition in the price of rice by each of the participants in Vietnam, India, Thailand, and Pakistan is analyzed below.

For instance, in Vietnam, the initial cost of production of rice borne by the farmer is USD 0.21 per kg and the margin added by the farmer is 0.02 USD per kg. The trader's costs and margin amount to 0.07 USD per kg, followed by the miller's costs and margin, which adds up to USD 0.04 per kg. Lastly, the costs and margin of the exporter amounts to 0.07 USD per kg. Thus, the FOB price of rice is 0.41 USD per kg.

Figure 11: Value addition (USD/kg) across the rice value chain in exporting countries



Note: Average exchange rate for 2020 used. [8, 9] Source: (Christophe Alliot 2018), (Dao The Anh 2020), (Pavithra, et al. 2017), ValueNotes analysis

The percentages in the bars indicate the percent share of the particular parameter in the total cost. For instance, the farmer's margin in Vietnam is 0.02, which is 5 percent of the total FOB price of rice (USD 0.41 per kg).

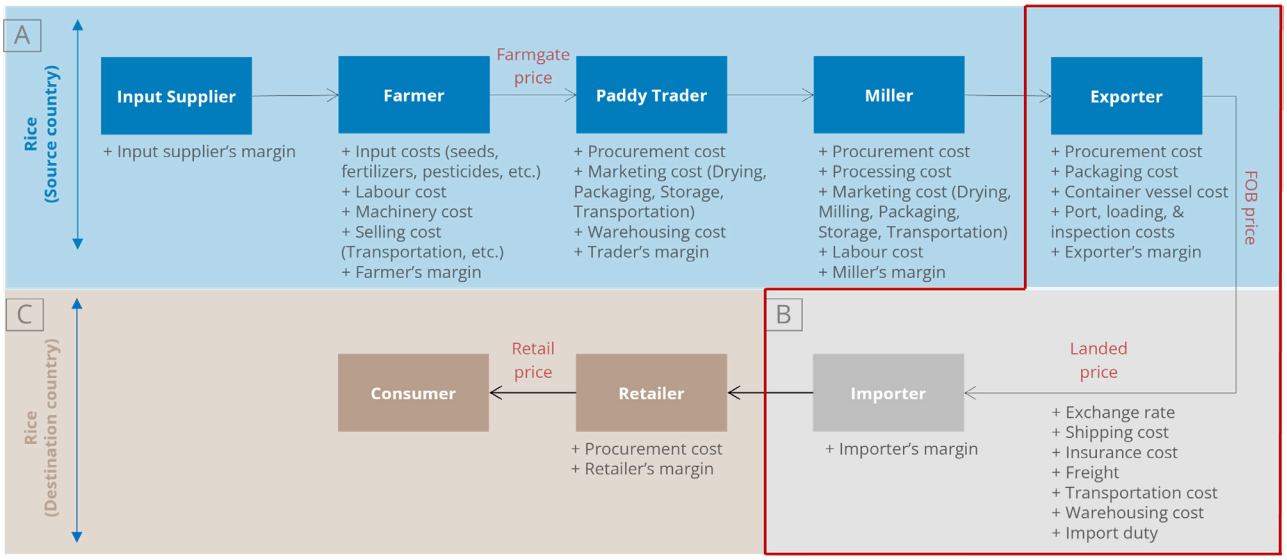
The price of rice sold by Thailand is more than double the price of rice from Vietnam and India. Rice from Pakistan is the least expensive but it exports an insignificant amount in the relevant region. The rice variety also affects the price of landed price. The increase in the final price of rice is highest in Thailand, and the cost of rice production is also comparatively higher there. The costs of production in India, Vietnam, and Pakistan are fairly similar. However, the value addition by the trader is very low in India, compared with Vietnam.

8 Exchange rates (2020) - 1 VND = 0.0000432 USD; 1 INR = 0.01335 USD; 1 THB = 0.03214 USD; 1 PKR = 0.0063 USD
9 The costs included are: Cost of production includes input (seeds, fertilizers, pesticides, etc.), labour, and machinery costs; Farmer's margin
Trader's costs & margin include marketing and warehousing cost, and trader's margin; Miller's costs & margin include processing, marketing, and labour costs, and miller's margin; Exporter's costs & margin include packaging, container vessel, port, loading, & inspection costs, and exporter's margin

3.1 Exporter to Importer (Landed price)

Part B of the value chain focuses on the price of rice after landing in the importing country. The landed price rises due to additional costs such as insurance, freight, shipping, warehousing, storage, import tariffs, etc. Thus, the landed price of rice varies substantially across importing countries.

This analysis looks at the value addition between the exporter and importer and the trade value chain between different countries under the scope.

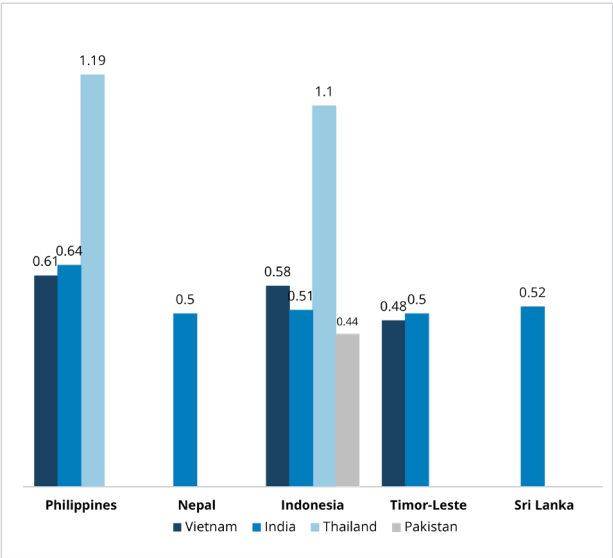


The figure on the right compares the landed price of rice for all the importing countries from the respective exporting countries – Vietnam, India, Thailand, and Pakistan.

The landed price of rice from Thailand is higher than from other countries. However, Thai rice accounts for only 3 percent of trade within the region. A detailed explanation of the different costs and the landed price in these countries is mentioned in the annex in detail.

The landed price of rice also depends on the rice variety and volume imported by the countries. For instance, the landed price is similar for Nepal and Timor-Leste when imported from India, despite the vast difference in the shipping costs. However, Timor-Leste only imports 25 percent broken rice (which is cheaper) compared to Nepal which imports 5 percent broken rice.

Figure 12: Landed price of imported rice (USD per kg) in importing countries

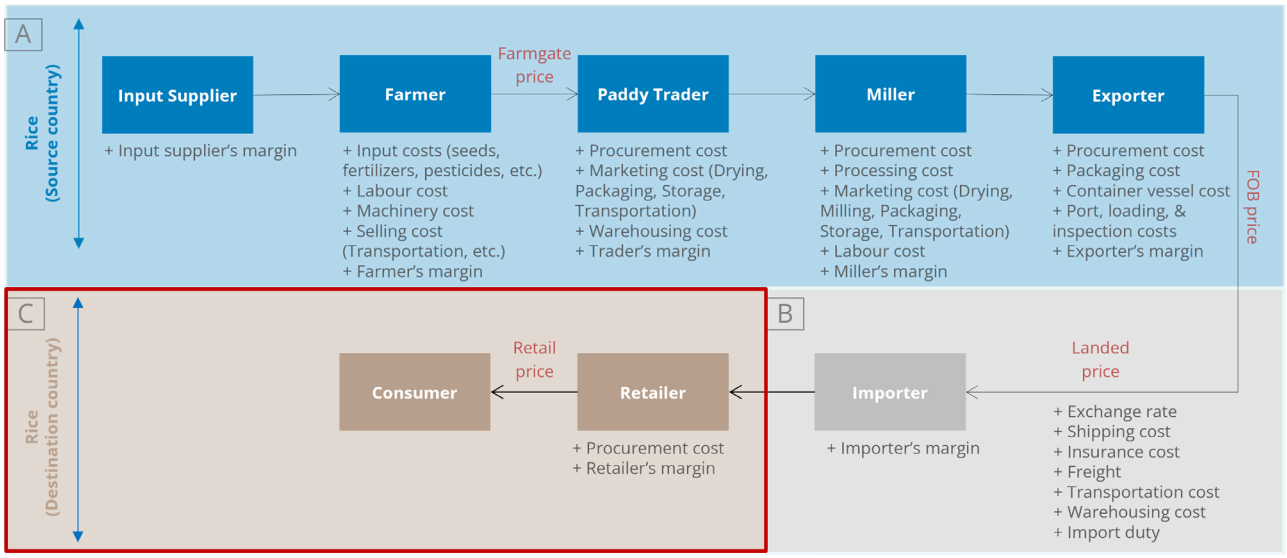


Source: ValueNotes Analysis

Note: Mostly, white rice has been considered for all the countries. The main rice varieties imported by each country is elaborated in section 2.2

3.2 mporter to Retailer (Retailer price)

Part C of the value chain considers importer to retailer prices:



In assessing the cost increase or value added in reaching the end consumer after imports, the source country is not relevant. In other words, there is no difference in the value chain after it is imported regardless of whether it is imported from India or Thailand, for example. Therefore, a deep analysis of this aspect of the value chain in each importing country is unnecessary for this report. Ultimately, the best terms for an importer bringing rice into the country will translate into the best terms for the consumer.

