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Understanding the Rice Value Chain in Lao PDR:

Defining the Way Forward for Rice Fortification

January 2023



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Executive Summary

The Lao People's Democratic Republic (Lao PDR) (population 7.2 million in 2021) is a low middle-income Southeast Asia country with a high prevalence of malnutrition, high stunting rates, and widespread micronutrient deficiencies (MNDs). At 206 kg per person per year, the country's per capita rice consumption is among the highest in the world (United States Department of Agriculture 2020) and rice is therefore an appropriate vehicle for food fortification to reduce the incidence of MNDs.

WFP is currently conducting acceptability studies for fortified rice in government social protection programmes. Government stakeholders indicate interest in scaling up rice fortification in the country and make the following points:

1. There is a need to generate demand to incentivize millers to invest in rice fortification.
2. Standards for rice fortification are currently under development.
3. It is essential to focus on the development of a sustainable domestic supply chain for raw materials (fortified rice kernels (FRK) and fortificants) and blending and extrusion machinery for fortified rice production.

Rice millers stress the need to create demand and to ensure that they will make a profit from rice fortification. They also stress:

1. Most rice millers are not aware of the production

techniques, raw materials, and machinery required to fortify rice. There is a lack of knowledge about costs involved and the possible channels to procure inputs.

2. Consumer demand for fortified rice might be negligible if its price is higher than non-fortified rice. Consumers might also be hesitant to buy fortified rice given their lack of knowledge about fortification.
3. The Government must create sufficient initial demand for fortified rice through their social protection programmes to address micronutrient deficiencies in vulnerable population groups, such as women of reproductive age and children.
4. The Ministry of Industry and Commerce should provide subsidies, trade relaxation schemes, free trade agreements, etc. to reduce the cost of inputs such as FRKs and ensure successful importation of blending machinery.

Discussions with stakeholders confirm that while the Government has made considerable efforts, barriers remain to the scaling up of rice fortification. In alignment with the 2018 Food Fortification Strategic Action Plan (FFSAP), WFP believes that scale up of rice fortification in Lao PDR should be implemented in three phases (outlined below) that highlight the immediate focus as well as the long-term strategy.

PHASE 1

- Engage with government bodies and facilitate the development of national nutritional standards for fortified rice and FRK
- Initiate a pilot blending operation with millers to understand costs and operational issues around rice fortification

PHASE 2

- Engage more millers in fortified rice production by conducting blending assessments and setting up blending infrastructure
- Distribute fortified rice through government social protection programmes
- Strengthen the regulatory environment for fortified rice

PHASE 3

- Increase private sector capacity for domestic production of FRK
- Spread awareness about the health benefits of fortified rice among consumers

The table below provides a summary of the barriers to rice fortification scale-up and corresponding recommendations to be implemented in phases:

SN	Barriers	Recommendations	
Phase 1	1	Lack of coordination among government entities involved in rice fortification	<p>Efficient communication with government decision-makers</p> <p>Ensure continuous coordination and cooperation within the Food Fortification Technical Working Group (FFTWG) to ensure efficiency and clarity in the implementation of rice fortification programmes</p>
	2	Relatively low priority given to budgets for rice fortification	<p>Advocacy with government bodies</p> <p>Conduct meetings with government entities to advocate for rice fortification as a priority in the budgetary allocation process</p>
	3	Absence of national standards for fortified rice and FRK	<p>Strengthen the regulatory environment</p> <p>Advocate with FFTWG to develop standards for fortified rice and FRK to ensure consistency in the quality of fortified rice and the micronutrients to be added to the FRK</p>
	4	Lack of awareness of millers' capabilities to produce fortified rice	<p>Pilot a blending operation</p> <p>Initiate the pilot of a blending operation with contracted millers to produce fortified rice</p>

	SN	Barriers	Recommendations
Phase 2	5	Limited knowledge among millers about the production techniques, costs involved, and suppliers of raw materials and machinery required for rice fortification	<p>Advocacy with millers</p> <p>Conduct periodic workshops and individual meetings ensuring continuous engagement with leading rice millers to improve their knowledge of rice fortification, its health and economic benefits, and the technical processes involved</p> <p>Initiate blending assessments with leading millers (assessing the requirement of new machinery or whether their existing machinery can be modified)</p> <p>Provide technical and financial support to interested millers for installation of blending machinery</p>
	6	Millers are unsure about the return on investment in fortified rice production due to lack of consumer demand	<p>Demand generation through social protection programmes</p> <p>To grow the demand for fortified rice in the market, invite tenders from leading millers to procure fortified rice for institutional feeding programmes and offer subsidies to millers to fund the fortification process</p>
	7	Underdeveloped Quality Assurance/ Quality Control system to monitor standards of fortified rice	<p>Strengthen the regulatory environment</p> <p>Advocate with FFTWG to develop standards for fortified rice and FRK to ensure consistency in the quality of fortified rice and the micronutrients to be added to the FRK</p>
Phase 3	8	Lack of awareness amongst the population about fortified rice and its benefits	<p>Pilot a blending operation</p> <p>Initiate the pilot of a blending operation with contracted millers to produce fortified rice</p>
	9	Lack of domestic availability of FRK	<p>Develop the domestic production capacity for FRK</p> <p>Provide necessary support to procure the patented technology for domestic production of FRK, aiming to reduce cost, and sustain an effective supply chain</p>

The commercialization of fortified rice can be successfully achieved in the long term through a public-private partnership between rice industry stakeholders and the Government. A campaign to generate awareness about the benefits of consuming fortified rice among the population is essential to create demand. In addition to the steps taken by the Government regarding food fortification (elaborated in section 2 of the report), appropriate advocacy with all stakeholders would support the reduction in the incidence of MNDs.



Introduction

Background

South-East Asian countries are weighed down by malnutrition, high stunting rates, and widespread micronutrient deficiencies (MNDs). A landlocked nation in Southeast Asia, Lao PDR (population of 7.2 million in 2021), is a low middle-income country with a high prevalence of all forms of malnutrition. The food consumption pattern in Lao PDR is less than ideal with low diversity. Carbohydrates, mostly in the form of rice, dominate the calorie intake with almost the entire Laotian population consuming rice daily (Food and Agriculture Organization of the United Nations 2022).

MNDs such as iron and vitamin A disproportionately affect women, adolescents, and children and contribute to poor growth, cognitive impairments, and increased risk of morbidity and mortality. In 2017, 33 percent of Lao children (6-59 months) were stunted and 40 percent of Lao Women of Reproductive Age (WRA) were anaemic due to iron deficiency (Lao Social Indicator Survey 2017). Iron deficiency can affect the growth and development of the foetus during pregnancy and the infant after birth.

Food fortification and the intake of a nutritious and diverse diet are effective ways to address MNDs. However, the adoption of such a diet is difficult due to social, economic and food security reasons and requires large-scale nutrition intervention programmes (World Food Programme 2021). The Government of Lao PDR is implementing multiple strategies such as micronutrient and dietary supplementation, food fortification, and diet diversification.

Similar to other Southeast Asian countries, the production and consumption of rice is significant in Lao PDR. Rice is the most widely consumed staple and is increasingly seen as an important fortification vehicle. The annual rice consumption per capita is 206 kg (United States Department of Agriculture (USDA) 2020). Lao PDR produces a large amount of rice -- 1.7 million metric tons (MT) in 2020 (United States Department of Agriculture 2020). It is self-sufficient in rice production and approximately 80 percent of the rice produced locally is used for self-consumption (World Food Programme 2017). The private sector tends to import special rice varieties such as Japanese Rice and Thai Hom Mali, which are not available in the country.