Essentially, the value addition from the importer to consumer is the same as that for local distributor/ retailer to consumer. Wholesaler margins range between about 3 to 7 percent while retailer margins vary between 5 to 10 percent in the countries under the scope.

The analysis above shows that the price of imported rice is mainly affected by the efficiency of the exporting country's domestic value chain along with shipping costs and import tariffs. For the successful commercialization of FR and for any trade to be viable, there should be a minimal increase in the final price of rice compared with regular rice. We therefore need to consider export/ import capabilities together with the value chain analysis to develop a framework to match potential FR/ FRK exporting and importing trading partners.

4. Framework to match potential FR/FRK exporting and importing trade partners

4.1 Purpose of developing the framework

As seen in the individual country reports, the countries under scope are at different stages of rice fortification scale-up. Some have a well-developed domestic infrastructure for producing FR and FRK while others will need more time to develop. Regional trade can exploit synergies across countries in the region to ensure fortification efforts continue despite local infrastructure constraints.

4.2 Methodology used to evaluate potential trade flows

We have created a simple evaluation approach to assess the potential trade flows for FR and FRK between countries. The framework is intended to aid in comprehending potential regional supply chain developments for FR/FRK. These are described below in more detail.

Part 1: To identify potential importers vs exporters (FR and FRK)

In order to assess export capability, we have considered three broad parameters:

Parameter	Data Points	Reasoning
Rice Export capacity	• Global rice exports of countries under the scope (in MMT) (2020) • Rice imports as a % of total rice consumption (2020)	• An existing value chain supporting substantial rice exports will be a strong starting point for success in FR exports, while significant importers may not be in a position to export.
Supply chain efficiency	• The % share of farmer's value in the final price of rice	• An inefficient supply chain suggests that the country may not be suited for exports. Typically, a larger share for farmers in the final price indicates fewer intermediaries and a more efficient supply chain.
FR/FRK capability	• No. of FR and FRK players (2022) • Stage of fortification scale-up • Availability of extrusion and blending machinery suppliers • Supply chain constraints • Government support for developing FR/FRK infrastructure	• Examining these parameters will help understand the extent of FR/FRK infrastructure development in a country. • Rice export capacity alone is not sufficient to become a FR exporter. The country must also have a well-developed domestic FR/FRK eco-system.

Methodology:

1. Each country has been rated for each parameter and sub-parameter. The rating was done on a scale of 0-5, where:
    - 5 for the countries that are best across a particular parameter
    - 0 for the countries that are the worst across a particular parameter
2. Ratings across sub-parameters are averaged for each country to derive ratings for parameters.
3. Based on this analysis, the countries have been mapped on a 3x4 matrix as below
    - Export Import assessment:
      -Exporters
      -Self-sufficient
      -Importers
    - Evolution of FR/FRK eco-system development:
      -No initiation at present
      -Early stage of capacity creation
      -Rapid development
      -Well-developed
4. Finally, this matrix provides objective reasoning to identify countries most suitable as FR exporters or importers.

After identifying potential exporters, we have then mapped importing countries with potential export partners, based on cost competitiveness. This part of the analysis is described below:

Part 2: To optimally match importers with exporters

Ultimately, it is important that importers get FR/FRK at the most competitive prices. This depends on several factors:

Parameter	Data Points	Reasoning
Distance	• Distance between the leading exporting and importing ports	• The distance between countries (key ports) is critical, as typically distances are closely correlated with shipping costs
Import tariffs	• Import tariff between the exporting and importing countries	• The tariff structure can also influence the price to the consumer, and is incorporated in the framework
Landed price	• Landed price between the exporting and importing countries	• The landed price (of rice) in any country, from different sources, broadly captures the overall price competitiveness of different exporters. We believe that competitive rice suppliers will also be more competitive when it comes to FR (assuming they have the infrastructure, which was assessed in Part 1).

Methodology:

1. Each importing country has been mapped against each exporting countries and was rated against above three parameters. The rating was done on a scale of 0-5, where:
    - 5 for the countries that are best across a particular parameter
    - 0 for the countries that are the worst across a particular parameter
2. After all the potential trade partners are compared, a combined rating was calculated (it includes all three parameters).
3. Based on the results of the rating, the countries were paired as below:

    √ √: Ideal trade partners

    √ : Trade partners are not ideal, but the trade is viable

    x : Unviable trade partners

The detailed analysis is elaborated in the subsequent pages.

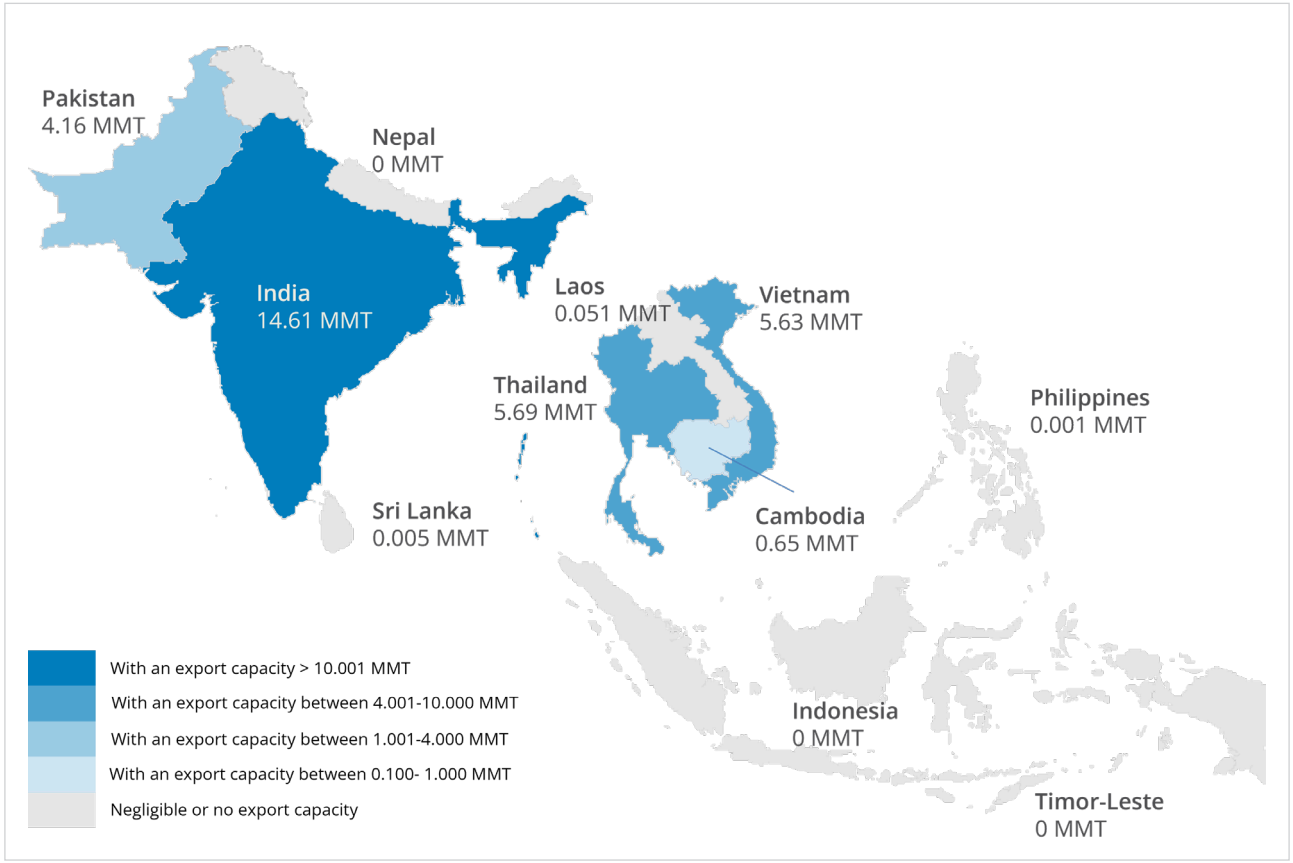
As seen in the methodology section, we have divided the framework in two parts, which are elaborated below:

4.3 Part 1: Identification of potential importers vs exporters (FR and FRK)

Here we identify the likely exporters and importers, based on existing export capacities, supply chain efficiencies and capability to manufacture FR and FRK.