In 2018, the Government of Lao PDR through the Ministry of Health endorsed the Food Fortification Strategic Action Plan (FFSAP) to advise on suitable food items for effective fortification interventions and to guide short-, medium-, and long-term intervention steps. One output from this plan was the creation of the Food Fortification Technical Working Group (FFTWG), led by the Ministry of Health, with the Nutrition Centre as the primary coordinating body. The FFTWG is currently working on a national standard, including technical guidelines, for fortified rice. Endorsement of this national standard will help guide the introduction of fortified rice through various social protection programmes, such as the school feeding programme (launched in 2002) and through emergency food distribution channels.

For more than a decade, WFP has been working with

governments, the private sector, and technical partners in Asia to improve the quality of rice through post-harvest fortification within school feeding and social protection programmes. Primarily, WFP provides technical assistance on policy and regulatory frameworks, advocacy, analysis and evidence generation, programming, and consumer awareness.

To introduce rice fortification in a sustainable manner that also enables scale up, the Government of Lao PDR, with support from WFP, needs to ensure that fortified rice is widely available and accessible, at least initially, through social protection programmes (specifically, the school meal programme). This can enable it to reach a wide segment of the population within Lao PDR, especially among the nutritionally vulnerable.

Objectives of the Study

The objectives of the study *Understanding the Rice Value Chain in Lao PDR: Defining the Way Forward for Rice Fortification* were to:

1. Undertake a detailed landscape analysis to identify and map the key players across the rice value chain in Lao PDR, including the existing commercial fortified rice supply chain; and
2. Identify and analyse demand and supply challenges across the rice value chain in Lao PDR and identify opportunities to introduce fortified rice through commercial channels and social protection programmes, such as school feeding.

Specific objectives

- Identify, map, and document the key players across the rice value chain that include the rice milling industry; blending and extrusion equipment manufacturers; FRK manufacturers and suppliers of vitamins and minerals/multi-micronutrient premixes; private food safety and quality testing laboratories; and retail organizations (including cooperatives, where these exist), and importers/distributors of commercial fortified rice in Lao PDR.
- Map all the rice value chain players and identify those that follow good manufacturing practices and adhere to national/international food safety and quality standards for processed foods.
- Study and illustrate the rice value chain and identify value chain engagement points/opportunities for potential rice fortification programme support.
- Identify and document the demand and supply

challenges faced by the key players across the rice value chain (infrastructural, capital availability, regulatory, supply chain, import/export regulations/policy, taxation, policy, and political environment) and identify opportunities to introduce and scale up fortified rice through commercial channels and government social protection programmes.

- Map the supply chain and trading (including cost mark-ups along the chain) of rice.
- Study and recommend potential options for strengthening the supply for scaling up rice fortification through commercial channels at the regional level including the feasibility of a regional hub of suppliers to cater to the fortified rice demand of the region and beyond.
- Collect and document information on opportunities and barriers for a range of rice fortification options.
- Review and hold consultations with relevant government and private sector stakeholders to identify potential private sector players engage for introducing fortified rice through commercial channels and government social protection programmes.
- Based on the consultations and analysis of the private sector, identify potential private-sector partnerships with WFP to introduce fortified rice through commercial channels and government social protection programmes.
- Identify the barriers and key factors involved in scaling up fortified rice through commercial markets and government social protection programmes.

Research Methodology

A structured research process for this study, as described below, was followed:

Project Set-up and Plan

- Project kick-off and discussions with WFP stakeholders to better understand context, objectives, and expectations
- Knowledge shared by WFP based on prior research such as *Rice Landscape Analysis in 2017* (World Food Programme 2017) and experience in rice fortification initiatives in various countries
- Preparation of project plan

Secondary Research and Primary Research Design

Intensive desk research on several topics was conducted, as follows:

- Nutrient deficiencies in Lao PDR;
- Experience in food fortification;
- The rice industry in Lao PDR: size, exports, domestic consumption, etc.;
- The supply chain for fortified and non-fortified rice in Lao PDR;
- Key stakeholders in the supply chain, from a fortification perspective; and
- Status of rice fortification initiatives and barriers to adoption and scale-up.

Sources used included:

- Available literature comprising research papers, development partners' reports, statistics, etc.

The initial secondary research identified information gaps, and key stakeholders that could provide valuable inputs.

A discussion guide was developed for each type of respondent, whether industry stakeholders or government/regulatory bodies.

During this process, the ValueNotes team had several discussions with WFP stakeholders to fine tune the list of

respondents.

Primary Research

The list of entities and respondents were identified by an iterative process.

- The reports and available literature used in secondary research identified the important stakeholders in government as well as the rice industry in Lao PDR.
- The team reached out to these stakeholders and conducted detailed discussions. For diversity in opinions, stakeholders from the Government and the private sector were contacted. This ensured equitable representation of views.
- A list of respondents contacted is provided in the annex.

Analysis and Report Writing

- All inputs were collated, analysed, and distilled to draft this report.
- In some cases, a few respondents were contacted again to seek clarification on their responses.
- The analysis and report were discussed with the WFP team (Regional office and Laos country office) and their recent research inputs and feedback were incorporated in subsequent versions.



Report Structure

The report is divided into seven chapters as described below:

Chapter	Title	Details
1	Nutrition Profile of Lao PDR	The first chapter focuses on the diet composition and the current malnutrition prevalence in the population of Lao PDR. <i>Helps understand the scale of the problem, and the need and urgency for improving nutrition interventions in Lao PDR..</i>
2	Food Fortification in Lao PDR	This chapter gives a background of the existing food fortification programmes in Lao PDR. Assessment of past experiences in fortification, difficulties faced while scaling up, and success stories on food fortification (if any). <i>Provides an understanding of institutional experience, and lessons learnt from earlier initiatives with other food items.</i>
3	Overview of Lao PDR Rice Ecosystem	The third chapter elaborates on the rice industry details (historical trend of production, consumption, exports, imports, production clusters, millers' capacities, rice varieties in demand, etc.). <i>This data helps us better understand the size and scale of the rice ecosystem in Lao PDR, and its implications for rice fortification scale-up.</i>
4	Rice Supply Chain	This section details the existing rice supply chain in the country. <i>Provides an understanding of institutional experience, and lessons learnt from earlier initiatives with other food items</i>
5	Fortified Rice Supply Chain	This section details the current fortified rice supply chain in the country. <i>Provides an understanding of the key stakeholders who are currently involved in rice fortification initiatives.</i>
6	Discussion and Analysis	This chapter provides further details of critical stakeholders and their respective roles. It includes the barriers faced by various stakeholders, when scaling up rice fortification efforts. <i>It helps to give a clear picture of the bottlenecks in scaling up rice fortification in Lao PDR. This is crucial for suggesting remedial measures or effective solutions.</i>
7	Recommendations for Scaling up Rice Fortification	The last chapter synthesizes the findings from earlier chapters and suggests specific recommendations to address or mitigate the barriers to scale-up. It also identifies the key stakeholders that need to be brought on board to address different issues. <i>It provides a detailed roadmap for the successful implementation of scaling up rice fortification in a measured and comprehensive manner.</i>
8	Annexes	Supplementary information and relevant statistics This section provides essential information to support the analyses throughout the report, including: <ul style="list-style-type: none"> - Key seasons for rice plantation and harvest - Market price of rice - Rice importing countries - Role of different entities in the rice supply chain - Cost mark-up of rice across the rice value chain - Technologies for rice fortification

1. Nutrition Profile of Lao PDR



Lao PDR is a small landlocked country where forests provide a large share of the rural population's food and income. The extent of malnutrition in the country differs based on geographical location and socio-economic status. People residing in rural regions are the most affected by malnutrition (FOOD SYSTEMS PROFILE - LAOs 2022). Given their dependence on subsistence farming, most rural households do not have enough income to afford a diverse and nutritious diet.