1. **Export capacities:** The export capacities of each country are analyzed through a comparative rating scale. The countries with relatively higher exports have a higher rating than the others.

Figure 13: Exports of countries under the scope (MMT) (2020)



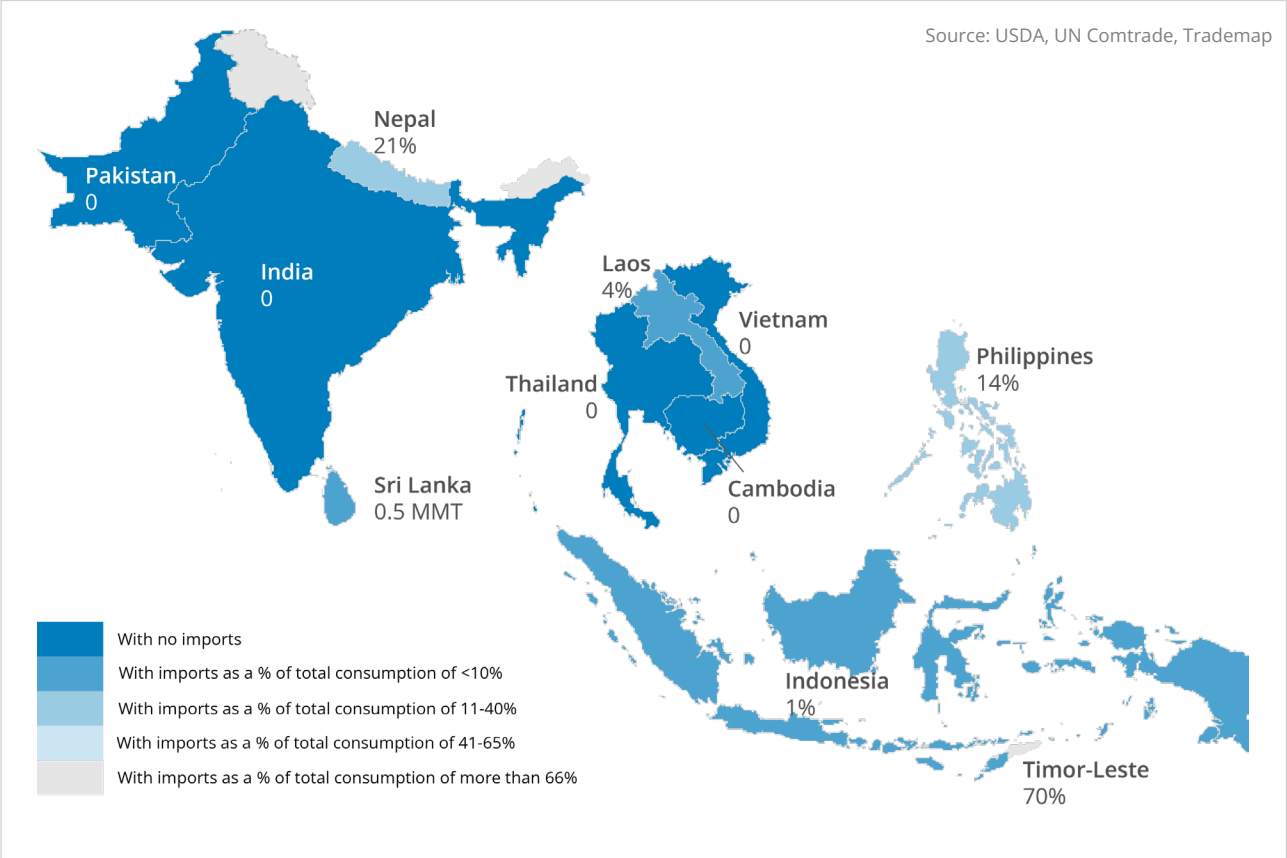
Source: UN Comtrade, Trademap

The top exporters in the region under the scope of this report are India, Thailand, Vietnam and Pakistan. However, India's export capacity at a global level is significantly higher than the others.

Simultaneously, to identify the import-dependent countries, imports as a percentage of total consumption are considered.

Import dependence of each country is analyzed through a comparative rating scale. Countries with relatively lower imports will get a higher rating than the others.

Figure 14: Imports as a % of total consumption (2020)



Disclaimer: The designations employed and the presentation of material in the map(s) do not imply the expression of any opinion whatsoever of WFP concerning the legal or constitutional status of any country, territory or sea area, or concerning the delimitation of frontiers.

A country's export/import capability combines export capability and import dependence. An average rating is calculated to understand the true strength of the country. A higher rating indicates higher export capability, while a lower rating indicates greater import dependence.

Table 5: Combined export/import rating

Export ('000 MMT)		Import as % of Total Consumption	Combined Rating
14.611	India	0%	4
5.689	Thailand	0%	3.5
5.633	Vietnam	0%	3.5
4.162	Pakistan	0%	3
0.654	Cambodia	0%	2.5
0.051	Lao PDR	4%	2
0.005	Sri Lanka	1%	2
0	Indonesia	1%	1.5
0.001	Philippines	14%	1
0	Nepal	21%	1
0	Timor-Leste	70%	0

As seen in the table, Timor-Leste, Nepal, and the Philippines depend most on imports.

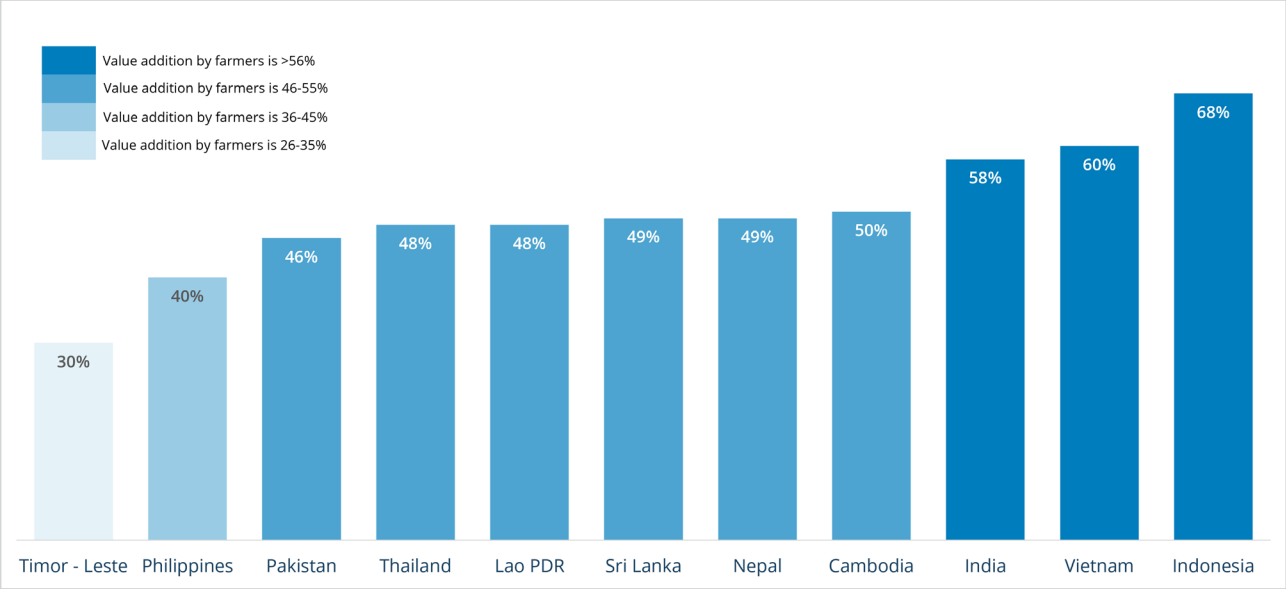
These countries import for multiple reasons, such as the nature of the terrain (including soil issues and non-arable land), natural disasters, high cost of production, and/or an inefficient supply chain.

The constraint of an inefficient supply chain is relatively easier to resolve than other constraints such as terrain and natural disasters. If the supply chain works better, the cost of production will fall. Hence, we have analyzed supply chain efficiency separately as below.

2. Supply chain efficiency:

An efficient supply chain provides a competitive (and cost) advantage to rice producers, making them more suitable exporters. We have assessed this based on the farmer's value share. A smaller cost increase post farm-gate prices reflects a more efficient value chain. The rating is on a comparative scale, where a country with relatively higher efficiency is rated higher.

Figure 15: Value added by farmers (%) in the source country[10]



Source: Country reports prepared by ValueNotes, (Pavithra, et al. 2017), (Dao The Anh 2020), ValueNotes Analysis
Note: The value chain is analyzed from the farmer to the retailer in the source country.

The farmer's value share in the retailer price is highest in Indonesia, followed by Vietnam and India.

Export capability and an efficient supply chain are essential parameters; however, these parameters are not sufficient. For a country to be an FR and FRK exporter, they must also have a well-developed FR ecosystem.

3. FR/FRK capability:

Here we examine the FR and FRK infrastructure in each country. The factors considered are:

- No. of FR and FRK players (2022)
- Stage of fortification scale-up
- Availability of extrusion and blending machinery suppliers
- Supply chain constraints
- Government support for developing FR/FRK infrastructure

10 Years considered: India - 2017, Thailand - 2022, Vietnam - 2017, Pakistan - 2018, Cambodia – 2017, Sri Lanka – 2022, Indonesia – 2022, Lao PDR - 2017, the Philippines – 2020, Nepal - 2018, Timor-Leste - 2022

Table 6: FR and FRK capabilities of the countries

Country	No. of FRK players	No. of FR players	Relative Rating
India	~ 15 – 20	~ 3 – 5	with more than 10 FR and FRK players
Thailand	1	1	with 1-3 FR and FRK players
Vietnam	0	1	with 1-3 FR and FRK players
Pakistan	0	0	without FR and FRK players
Cambodia	0	1	with 1-3 FR and FRK players
Sri Lanka	0	0	without FR and FRK players
Indonesia	0	4	with 3-5 FR and FRK players
Lao PDR	0	0	without FR and FRK players
Philippines	1	5	with 5-10 FR and FRK players
Nepal	0	0	without FR and FRK players
Timor-Leste	0	0	without FR and FRK players

Source: Previous country reports prepared by ValueNotes

Table 7: The stages of fortification scale-up and present efforts

Country	Stage Fortification Scale Up 1 2 3 4 5	Relative Rating
India		• In 2021, the government announced distribution of FR through the Public Distribution System and other government schemes across the country would be accomplished by 2024 thus creating a robust FR ecosystem.
Thailand		• Thailand exports FR and FRK to other countries and helps with various initiatives taken by WFP. The country has developed the ecosystem to supply extrusion and blending machinery locally.
Vietnam		• In process of creating local FR infrastructure. • FR manufacturers and blending machinery suppliers are available.
Pakistan		• The government has recently started looking at FR to help tackle malnutrition.
Cambodia		• Initial stage of creating a local ecosystem for FR. • In 2019, GTC, a state-owned mill, partnered with WFP to blend imported FRK with regular rice.
Sri Lanka		• A few millers plan to introduce FR in the local market. However, due to the current economic crisis, this may not materialize very soon. • In the process of developing a local ecosystem for blending machinery by providing fabricated blenders to millers.
Indonesia		• Local FR infrastructure is developing rapidly through collaborations between government entities. • The government is focusing on local availability of FRK, blending and extrusion machinery.
Lao PDR		• WFP is in discussion with selected millers about the feasibility of producing FR/FRK commercially.
Philippines		• Already has a few FR suppliers and is in the process of developing a local ecosystem by locally producing FRK and blending machinery.
Nepal		• During a 2021 trial, state-owned FMTC installed fortification equipment. However, production has not begun.
Timor-Leste		• The Food Fortification Decree Law, which includes the standards for rice fortification, is in the process of being approved. After the law is passed, rice fortification will be mandatory. • To begin the FR production process, WFP has identified two vendors to provide blending machinery to them.

Note: The scale indicating the stages of fortification scale-up is an indicative scale.

Stages of fortification scale-up

1. Pre-engagement phase
2. Government involvement and private partners' identification in implementation of a pilot program
3. Laying down food standards for fortification
4. Optimal scale-up through social safety net programs based on food preference in specific areas and commercial demand generation
5. Mass availability of fortified rice in a sustainable way

Table 8: Supply chain efficiency

Country	Supply chain efficiency			
	Higher concentration of large millers	Involvement of fewer middlemen	Local availability of raw materials for FR/ FRK	Local availability of machinery for FR/FRK
India	√	√	√	√
Thailand	√	√	√	√
Vietnam	√	√	X	√
Pakistan	√	√	X	X
Cambodia	X	X	X	X
Sri Lanka	√	√	X	X
Indonesia	X	√	√	X
Lao PDR	X	X	X	X
Philippines	X	√	√	√
Nepal	√	√	X	X
Timor-Leste	X	√	X	X

Source: ValueNotes Analysis

Based on the parameters analyzed above, the 11 countries under the scope of the study have been categorized into four groups.

Table 9: Classification of countries as per their export and FR/FRK capabilities

Capabilities	FR/FRK Ecosystem			
	No current initiation	Early stage of capacity creation	Rapid development	Well-developed
Exporter	Pakistan	Cambodia, Vietnam		India, Thailand
Self-sufficient	Lao PDR, Sri Lanka	Indonesia		
Importer	Nepal	Timor-Leste	Philippines	

Source: ValueNotes Analysis

- Based on the above analysis, India, and Thailand can export FR and FRK.
- Vietnam has the capacity to export rice and FR; however, there is an absence of FRK infrastructure in the country.
- **Although Pakistan has rice export capacity, the country does not have the required FR and FRK infrastructure and therefore is not considered an exporter. Hence, we have considered the country as an importer of FR/FRK for the subsequent section.**

The next section analyses optimum trade flows by matching the exporters with the right importers.

4.4 Part 2: Optimal matching of importers with exporters

For any trade flow to be successful, the cost of trade has to be low. To better understand this aspect, the exporting and importing countries are divided into South and Southeast Asian countries. This demarcation helps us understand the impact of various costs between the exporting and importing countries across parameters listed below:

1. Distance
2. Import Tariff
3. Landed price

The three exporting countries (India, Vietnam, and Thailand) are mapped against all the importing countries and analyzed on the three above-mentioned parameters.

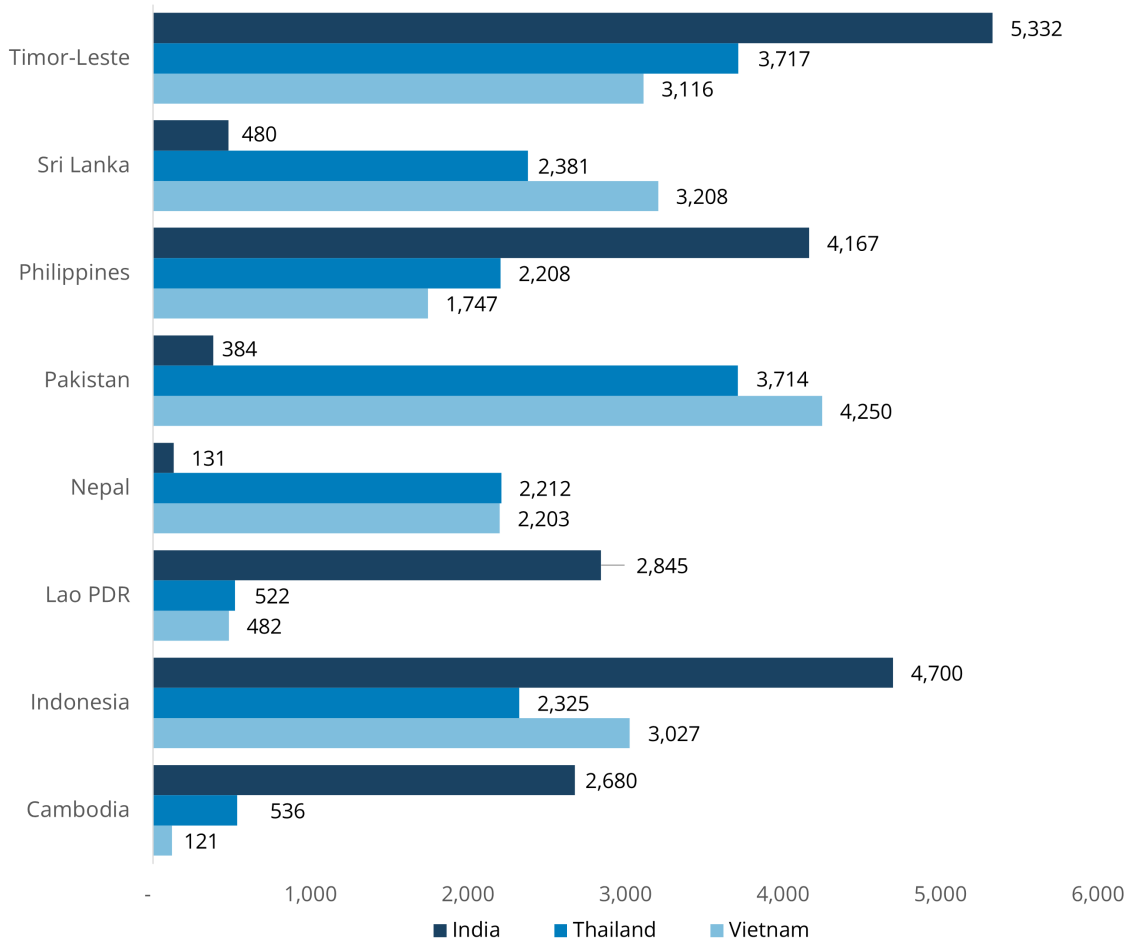
The countries are then rated on a relative scale. Countries with the least distance, the lowest import tariff, and the lowest landed price have the highest combined rating. For an importing country, an optimum trade flow would be with an exporting country with a higher rating.