The typical diet in Lao PDR is centred on rice, maize, cassava, other roots, tubers, and condiments such as mono sodium glutamate. With an annual per capita consumption of 206 kilograms, rice is the main staple throughout the country. This results in excess consumption of carbohydrates and inadequate intake of fats and proteins. While most of the population exceeds its daily energy requirements, the lack of diversity in the diet leads to inadequate nutritional intake, causing widespread MNDs (Laos Rice Report Annual 2020).

As the income of the urban population in Lao PDR increases, dietary preferences are shifting towards more diverse food options including processed food items (noodles, bread, etc.) and animal-source proteins (Laos Rice Report Annual 2020). However, a nutritious diet that meets dietary requirements recommended by the World Health Organization remains unaffordable for most households (World Food Programme 2017).

As the diets in Lao PDR depend heavily on cereals, diversifying food production is essential to support nutritional improvement towards more balanced diets. In the meantime, the fortification of food items, particularly rice, could aid in meeting the dietary guidelines for better nutrition in the population of Lao PDR.

1.1 Micronutrient Deficiencies

The widespread prevalence of MNDs has impacted the most vulnerable groups of Lao PDR, as follows:

- Iron and zinc are the crucial MNDs among women of reproductive age, and children aged between 6 - 59 months.

- Iron deficiency has led to a moderate to high prevalence of anaemia across various population groups (Food and Nutrition Security Survey 2015).
- In 2017, the prevalence of anaemia in children (under 5 years) was 44 percent while in women of reproductive age it was 40 percent (Lao Social Indicator Survey 2017) (National Nutrition Plan of Action 2021-2025).
- The prevalence of stunting among children (6-59 months) was 33 percent (UNICEF 2017).
- The prevalence of wasting in children (6-59 months) was 9 percent (UNICEF 2017).

Figure 1: MNDs (%) among the vulnerable population groups in Lao PDR

Children aged between 6-59 months	Zinc	42%	(Ministry of Health & Ministry of Planning and Investment, 2015)
	Vitamin A	33%	(Government of Lao PDR, 2018)
	Iodine	27%	(Ministry of Health, 2015)
Women of reproductive age	Iron	17%	(Ministry of Health & Ministry of Planning and Investment, 2015)
Pregnant women	Iron	78%	(Ministry of Health & Ministry of Planning and Investment, 2015)
Total population	Zinc	36%	(Ministry of Health & Ministry of Planning and Investment, 2015)

Source: Government of Lao PDR (2018), MoH (2016)

Malnutrition persists, especially in rural areas, despite significant efforts by the Government.

The table below highlights the multiple nutrition initiatives undertaken by the Government of Lao PDR:

Table 1: Government initiatives to address malnutrition in Lao PDR

Year	Programme	Entities involved	Description
1995	Introduction of Universal Salt Iodization Decree	Government of Lao PDR	<ul style="list-style-type: none"> • Salt iodization was made mandatory in the country in 1995 through the Prime Minister's Legislation on Salt Iodization No. 42/PM (Iodine Global Network 2016). • Iodine Deficiency Disorder elimination efforts through universal salt iodization are now fully integrated into the national nutrition policy (Iodine Global Network 2016).

Year	Programme	Entities involved	Description
2002	School Meal Programme	The Ministry of Education and Sports, WFP	<ul style="list-style-type: none"> 30,000 primary school children in three provinces were provided with mid-morning snacks. In 2016 - 2017, more nutritious cooked meals replaced the mid-morning snacks. In 2021, the programme expanded, reaching 1,430 schools and 63,000 school children across Lao PDR (World Food Programme 2021). In 2021, WFP introduced fortified rice into the school meals program. Between 2022-2024, the School Meals Program will consist of 100g/child/school day lunch of fortified rice¹ (World Food Programme 2022)
2006	McGovern-Dole Food for Education Programme	The Ministry of Education and Sports, Catholic Relief Services, USDA	<ul style="list-style-type: none"> The programme provides donations of agricultural commodities. It also provides financial and technical assistance to support school feeding, and maternal and child nutrition projects for those in need. USA will provide food for school meals until 2025 (World Food Programme 2022)
2008	National Nutrition Policy	Ministry of Health	<ul style="list-style-type: none"> The policy was adopted to promote and improve nutrition with a focus on women, children, and disadvantaged groups (National Nutrition Policy 2008). It helped to shape a policy environment for the integration and implementation of future nutrition interventions. In 2019, the National Nutrition Landscape Analysis was conducted to assess nutrition levels in the country (Landscape analysis of Nutrition policy in Lao PDR 2019).
2011	Scaling Up Nutrition Movement (SUN Movement)	SUN Secretariat	<ul style="list-style-type: none"> Lao PDR joined the SUN Movement. The SUN Business Network (SBN) was subsequently launched in June 2018. The movement commits to reducing malnutrition with the help of a network of agencies, institutions and donors (Lao People's Democratic Republic 2022).
2012	The 1000 Day Project	The Ministry of Health, Lao Women's Union, UNICEF, mining company Minerals and Metal Group	<ul style="list-style-type: none"> Launched with an aim to improve the nutritional status of infants and young children in rural areas of Lao PDR.

1. Over 85 percent will be provided by USDA and a small quantity through local procurement from 2022 - 2023 to 2023 - 2024 school year.

Year	Programme	Entities involved	Description
			<ul style="list-style-type: none"> • Distribution of SuperKid micronutrient powder and malnutrition screening sessions for children under 5. • As of 2018, 287,333 children had benefitted from the project (World Food Programme 2017) (UNICEF 2017).
2016-2025	2016 - 2025 National Nutrition Strategy and 2016-2020 Plan of Action	Government of Lao PDR (National Nutrition Committee) and development partners	<ul style="list-style-type: none"> • The goal of the programme is to reduce rates of stunting, wasting and anaemia in children; prevent obesity; and promote breastfeeding. • Food fortification was identified as a key intervention to improve the nutrient intake of the population. • In 2021, WFP used fortified rice donated by USDA in the school meals programme. • Ministry of Health drafted the FFSAP. • Meetings were conducted by FFTWG and WFP to draft the food fortification standards (National Nutrition Plan of Action 2021-2025) (Food-Fortification-Action-Plan_Eng 2022) (WFP Lao PDR country report, November 2021).
2016	Agriculture for Nutrition (AFN) project	The Ministry of Agriculture and Forestry, the International Fund for Agricultural Development, WFP and FAO	<ul style="list-style-type: none"> • Promoting the diversification of agricultural practices through agriculture training, grants and farmer nutrition schools resulting in a positive impact on soil conservation, biodiversity, and income and nutritional outcomes. • Community-based approaches with a strong focus on women's empowerment resulted in higher purchasing power and better dietary diversity among women and children (Food and Agriculture Organization 2021).
2018	National Guidelines on IMAM and the National Micronutrient and Deworming Guidelines	Ministry of Health	<ul style="list-style-type: none"> • Ministry of Health developed guidelines to enable health workers to adequately manage and treat malnourished children and provide micronutrient related services. (UNICEF 2018)
2018	National Information Platforms for Nutrition (NIPN)	Ministry of Planning and investment and UNICEF	<ul style="list-style-type: none"> • Aims to strength information systems to prevent malnutrition and its consequences. • The nutrition information system will generate quality data, perform analyses, track progress, and use the information for policy development, contributing to expanding and scaling up effective programmes (UNICEF 2018).