1. Distance

This parameter is important as greater distance will entail higher shipping costs, thereby increasing the final price of rice.

Trading partners with the least distance have the highest relative rating. The rating decreases as the distance increases.

Figure 16: Distance between the exporting and importing ports (in km)



Source: distancebetween2.com

Note: Although Pakistan is a net rice exporter, it has been included as an importer because it currently has no FR/FRK infrastructure.

2. Import tariff

Import tariffs add to the final price paid by the importing country. Therefore, lower tariff rates are preferred.

Most of the importing countries levy the same tariffs across the exporting countries. However, in a few instances the import tariffs change because of trade agreements and Most Favored Nation status.

Importing countries with the lowest tariffs have the highest relative rating. The rating decreases as the tariff increases.

Table 10: Import tariff between the exporting and importing ports (in percentage)

Export Country	South Asian Countries			Southeast Asian Countries				
	Nepal	Pakistan	Sri Lanka	Cambodia	Indonesia	Lao PDR	Philippines	Timor-Leste
India	9%	11%	15%/ LKR 28/kg	0%	IDR 450/KG	5%	35%	3%
Relative rating								
Thailand and Vietnam	10%	11%	15%/ LKR 28/kg	0%	25%	5% (Thailand) 0% (Vietnam)	35%	3%
Relative rating								

Source: Customs websites, ASEAN, ValueNotes Analysis

Note: Although Pakistan is a net rice exporter, it has been included as an importer because it currently has no FR/FRK infrastructure.

Explanation of the rating:

- for countries with import tariffs of less than 5%
- for countries with import tariffs of 6 – 10%
- for countries with import tariffs of 11 – 15%
- for countries with import tariffs of 16 – 25%
- for countries with import tariffs of more than 26%

3. Landed price

The landed price of rice is indicative of the final price of FR in each importing country. Therefore, a lower landed price is preferable.

Importing countries with the lowest landed price have the highest relative rating, and the rating decreases as the landed price increases.

Table 11: Landed price between the exporting and importing ports (USD/kg)

Export Country	South Asian Countries		Southeast Asian Countries				
	Nepal	Sri Lanka	Cambodia	Indonesia	Lao PDR	Philippines	Timor-Leste
India	0.50	0.52	0.47	0.51	NA	0.64	0.50
Thailand	NA	NA	0.87	1.10	0.91	1.19	NA
Vietnam	NA	NA	NA	0.58	0.59	0.61	0.48

Source: ValueNotes Analysis

Note: NA represents no trade for 2021.
Thai landed prices are higher than in other countries. Thai rice accounts for only 3% of trade within the region, and countries import specific rice varieties from Thailand.
Pakistan is a net exporter but is an importer for FR/FRK because of lack of required FR/FRK infrastructure. As a result, it does not have any information on the landed price.

To understand the optimum trade flows, a cumulative rating is calculated.

Each exporting country has a cumulative rating against each importing country. An importing country with a higher rating is a more suitable trading partner compared with a country with a lower rating.

Exporting Country	Distance (km)	Import tariff	Landed price (USD/kg)	Trade partner rating
NEPAL				
India	131	9%	0.5	√ √
Thailand	2,212	10%	NA	X
Vietnam	2,203	10%	NA	X
PAKISTAN				
India	384	11%	NA	X
Thailand	3,714	11%	NA	√
Vietnam	4,250	11%	NA	√
Own production	-	-	-	√ √
SRI LANKA				
India	480	15%	0.52	√ √
Thailand	2,381	15%	NA	X
Vietnam	3,208	15%	NA	X
CAMBODIA				
India	2,680	0%	0.47	√
Thailand	536	0%	0.87	√ √
Vietnam	121	0%	NA	√ √

INDONESIA				
India	4,700	IDR 450/kg	0.51	X
Thailand	2,325	25%	1.1	X
Vietnam	3,027	25%	0.58	√
Own production	-	-	-	√ √
LAO PDR				
India	2,845	5%	NA	√
Thailand	522	5%	0.91	√ √
Vietnam	482	0%	0.59	√ √
THE PHILIPPINES				
India	4,167	35%	0.64	X
Thailand	2,208	35%	1.19	X
Vietnam	1,747	35%	0.61	√
Own production	-	-	-	√ √
TIMOR-LESTE				
India	5,332	3%	0.5	√ √
Thailand	3,717	3%	NA	√
Vietnam	3,116	3%	0.48	√ √

Note: NA represents no trade for 2021.
Landed price is not considered as Pakistan is a net exporter of rice

Explanation of the rating:

- √ √ best fit trade partners
- √ probable fit trade partners
- X unviable fit trade partners

A summary of the potential trade partners is provided in the table below.

Table 12: Potential trade partners

Country	South Asian Countries			Southeast Asian Countries				
	Nepal	Pakistan	Sri Lanka	Cambodia	Indonesia	Lao PDR	Philippines	Timor-Leste
Exports								
India	√ √	X	√ √	√	X	√	X	√ √
Thailand	X	√	X	√ √	X	√ √	X	√
Vietnam	X	√	X	√ √	√	√ √	√	√ √
Own production	X	√ √	X	X	√ √	X	√ √	X

Source: ValueNotes Analysis

Note: Although Pakistan is is a net exporter, it has been included as an importer because it currently has no FR/FRK infrastructure.

Based on the existing infrastructure, a country can either import FR or FRK, as shown in the subsequent table.

Table 13: Hubs for exporting FR and FRK

Export Country	South Asian Countries			Southeast Asian Countries				
	Nepal	Pakistan	Sri Lanka	Cambodia	Indonesia	Lao PDR	Philippines	Timor-Leste
India	FR	X	FR/FRK	FR	X	FR	X	FR
Thailand	X	FRK	X	FR	X	FR	X	FR
Vietnam	X	FR	X	FR	FR/FRK	FR	FR/FRK	FR
Pakistan	X	X	FRK	X	FRK	X	X	FR

Detailed discussions with crucial stakeholder such as rice exporters, importers, FRK manufacturers and government entities were held to understand the bottlenecks in FR export/import trade. The next chapter highlights these discussions.

5. Key Stakeholders's Views on FR export/ import trade

The previous chapters have highlighted the following:

1. Key rice exporters in the region - Vietnam, India, and Thailand
2. Key rice importers in the region - The Philippines, Nepal, and Timor-Leste
3. Prominent ports used by the various countries
4. The difference in the landed price of rice when importing from different countries

To understand the potential of FR trade and assess its feasibility within the countries under the scope, detailed discussions were held with private sector stakeholders, such as exporters, importers, FR suppliers, and FRK manufacturers, from a few of these countries as well as discussions with government entities. The main points discussed with these respondents were as follows:

Rice exporters

1. Lack of awareness about FR – The majority of rice exporters are unaware of FR and its health benefits. Without awareness, it is difficult to engage exporters in the FR supply chain.
2. Lack of willingness to invest in FR due to negligible demand – Exporters have cited that the demand for FR in export markets is negligible. Unless there is sufficient demand for FR from the importing countries under the scope, exporters would not consider investing in the production or distribution of FR.
3. Opportunity in other markets – In countries such as Dubai, Qatar, Saudi Arabia, the United States, the United Kingdom, etc., the acceptance of premium varieties of rice is higher. A few exporters indicated that targeting these countries for FR instead of South and South East Asia as a premium health product could be profitable. However, this is not currently feasible given the lack of exporter resources to create demand in other countries. Exporters would supply products only when ordered by the importer.