Further scaling up Government efforts, with a specific focus on integrating fortification programmes into national public health interventions to ensure that the overall nutrition status improves.

2. Food Fortification in Lao PDR

In 1995, the Government of Lao PDR mandated salt fortification to prevent iodine deficiency disorder (IDD). Subsequently, under the Plans of Action (2016 – 2020 and 2021-2025) of the National Nutrition Strategy (2025), the Government identified food fortification as one of several key interventions to improve nutrient intake. The FFSAP for Lao PDR serves as an addendum to these initiatives. This plan is led by the National Nutrition Committee Secretariat, with technical assistance from WFP. It examines the potential for fortification of a range of foods such as rice, oil, fish, noodles, fish and soy sauce, dairy products and wheat flour.

Legislation –

There are currently no standards for food fortification in Lao PDR, except for salt iodization. Although Lao PDR has had a National Food Safety Laboratory since 2017, it is not yet equipped to analyse fortified rice and FRK (The Laotian Times 2017). Additionally, the Food and Drug Administration and the Food and Drug Quality Control Centre under the Ministry of Health are responsible for implementing food analysis and ensuring the quality of imported and locally produced foods. These entities are expected to ensure regulatory monitoring for future fortification programmes as well (Government of Lao PDR 2018).

Salt –

Prior to the 1990s, IDD was recognized as a significant public health problem in Lao PDR. Surveys conducted between 1989 and 1990 in five northern and four southern provinces reported significantly elevated goitre rates in school-aged children. Additionally, a nationwide survey in 1993 found that 95 percent of children were iodine deficient (Government of Lao PDR 2018). Subsequently, salt iodization has been mandatory in the country since 1995 through the Prime Minister's Legislation on Salt Iodization No. 42/PM (Government of Lao PDR 2018).

Despite mandatory fortification, the inspection of iodized salt produced by salt manufacturers has not been sufficient. The Government initially provided

imported iodine to salt manufacturers free of cost but most manufacturers stopped fortifying salt when government support ceased, and they were required to bear the cost and related import tariffs. As a result, iodized salt was often sold without adding the required, or any, micronutrients, despite the packaging claiming the product to be iodized. To address the challenges, the Ministry of Health and the Ministry of Industry and Commerce focused on strengthening the management of the Potassium Iodate Revolving Fund (which was established in 2006 to provide a continuous supply of affordable potassium iodate to salt producers) and streamlined the monitoring process of salt factories.

It is essential that the concerned regulatory bodies continue to ensure the development of an effective monitoring and regulatory framework for food fortification.

Edible oil –

As of 2018, barely 14 percent of the population used cooking oil. However, with growing economic development in Lao PDR, its consumption is expected to increase. Imported palm oil from Malaysia and Thailand has become an increasingly important source of oil consumption in Lao PDR (Government of Lao PDR 2018).

The Government of Lao PDR plans to incorporate industrial fortification of edible oil as part of its FFSAP (Government of Lao PDR 2018). Fortifying vegetable oil is the least expensive fortification process available, and the effectiveness of the technology has been well established for nearly a century. Only a limited number of mills serve the majority of the country and the increase in cost due to fortification is only 0.1 - 0.3 percent of the retail price. This will allow producers to absorb the costs of fortification.

WFP is providing fortified oil under its school meals programme along with fortified rice.

Soy Sauce and Fish Sauce -

Fish sauce and soy sauce are popular seasonings in Lao PDR. They are consumed by over 25 percent of the population (Government of Lao PDR 2018). They are mostly imported from countries such as Thailand,

Vietnam, Cambodia, and China. As these countries have either mandatory or voluntary fortification in place, the products are already fortified (Government of Lao PDR 2018).

Instant and fresh noodles -

Instant noodles are fortified throughout the world, either by directly fortifying the wheat flour or indirectly through fortification of the seasoning mix. However, although most noodles consumed in Lao PDR are fresh, wet noodles, dried noodles have been locally processed for commercialization. These wet and dried noodles are made of rice flour or cassava. Cassava is seen as one of the feasible vehicles for fortification in Lao PDR, listed in the FFSAP (Government of Lao PDR 2018).

Rice -

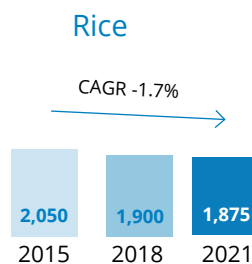
A Rice Landscape Analysis was carried out in 2017 to provide key decision makers with information on factors that influence the potential, feasibility, and sustainability of rice fortification. It found that 80 percent of locally produced rice is consumed by farmers themselves (World Food Programme 2017), potentially limiting the opportunity for commercially milled fortified rice to reach a majority of the population. As a result, the Government of Lao PDR decided to introduce fortified rice through its social security programmes such as the school feeding programmes and emergency responses in the first instance (Government of Lao PDR 2018).

A recent acceptability study found that some of the parents of the students who received fortified rice are already more willing to buy fortified rice due to its health benefits. As a result, the introduction of fortified rice through social safety net programmes can address micronutrient loss and influence the demand for healthy food choices.

2.1 Consumption of Key Cereals in Lao PDR

Per capita rice consumption has been gradually declining in Lao PDR. This can be attributed to an increase in urbanization and a shift in food preferences (to bread, noodles etc.) in the urban population. However, as rice remains the primary staple, it is an appropriate food vehicle for fortification to improve nutrition status across the population.

Figure 2: Consumption of key cereals in Lao PDR ('000 MT)



Note: CAGR stands for Compound Annual Growth Rate over a given period. Source: USDA, Index Mundi

2.2 Rice Fortification Status in Lao PDR

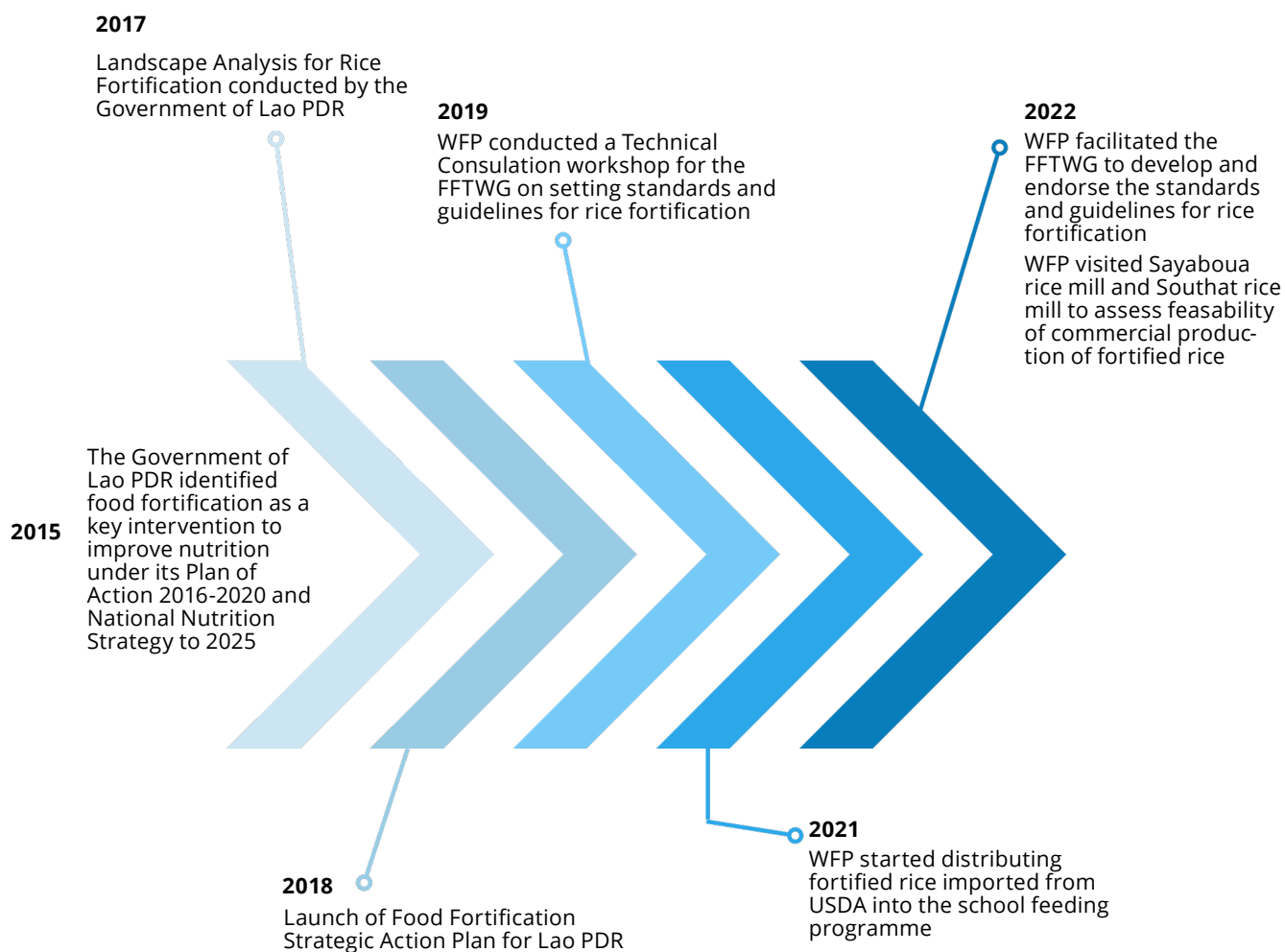
WFP conducted a landscape analysis of the rice supply chain in 2017 to gauge the feasibility and sustainability of rice fortification. The analysis concluded that the rice milling industry is fragmented and rice production is primarily subsistence-based (World Food Programme 2017). Based on these results the NNC Secretariat on Food Fortification, with WFP's assistance, released FFSAP for Lao PDR in 2018 and formed the FFTWG.

Given the challenges identified in the analysis, the FFSAP concluded at that time that commercial rice fortification might not be feasible and that fortified rice should be used for social protection programmes and for emergency stocks. However, the Government now expects that the dependence on subsistence farming for rice consumption will decline due to increasing urbanization and off-farm employment. Rice consumption through market channels such as grocery stores, wet markets, etc. is therefore expected to increase. These projections have resulted in an increased focus on scaling up rice fortification efforts (Food Fortification Strategic Plan 2018).

In 2021, WFP introduced fortified rice in the School Meals Programme in Lao PDR. USDA donated 1,300 MT of fortified rice which was targeted to reach 63,000 school children (WFP Lao PDR country report, November 2021).

In June 2022, the FFTWG met to draft rice fortification standards and to produce a roadmap for locally fortified rice (Lao News Agency 2022). As part of this roadmap, WFP has been visiting medium to large millers such as Southat rice mill and Sayboua rice mill in Lao PDR to raise awareness about rice fortification and its benefits. This will also shed light on the feasibility of producing fortified rice and FRK commercially.

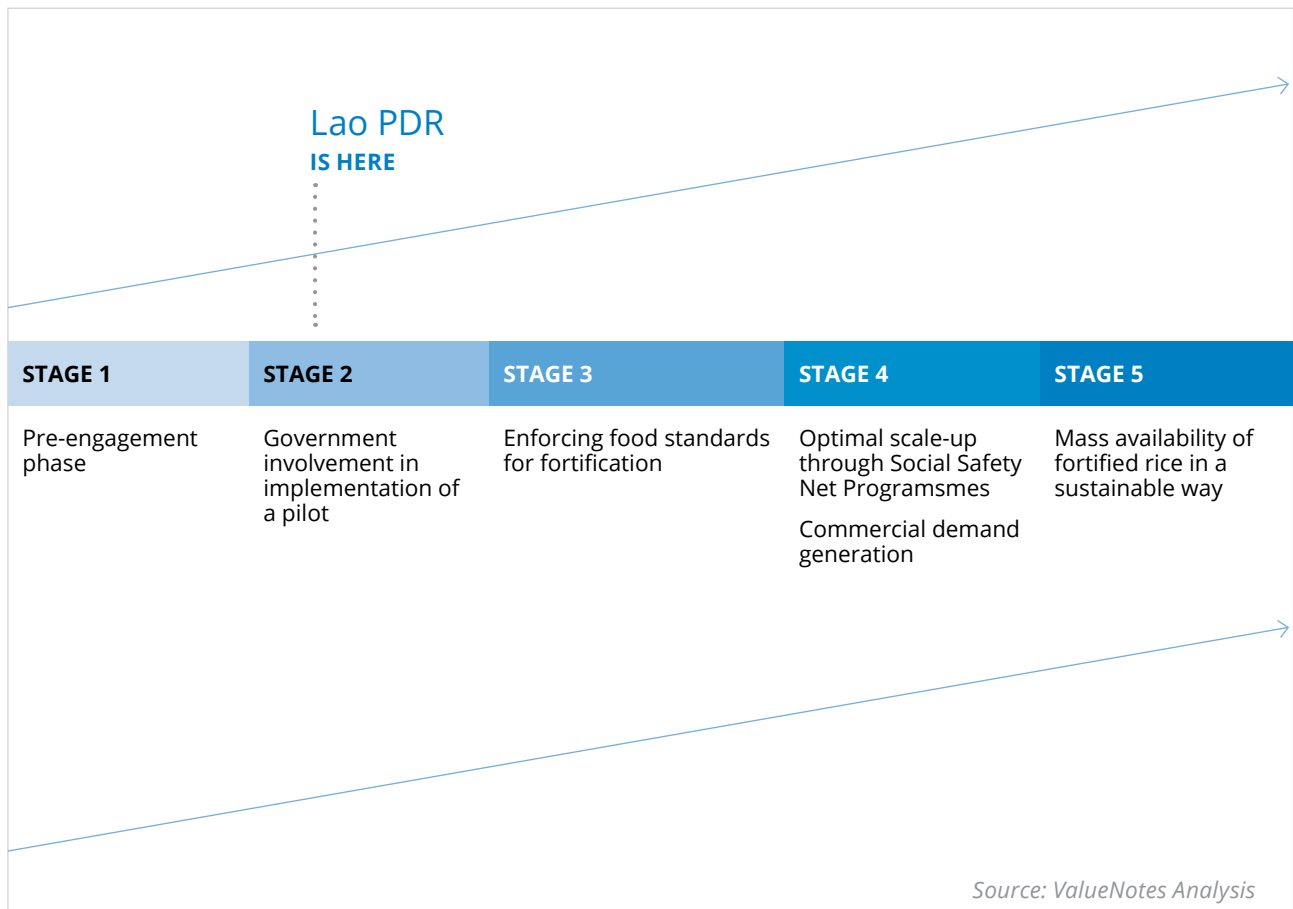
Figure 3: Timeline for rice fortification in Lao PDR



Source: WFP, Government of Lao PDR, Lao News Agency, ValueNotes Analysis



Figure 4: Stages of rice fortification scale up - Lao PDR



To enable mass fortification of rice in Lao PDR, it is crucial to understand the rice industry, rice processing capacity, roles of the various stakeholders, the supply chain, and barriers faced in fortification.