Rice importers

1. Lack of awareness about FR – Low awareness about FR is a huge challenge in importing countries under the scope, which ultimately leads to a lack of demand in the market.
2. Exploring the viability of imports – Initially, importers could consider the possibility of importing FR from established markets like India or Thailand. For instance, in Nepal and the Philippines, importers indicated that imported FR would be cheaper than domestic production. Additionally, millers could combine regular rice with small

quantities of imported fortified rice and to sell in the market. This could be done initially to keep costs low and create a market for FR. However, this might not be feasible over the long term.

3. High prices of imported FR – In countries such as Timor-Leste and the Philippines, a significant portion of rice consumption is met by imports. Most importers in these countries import bulk rice, which is cheaper. However, importing FR, which is usually sold in packaged form, would be expensive compared to importing regular rice in bulk. Therefore, importers in these countries are reluctant to import FR to sell in the domestic market.

4. Increase in importer costs – The importers said that FR needs to be packaged and labeled properly with appealing packaging that differentiates it from regular rice. However, this would be an additional cost for importers. Additionally, importers would also need to convince retailers to stock their FR brand, leading to an increase in investment in the promotion of the product.

FRK manufacturers

1. Lack of demand – In India, FR production is mandatory for nutrition-based schemes and voluntary for private players. Despite the wide reach of government distribution programmes, the demand for FR is negligible. This is primarily due to a lack of awareness about FR in the population. One of the FRK manufacturers in the country mentioned that around 30% of FR production companies have shut down their operations due to a lack of demand.

2. Lack of support from the government – FRK manufacturers in India mentioned that they did not receive any support from the government in creating the infrastructure required for FRK production and had to bear the entire cost of machinery. They suggested that support from the government could encourage more manufacturers to invest in FRK manufacturing and would ultimately help reduce the cost of FR.

Government entities

1. Exploring an opportunity in countries with mandatory rice fortification – The fortification of rice is mandatory in the Philippines and Papua New Guinea. Exporters could assess the viability of exporting FR to these markets. Additionally, Timor-Leste is in the process of passing the Food Fortification Decree Law. Once it is passed, the fortification of rice will be mandatory, providing a potential market for FRK.

2. Support required for domestic production of FRK – In countries like Lao PDR, Nepal, Pakistan, Sri Lanka, and Timor-Leste, there is no local production of FRK. In these countries, WFP could engage with government entities to reduce import tariffs and provide tax exemptions, thereby promoting domestic production.

Discussions with various stakeholders highlighted that most market participants were not interested in investing in rice fortification due to a lack of demand for FR in most South and Southeast Asian countries. Since rice fortification scale-up is at a nascent stage in most countries (under scope), consumers are unaware of FR and its health benefits. Therefore, importers and exporters do not see it as a lucrative opportunity at present.

6. Conclusion and Recommendations

Conclusion

Based on the data and analysis above, we can conclude that the FR/FRK trade depends on each country's rice export capabilities and the existing FR/FRK ecosystem development. Ideally, the creation of multiple supply hubs could greatly enhance FR/FRK access in the region.

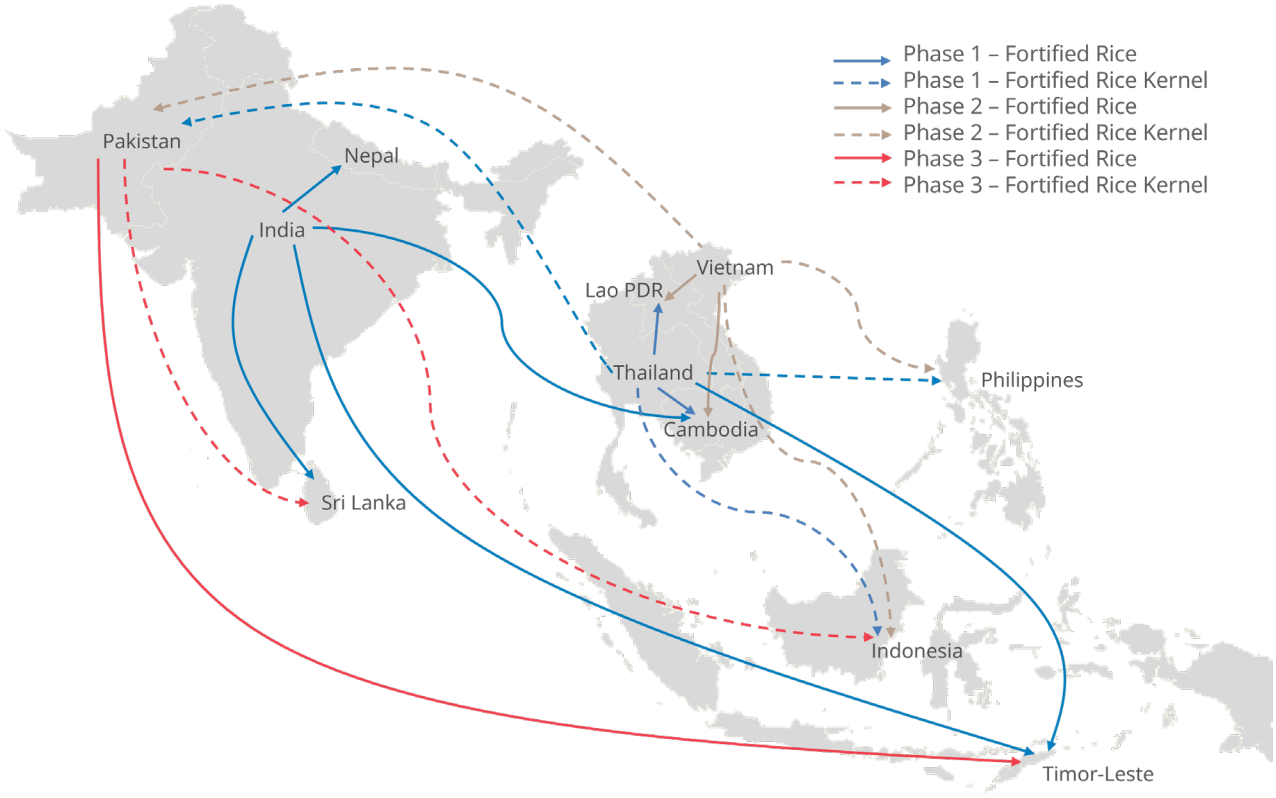
The potential exporting countries are at different stages of FR/FRK infrastructure development so their use as hubs should occur in a phased manner, as below.

Phases	Stage of FR/FRK infrastructure development	Hubs
Phase 1: short term	Countries where the infrastructure is already developed	India, Thailand
Phase 2: medium term	Countries where the infrastructure is partially developed	Vietnam

Note that importing countries may build up their domestic FR/FRK capabilities in the long term. However, they may not be in a position to export – given domestic rice industry constraints (capacity or competitiveness).

The potential regional trade flows are mapped below. The diagram also shows how trade flows might change over time, as different countries scale up – as described in the phases above.

Figure 17: Proposed hubs for exporting FR and FRK



Phase 1: short term

Develop India/Thailand as export hubs as they have well-developed FR/FRK infrastructure

India

India, the largest exporter in the region, has the lowest cost of production. Thus, it can potentially become a major FR/FRK export hub, especially for South Asia.

Thailand

Vietnam does not have the infrastructure required to supply FR/FRK in Phase 1. Thus, Thailand can be developed as a Southeast Asia hub to export FR/FRK, as it is one of the major rice exporters. This is despite its higher production costs than Vietnam.