3. Overview of the Lao PDR Rice Ecosystem

This section elaborates on rice production and consumption data, industry structure (rice mills), and the market segmentation of rice as per distribution channels.

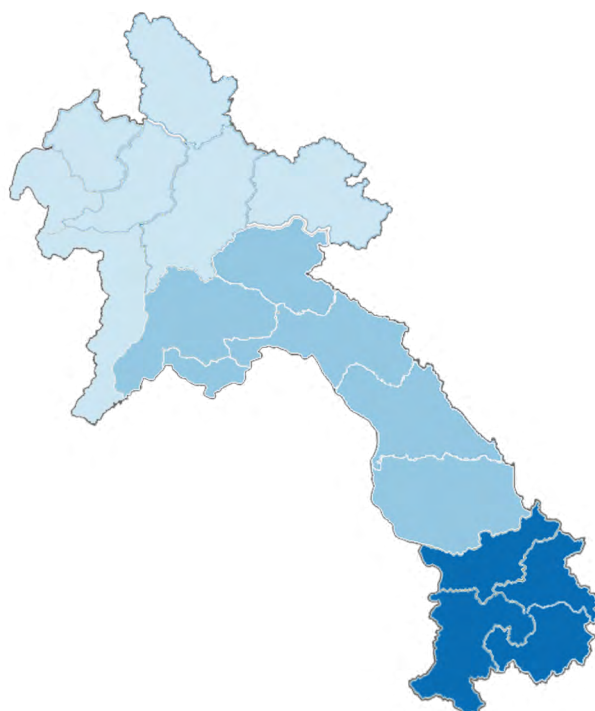
3.1 Rice Producing Clusters in Lao PDR

Rice is cultivated in three regions of Lao PDR – Northern, Central and Southern. The Central region contributes 59 percent of total rice production, while the Southern and Northern regions account for 24 percent and 17 percent respectively (Ministry of Agriculture and Forestry 2021).

The major rice producing provinces in the country are Savannakhet (25 percent), Champasak (13 percent) and Khammouane (10 percent) (Ministry of Agriculture and Forestry 2021).



Figure 5: Rice producing clusters in Lao PDR and share of rice production (2020)



Production by zones (%)

Northern region	17%
Central region	59%
Southern region	24%

Source: Department of Planning and Cooperation, Ministry of Agriculture and Forestry

More than 3,000 rice varieties are grown in Lao PDR with rice is commonly classified into two varieties – glutinous and non-glutinous. It is further categorized based by fragrance (fragrant and non-fragrant) and colour (black, white, red, and purple) (United States Department of Agriculture 2020). The population prefers glutinous rice, with 80 percent of production consisting of this variety.

3.2 Classification of Rice Mills

There are more than 35,000 rice mills in the country, mostly operated by the private sector, which can be classified as large, medium, and small scale based on their tonnage capacity per day (Figure 6).



Figure 6: Classification of rice mills by tonnage capacity

Number of Mills	Production Capacity	% Contribution to total production
Large 405	>10 MT / day	~12%
Medium 590	5-10 MT / day	~8%
Small 7,783	<5 MT / day	~44%
Commune 25,854	<2 MT / day	3~6%

Source: WFP, World Bank, ValueNotes analysis

In Lao PDR, small and commune mills with capacities less than 5 MT/day contribute 80 percent of the total rice produced. These mills primarily cater to individual households producing for self-consumption. Medium and large mills only account for around 20 percent of the rice produced. These mills cater to the commercial sector for sale of rice in the market.

There is little information on the rice milling yield (percent of milled rice obtained from paddy rice) in Lao PDR although government reports suggest it ranges between 50 percent-70 percent. The yield also depends on the quality of equipment used (Government of Lao

PDR 2018).

A few large millers may have the capacity to invest in rice fortification, but most are unwilling to invest due to a lack of clarity around the available market for fortified rice (elaborated in section 6.3). Consequently, millers are hesitant to participate in this initiative without guaranteed market demand and support from the Government.

3.3 Domestic Rice Production, Imports, and Exports

Rice Production –

Total paddy production has been gradually increasing. In 2021, paddy production in the Lao PDR was estimated as 3 million MT; with an average yield of 3.2 MT/ha on 980 ha area under production. About 63 percent of the paddy produced in 2021 was milled (United States Department of Agriculture 2020).

Imports –

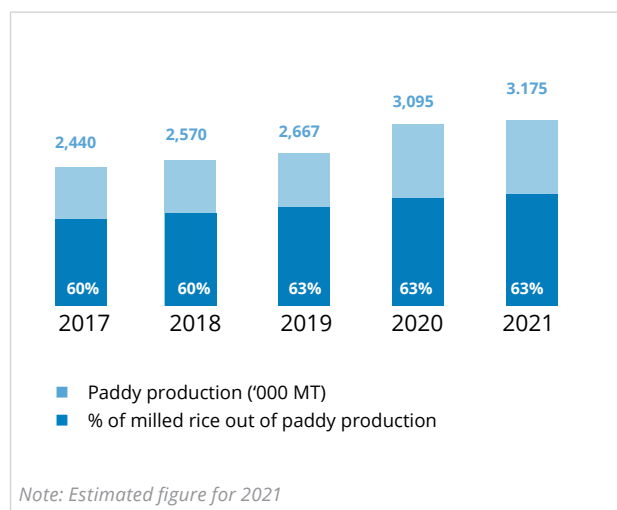
Rice productivity in Lao PDR has been improving since

1990 because of incentives provided by the Government to farmers and increased cultivation of more productive rice varieties. Rice imports account for a very small proportion of the rice consumed in Lao PDR (World Food Programme 2017). In 2021, around 3 percent of the total milled rice consumed in Lao PDR was imported, primarily from Thailand and Vietnam.

Exports –

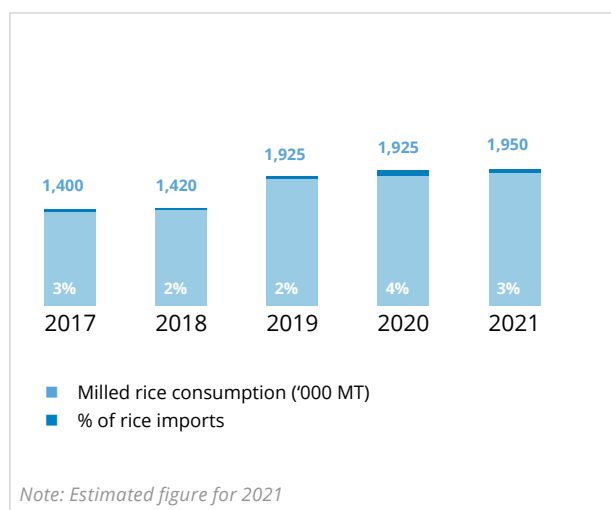
Since most rice is consumed domestically, there are negligible exports. Over the past five years, the country exported around 1 percent of the rice produced (Trademap 2021).

Figure 7: Share of milled rice out of total paddy production ('000 MT) (2017-2021)



Source: USDA

Figure 8: Milled rice production and imports ('000 MT) in Lao PDR (2017-2021)



Source: USDA, Trademap

3.4 Market Segmentation

Consumers purchase rice through two channels:

1. Traditional channel – Includes wet markets and traditional grocery stores. Rice sold through this channel is perceived to be cheap and fresh, with different flexible shopping options and most of the population prefers this channel.
2. Modern retail channel – Includes supermarkets, mini-markets, and online platforms (Shopping-d.com, ubuy, lazada.com). This channel only caters to a small segment of the population residing in cities, mostly foreign nationals and the high-income segment of the Lao population.



4. Rice Supply Chain

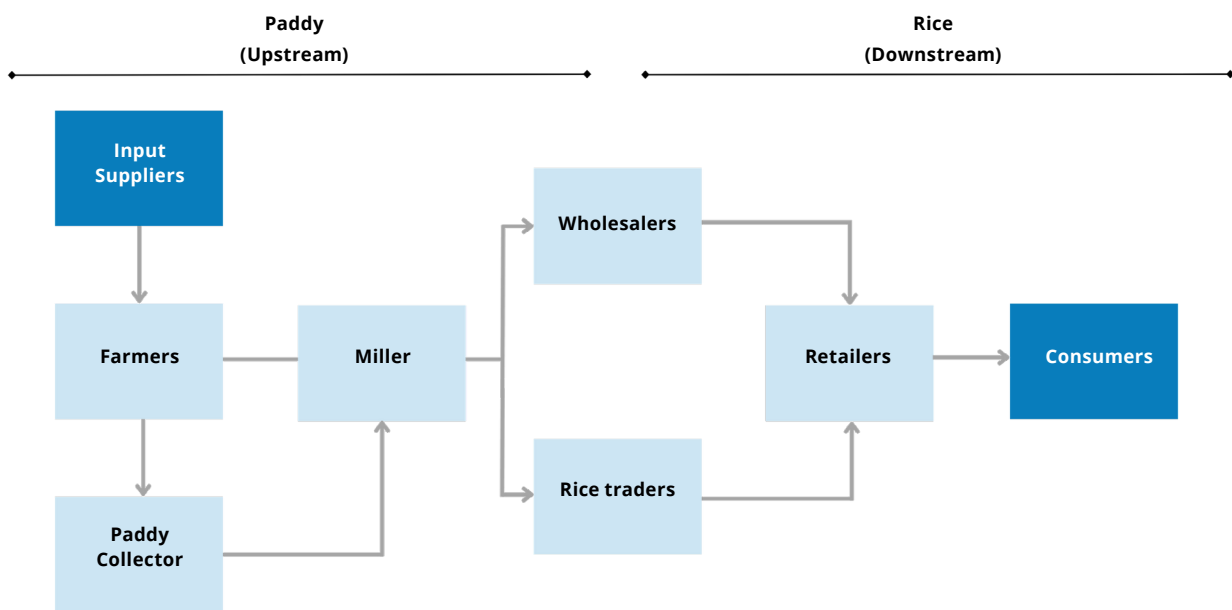
In Lao PDR, there are separate supply chains for the distribution of rice by private millers (Figure 9) and by the Government network (Figure 10). The rice supply chain in Lao PDR is fragmented due to the involvement of multiple players.

The rice distributed by government is used for various social protection programmes, such as dietary

supplementation programmes in schools, day care centres, the creation of food banks and for relief measures (disasters, epidemics).

A robust domestic supply chain for fortified rice must be developed for a sustainable ecosystem for rice fortification. This will require the involvement of important stakeholders.

Figure 9: Private millers' rice value chain in Lao PDR^{2,3}

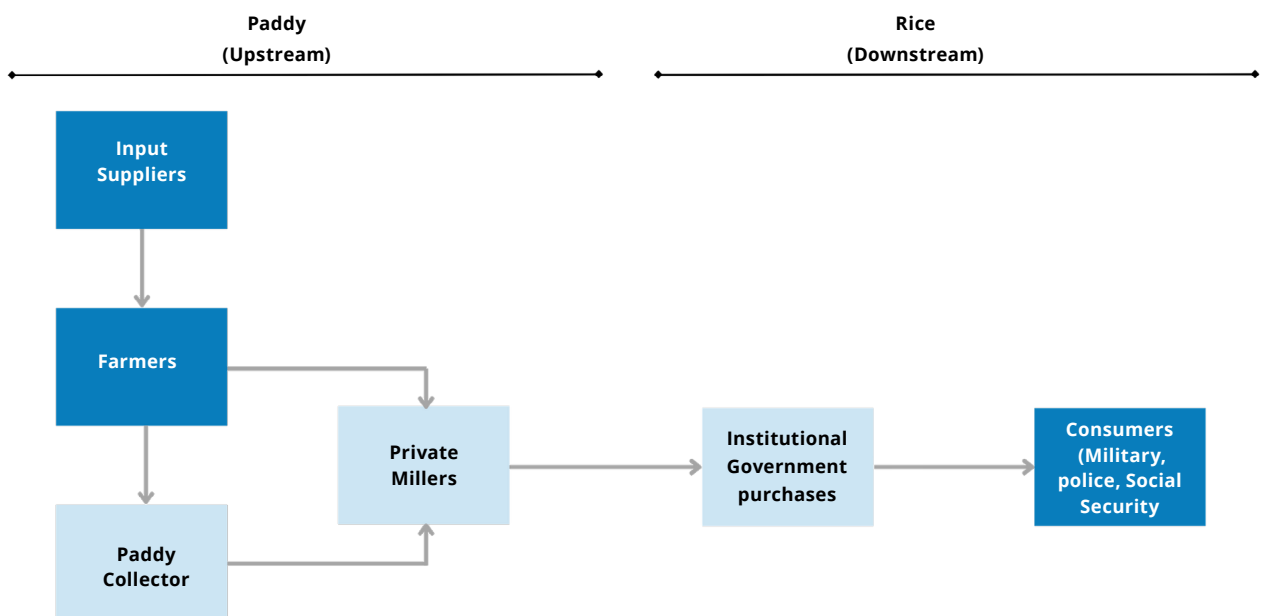


Source: WFP, ValueNotes analysis

2. Role of Different Entities in the Rice Supply Chain
 3. Cost Mark-up of Rice across the Rice Value Chain



Figure 10: Government rice value chain in Lao PDR



Source: WFP, ValueNotes analysis

5. Fortified Rice Supply Chain

There is no locally fortified rice supply chain in Lao PDR and fortified rice is only available through import. There are no domestic suppliers of FRK or the necessary blending units. However, FFTWG is developing a local supply chain for fortified rice. There are multiple stakeholders who will be crucial to this:

1. Government entities/ministries
2. Other stakeholders (machinery and raw material suppliers, rice associations, etc.)

5.1 Government Entities

In Lao PDR there is minimal government involvement in agricultural marketing and trade. Several government entities have now been formed and appointed to lead in setting, reviewing, and implementing regulations to facilitate production and distribution of fortified rice.

Table 2: Government entities involved in scaling up rice fortification in Lao PDR

Authority	Role
National Food Fortification Technical Working Group (FFTWG)	<ul style="list-style-type: none"> - Consists of representatives from Ministry of Health, Nutrition Centre, Ministry of Industry and Commerce, and Ministry of Finance - Facilitate advocacy and awareness about food fortification at all levels and initiate partnership with private sector - Support development of rice fortification standards and regulatory framework enabling establishment of supply chain of fortified kernels - Support development of policy framework to encourage initiation of institutional procurement of fortified rice
Steering Committee	<ul style="list-style-type: none"> - Includes representatives from various departments of Ministry of Health - Provides overall supervision on development and promotion of food fortification, including rice fortification - Provides technical supervision
Technical committee	<ul style="list-style-type: none"> - Consists of representatives from Ministry of Health, Ministry of Education and Sports, Ministry of Finance, Ministry of Industry and Commerce, Food and Drug Association, Ministry of Labour and Social Welfare, Ministry of Information, Culture and Tourism, Ministry of Agriculture and Forestry - Develops policies, strategies, and action plans (short-term, medium-term and long-term) on development and promotion of food fortification with vitamins and minerals - Develops and promotes the addition of vitamins and minerals into foods, based on the context of social and economic development in the present and future

Authority	Role
Secretariat committee	<ul style="list-style-type: none"> - Consists of representatives from various departments of Ministry of Health - Tracks and reports progress to the Steering Committee at regular intervals - Coordinates with relevant secretariats at different levels to ensure cohesion and uniform implementation of programmes
Ministry of Industry and Commerce	<ul style="list-style-type: none"> - Develops and approves national fortification standards and proposes labelling requirements - Ensures imports of fortificants and fortified foods are approved and quality standards are being met - Participates in WTO trade regulation discussions on fortified foods
Ministry of Finance	<ul style="list-style-type: none"> - Decides on tax arrangements for facilitating the import of fortificants and fortified foods for initial, as well as long term financing - Facilitates optimal import tariffs
Food and Drug Administration	<ul style="list-style-type: none"> - Implements food safety and regulatory monitoring legislation
National Food Safety Laboratory	<ul style="list-style-type: none"> - Ensures that the standards of fortification are being met by the respective entities - Serves as a reference centre for the control of food quality across the nation.