Importing Country	Exporting Country		Rationale
	India	Thailand	
Nepal	√	-	• India and Nepal have a strong trade relationship, as India accounts for 100% of Nepal's rice imports. Existing trade relationships, geography, and low costs make Nepal and India natural partners.
Pakistan	-	√	• Until domestic millers can start producing FR/FRK, the country will need to import. Although Indian imports would be the cheapest, strained trade relations might make this unviable. Hence, it can import FR from Thailand (in Phase 1). However, the cost of imports will be relatively higher because of the higher shipping cost. • Alternatively, Pakistan could consider importing FRK from other South Asia countries (for instance, Bangladesh). However, that analysis is outside the scope of this study.
Sri Lanka	√	-	• Sri Lanka is self-sufficient in rice production. It is currently in the initial stages of developing the local FR/FRK ecosystem. However, the ongoing economic and agrarian crisis has hampered local infrastructure development. • Sri Lanka could import FR/FRK from India due to pre-existing trade ties, geographical proximity, and low landed price.
Cambodia	√	√	• Cambodia can import FR from India in Phase 1, as it is likely to be cost competitive. • Along with India, in Phase 1 Cambodia can also import FR from Thailand to take advantage of the geographical proximity and existing trade relationship.
Lao PDR	-	√	• Lao PDR is a self-sufficient in producing rice. However, it is at a nascent stage in understanding the feasibility of local FR/FRK production. • Lao PDR can import FR from Thailand because of pre-existing trade ties and close geographical proximity.
Philippines and Indonesia	-	√	• The Philippines and Indonesia are already in developing their domestic FR ecosystems. Until the local ecosystem is built, both countries need to import FRK. • Although the cost of imports from India is lower, the geographical proximity and existing trade relations make Thailand a more suitable trade partner for them in Phase 1.
Timor-Leste	√	√	• Timor-Leste is in the process of passing the Food Fortification Decree Law. However, their heavy reliance on subsistence farming might delay local infrastructure development. • Timor-Leste could import FR from both India and Thailand. • Thailand can be considered a trade partner in phase 1 despite the higher landed price due to the country's established trade relations and proximity. • Despite the distance between India and Timor-Leste, the low landed costs and established trade relationship makes India a suitable trading partner.

Phase 2 (medium term):

Vietnam has a partially developed FR/FRK ecosystem, which can be further scaled up in the medium term

Of total rice exports from Vietnam in 2020, 43 percent went to countries within the region. Thus, Vietnam is the strongest rice exporter in the region and can be developed as a major FR/FRK export hub.

Currently, some millers in Vietnam can export FR with the FRK needed to produce FR imported from Thailand. Hence, Vietnam needs to focus on developing the FRK infrastructure. Millers are not investing in FRK machinery because of low demand but once demand increases, they will invest.

In Southeast Asia, Vietnam has the lowest cost of production which ultimately results in the lowest price for consumers. Once the infrastructure is developed, some of importers may consider buying from Vietnam as well.

Country	Rationale for imports of FR/FRK from Vietnam
Cambodia	Cambodia has informal exports to Vietnam as the cost of processing paddy is lower. The processed paddy is then re-exported. Therefore, in Phase 2, Vietnam is likely to be the most suitable FR exporter for Cambodia.
Lao PDR	Although Thailand accounts for 77 percent of rice imports to Lao PDR, the high landed cost compared to Vietnam could be a deterrent. Therefore, Lao PDR could also import FR from Vietnam in Phase 2.
Pakistan	If the domestic FRK infrastructure is not developed, then Pakistan could import FRK from Vietnam in Phase 2, in addition to Thailand.

As mentioned in Phase 1, the Philippines and Indonesia are rapidly developing their local FR ecosystem. In the second phase, both countries would have most likely developed their local infrastructure to supply FR and FRK in their domestic markets. However, if local infrastructure was still not developed, both countries could increase imports from Vietnam. This is due to the existing trade relationship (95 percent of Philippine imports and more than 30 percent of the imports to Indonesia comes from Vietnam).

Phase 3 (long term):

Pakistan has recently started exploring rice fortification. The country has no existing FR/FRK infrastructure and needs to develop it.

As Pakistan is a major rice exporter in the region, it can be developed as a hub for exporting FR/FRK in Phase 3.

However, FR/FRK infrastructure development will happen only in the long term, due to:

1. Perceived low return on investment in fortified rice production due to lack of consumer demand and low awareness of various production techniques and costs;
2. Lack of a regulatory environment for fortified rice and FRK; and
3. The current economic crisis in Pakistan.

Once Pakistan develops its FR/FRK infrastructure, the following markets for exports could be explored:

1. Timor-Leste
2. Indonesia
3. Sri Lanka

Even though we have considered the possibility of Pakistan exporting to Indonesia, it is likely that Indonesia would have developed its local infrastructure before Pakistan is in a position to export.

The essential infrastructure required to produce FR in each country will not be built in the short term. However, the lack of infrastructure should not act as a barrier to tackling the problem of micronutrient deficiencies. Regional trade will help bridge the gap.

Recommendation 1: Engagement with government decision makers

Facilitate to government authorities on:

1.1 Development of harmonized rice fortification standards for promoting regional trade

Currently, the countries under scope are at different stages of developing standards for rice fortification[11]. Differing standards from country to country would deter regional trade as exporters would have to ensure compliance with the standards of each importing country, which would be onerous. This would reduce efficiencies and raise costs for exporters, thereby impacting the final price to the consumer. Harmonizing standards would also simplify testing – as countries across the region could leverage common technologies/ methods for testing.

It is therefore essential for standards to be aligned or harmonized. Given that several countries are in the process of creating standards, it is imperative that these do not diverge substantially.

The role of a multilateral agency like WFP is critical. WFP can act as a key facilitator and coordinate with governments and regulators to guide this harmonization process.

1.2 Designing a monitoring system to ensure that the FR meets a harmonized standard

Once harmonized rice fortification standards are implemented, a well-designed monitoring system is essential for quality control and assurance. WFP, in partnership with government bodies, should provide technical assistance to support the regulatory authorities in effectively integrating a quality assurance and quality control plan for rice fortification.

WFP should provide capacity strengthening support to government authorities in setting up labs to test standards of imported fortified rice. The laboratories should either be located at the port or close to the port. Government authorities in the destination country should coordinate with food safety authorities in the source countries to ensure that FR/FRK is tested and certified at the source per the standards outlined. This would help monitor the quality of imported fortified rice and, in the long run, to monitor FR/FRK production if FR/ FRK were to be produced locally.

Development of harmonized standards and compliance are essential to ensure that the regional trade model is successful.

1.3 Advocacy with government entities and regional trade blocs to reduce taxes and import duties

In the interest of public health and to promote domestic production, WFP should advocate with government entities and regional trade blocs to reduce tariffs and reduce tax exemptions on FR and FRK.

1. Engage with government to reduce or remove taxes on the industries that are directly and indirectly engaged in the production of FR/FRK.

2. To protect the domestic rice industry, rice is not included in the exemptions under existing regional free trade agreements. However, to promote the production of FR/FRK, WFP can advocate with the regional trade bodies (such as ASEAN and SAARC) to remove/reduce the import tariffs on these products.

These steps will reduce the final cost of FR to consumers.

11 Details on the development of food standards is mentioned in the Annex (table 16)

Recommendation 2: Engagement with industry stakeholders

Conduct regular discussions with importers to spread awareness

There is a lack of awareness among rice importers about the economic and health benefits of rice fortification. Therefore, WFP, government entities and rice associations should undertake workshops, conferences, and seminars with importers to generate awareness about rice fortification and its impact on addressing micronutrient deficiency. This engagement should be done on a regular basis and not just a single session. The workshops can include discussions on:

i. Health benefits of consuming fortified rice. Importers are an important link to consumers, and it is essential to educate them about the health benefits of fortified rice. Once the importers are aware of the health benefits, they can better promote the rice in the market.

ii. Success stories of rice fortification in other countries through existing case studies of WFP

Conduct periodic meetings with exporters to inform them about the established standards

WFP and the rice associations of the exporting countries should hold regular meetings/workshops with exporters to disseminate information about:

i. Health benefits of consuming FR

ii. The set standards for FR

iii. The business opportunities in the importing countries

Connect importers and exporters through regular meetings

For regional trade to be successful, the importers need to be connected with exporters and vice-versa. WFP could facilitate regular meetings through seminars/webinars/conferences.

Additionally, a delegation from the importing country (which includes importers, ministry officials and WFP country office representatives) could visit the exporting country to tour the production facilities of the major exporters.

WFP can also help large exporters/producers establish partnerships/subsidiaries/joint ventures in the importing countries. This would help ease the localization challenges in addressing local regulations and product distribution.

There will be an added advantage if the countries have an existing trade relationship in rice.

Recommendation 3: Engage with development partners to fund the development of proposed trade flows

For successful implementation of the regional trade, initial funding will be required for activities such as persuading the millers to participate in regional trade, setting up testing labs and undertaking promotional activities.

Development partners such as, Asian Development Bank, Institut de Recherche pour le Développement, The United States Agency for International Development, Program for Appropriate Technology in Health, etc. could be approached by WFP. Funds could be utilized to supply FRK and blending machinery to the millers, install blending machinery in mills, as well as provide training and support. Government entities could utilize the funds to set up testing labs and undertake various promotional activities to increase awareness about the benefits of consuming fortified rice. This would help to develop FR/FRK export hubs, especially where the infrastructure is not fully developed.

Recommendation 4: Leverage hubs to supply FR/FRK in Africa and create additional demand for exporters

Africa is also plagued by widespread prevalence of micronutrient deficiencies and would also benefit from consuming FR. As seen in chapter 2.1, a significant portion of exports from India, Vietnam, Thailand and Pakistan goes to Africa. The regional trade proposed would help develop a strong infrastructure of FR and FRK suppliers in these hubs which could be leveraged by WFP to supply FR/FRK in Africa, thereby creating additional demand for the exporters.

Furthermore, these countries also export rice to the Middle East, where there is high demand for premium health products. The FR suppliers could also explore the possibility of supplying FR to this region.

For the success of regional trade, it is essential for effective coordination between all stakeholders coupled with a long-term commitment. In the long run, a combination of government support and rising acceptance by the public will help create a sustainable ecosystem that will help significantly reduce MNDs in the region.

7. Annex

Research Methodology

The research process for this study was structured as described below:

1. **Project Set-up and Plan**
    - Project kick-off and discussions with WFP stakeholders to understand context, objectives and expectations;
    - Knowledge shared by WFP based on prior research and experience in rice fortification initiatives in various countries; and
    - Preparation of a detailed project implementation plan.
2. **Secondary Research and Primary Research Design**
    - Method of collection includes primary research, face-to-face interviews, Zoom interviews, fieldwork and secondary research.
    - Some secondary data sources used include WFP reports, the previous country reports prepared by ValueNotes, EXIM trade database across countries etc.
    - Extensive desk research on several topics was conducted, as follows:

        Experience in rice fortification;

        Key supply chain and the costs associated;

        EXIM trade database;

        Understanding the tariffs structure across countries;

        Sustainable rice platform;

        ASEAN rice distribution;

        SUN Business Network; and

        FR kernels and FR suppliers.

    - A list of respondents who were contacted is provided below:

        Large rice millers;

        Rice importers;

        Rice exporters;

        Retailers;

        FR and/or FRK suppliers; and

        Government entities.

3. Analysis

- The dynamics of each country in terms of its rice industry, infrastructure, supply chain, etc. need to be understood to determine whether rice fortification could be better achieved by setting up local FR infrastructure or via imports.
- This analysis is broadly broken down into four parts, as below:

    Rice Value Chain in South and Southeast Asia;

    Regional Rice Trade Analysis;

    Rice Value Chain Analysis; and

    Framework to match potential FR/FRK exporting and importing trading partners.

Value addition across the Rice Value Chain

For instance, in India, the farmer's cost of production is INR 16.5 per kg, and the farmer sells the rice to the trader at INR 17.59 per kg. The difference of INR 1.09 per kg is the margin or the value addition in the price of rice by the farmer.

Table 14: Value addition across the rice value chain

Selling Price by Player	Vietnam (VND/kg)	India (INR/kg)	Thailand (THB/kg)	Pakistan (PKR/kg)
Cost of production	4380.00	16.50	9.00	27.80
Margin	507.00	1.09	4.30	3.48
Farmer (Farmgate price)	4887.00	17.59	13.30	31.28
Trader's Margin	1394.00	0.65	2.50	9.52
Paddy trader	6281.00	18.24	15.80	40.80
Miller's processing cost + margin	662.00	10.20	8.10	11.56
Miller	6943.00	28.44	23.90	52.36
Port, loading, and inspection costs	150.00	1.50	0.41	2.22
Margin	1049.00	1.50	1.22	2.22
Exporter (FOB)	8142.00	31.43	25.53	57.60

Table 15: Value addition (USD/kg) across the rice value chain (2020-2021)

Selling Price by Player	Vietnam	India	Thailand	Pakistan
Cost of production	0.21	0.22	0.29	0.18
Margin	0.02	0.01	0.14	0.02
Farmer (Farmgate price)	0.23	0.23	0.43	0.20
Trader's Margin	0.07	0.01	0.08	0.06
Paddy trader	0.30	0.24	0.51	0.26
Miller's processing cost + margin	0.04	0.14	0.26	0.07
Miller	0.34	0.38	0.77	0.33
Port, loading, and inspection costs	0.05	0.02	0.01	0.01
Margin	0.02	0.02	0.04	0.01
Exporter (FOB)	0.41	0.42	0.82	0.35

Source: (Christophe Alliot 2018), (Dao The Anh 2020), (Pavithra, et al. 2017), ValueNotes Analysis

Note: Average exchange rates of 2020 used.[12]

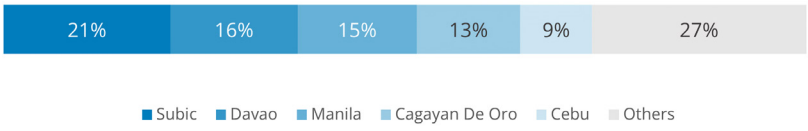
Key ports used in Regional Rice Trade

In South and Southeast Asia, rice is mostly traded over sea routes. This section analyzes the rice volumes traded through different ports to demonstrate the most prominent ports used in each country.

The Philippines

Vietnamese imports arrive mainly at ports in Subic, Davao, and Manila. Thailand supplies via Subic, Manila, and Port San Fernando. Indian imports arrive mainly at Manila.

Figure 18: % Share of rice volume (MMT) by port in the Philippines (2020)

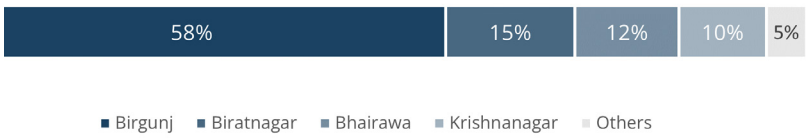


Source: EXIM Trade, ValueNotes Analysis

Nepal

India primarily exports rice to Nepal via Birgunj.

Figure 19: % Share of rice volume (MMT) by port in Nepal (2020)



Indonesia

Vietnam supplies rice to Indonesia primarily through Jakarta and Tanjung Perak, whereas Thai imports come via Tanjung Perak and Tanjung Priok. India and Pakistan mainly supply rice via Surabaya Java and Jakarta.

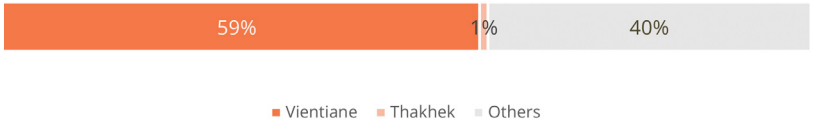
Figure 20: % Share of rice volume (MMT) by port in Indonesia (2020)

Source: EXIM Trade, ValueNotes Analysis

Lao PDR

Vietnam supplies rice mainly via Vientiane.

Figure 21: % Share of rice volume (MMT) by port in Lao PDR (2020)



Source: EXIM Trade, ValueNotes Analysis

Timor-Leste and Sri Lanka

The main port for rice import in Timor-Leste is Dili, whereas Colombo is the main port for Sri Lanka.

Supply Chain Infrastructure for Fortified Rice

Table 16: Presence of standards and current delivery options for fortified rice

Country	Distribution through Social protection programmes	Presence of voluntary fortification	Presence of mandatory fortification law	Development of food safety standards	Monitoring and enforcement of standards
Cambodia	X	X	X	In progress	X
Indonesia	√	√	X	In progress	X
Lao PDR	√	X	X	In progress	X
Nepal	X	√	X	√	X
Pakistan	X	X	X	X	X
Philippines	√	√	√	√	Minimal
Sri Lanka	X	X	X	In progress	X
Timor-Leste	In progress	X	√		X

Country	Blending machinery	FRK	Extruder machinery
Cambodia	Imported	Imported	No domestic production of FRK
Indonesia	Locally modified by mills	Currently imported, local production efforts in progress	Imported by BULOG to locally produce FRK
Lao PDR	FR production yet to start	FR production yet to start	No domestic production of FRK
Nepal	Imported	FR production yet to start (FRK was imported for a trial run of producing FR)	No domestic production of FRK
Pakistan	FR production yet to start	FR production yet to start	Imported machinery present at a national university (NIFSAT); however, it requires modification for extruding FRK
Philippines	Locally available (provided by govt. entity FNRI in partnership with local equipment fabricator)	Locally available	Imported by a few private millers
Sri Lanka	Imported	Imported	No domestic production of FRK
Timor-Leste	Imported	FR production yet to start	No domestic production of FRK

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