5.2 Other Stakeholders

In Lao PDR, only fortified rice donated by USDA via McGovern-Dole has been used for pilot distribution in the school feeding programme.

Lao PDR does not have any fortified rice manufacturers

and sustained production requires the local production of FRK. As FRK does not need to be produced solely by rice millers, other food processors and pharmaceutical manufacturers will also play vital roles. Additionally, the role of rice associations as well as technical partners will be critical in disseminating information to millers. Their roles are discussed in the table below:

Table 3: Other stakeholders in rice fortification in Lao PDR

Authority	Role
FRK suppliers	<ul style="list-style-type: none"> - Currently, there is no domestic supply of FRK in Lao PDR.
Blending machinery suppliers	<ul style="list-style-type: none"> - Blending machinery is imported by distributors and supplied to millers. - There are no local blending machinery suppliers in Lao PDR.
Extruder suppliers	<ul style="list-style-type: none"> - Lao PDR does not have any local suppliers of extrusion machinery. - Some of the international companies supplying machinery are BUHLER and Satake.
International Development Partners	<ul style="list-style-type: none"> - WFP and USDA are the primary development partners for rice fortification in Lao PDR. - SBN helps in coordinating and representing the private sector in the fortification initiative.

6. Discussion and Analyses

6.1 Stakeholder Discussion - Summary of Findings

Rice is primarily produced for self-consumption with only 10-20 percent of the rice sold to be processed in commercial mills (World Food Programme 2017). This leads to a low supply of paddy rice in the market which could be a major hindrance to commercial rice fortification while demand is still small.

The Ministry of Agriculture and Forestry has been supporting farmers in forming collective groups to improve communication and ensure effective implementation of agricultural policies. The Agriculture for Nutrition programme was introduced in 2016 to

provide training to farmers on efficient agricultural practices and introduce economies of scale to reduce associated costs. Owing to its success, this initiative will be scaled up to cover more provinces in 2023 and beyond.

Government stakeholders show a keen interest in scaling up the rice fortification processes. The focus of discussion was on the need for demand generation to incentivize millers to consider investment in rice fortification and develop standards to regulate fortified rice production. Key suggestions included the development of a sustainable supply chain for raw materials such as FRK and machinery (blending machines).

Table 4: Summary of discussion with government stakeholders

Discussion themes	Entity	Details
Experience of fortified rice	MAF	
	NC	<ul style="list-style-type: none"> Lao PDR does not have sufficient experience in fortified rice production.
	MoIC	
Experience with Salt fortification	MOF	<ul style="list-style-type: none"> The Government initially provided imported iodine to the salt manufacturers free of cost; however, they stopped fortifying salt when government aid was halted.
	NC	<ul style="list-style-type: none"> Most salt manufacturers avoided importing iodine due to its high cost and imposition of import tariffs on the product. Consequently, they started selling salt without adding the required micronutrients. False claims were also made in a few cases, where the packaging claimed that the salt was iodized when it was not.
Affordability of fortified rice	MOF	<ul style="list-style-type: none"> The price of fortified rice should be on par with non-fortified rice. The price should not increase more than 5 – 10 percent above the price of non-fortified rice.
	MOIC	<ul style="list-style-type: none"> The price can be kept slightly higher than non-fortified rice to indicate the addition of essential micronutrients
Uncertainty of demand	NC MOIC	<ul style="list-style-type: none"> Laotian people are very sensitive to the taste of rice. If fortification impacts the taste or smell of rice, they might not buy it.
Role of government entities	NC MAF	<ul style="list-style-type: none"> Although the roles of government entities are clearly defined, there is a need to strengthen coordination among those involved in rice fortification.

Awareness creation	MOF	<ul style="list-style-type: none"> Consumers are not aware of rice fortification. It is necessary to advertise and promote fortified rice effectively to ensure that consumers purchase and consume it. Ministry of Agriculture and Forestry pointed out that promotional efforts by government entities such as the Nutrition Centre and Ministry of Health will encourage consumers to purchase fortified rice. Lao PDR does not currently have a policy to support the promotion of fortified rice. This may pose a major barrier to promoting fortified rice consumption among the population.
	MAF	
	NC	
	MOIC	
Lack of food safety standards	NAFRI	<ul style="list-style-type: none"> There are no standards for rice fortification indicating absence of a robust regulatory environment.
	MAF	<ul style="list-style-type: none"> Additionally, there are no enforcement regulations in place to ensure the quality and safety of fortified rice.
Local availability of Fortified Kernels	NC	<ul style="list-style-type: none"> It is essential to have local availability of FRK and fortificant premix to keep the cost of production minimal. FRK is currently being imported by WFP for the pilot study of rice fortification. Concerned government entities do not have sufficient knowledge about the price and supply channels of FRK. Domestic production of FRK should be encouraged in the long term.
WFP support required	MAF	<ul style="list-style-type: none"> WFP should initiate the rice fortification scale-up programme. The Government does not have the resources to spearhead large-scale programmes.
	MOF	<ul style="list-style-type: none"> It is crucial to allocate a budget to purchase FRK as government resources are insufficient. WFP should provide technical assistance to millers to set up the blending infrastructure.
	NC	<ul style="list-style-type: none"> WFP can hire subject matter experts to advise on the scale-up of the rice fortification programme, beginning from the pilot stage to the final stage of commercialization.
Subsidy	MOIC	<ul style="list-style-type: none"> Government should provide subsidies to millers to procure of machinery and raw materials to produce FR. They should provide technical assistance to address the challenges faced by the millers.
	MAF	<ul style="list-style-type: none"> Ministry of Planning and Investment could provide tax exemptions on the import of FRK and machinery for fortification.
Others	NAFRI	<ul style="list-style-type: none"> Lao PDR has limited resources to conduct agricultural research. To increase the agricultural research capacity, it is important to partner with international research institutes.

Discussion with millers –

While the stakeholders in the rice value chain, particularly millers, were aware of rice fortification and its health benefits, discussions with the millers centred on two key variables – the expected demand for fortified rice and the cost/return on their investment (profits). The millers are hesitant to invest due to inadequate

information around these two issues. They were also unaware of the production techniques involved, and the raw materials and machinery necessary.

Table 5: Summary of discussion with millers

Discussion themes	Details
Barriers in the rice industry	<ul style="list-style-type: none"> - It is important to tackle the barriers in the domestic rice industry with respect to inefficient technology and high cost of production. - Large mills are fragmented and mostly spread across a few major cities. - Most of the rice produced by smallholder farmers is used for self-consumption. - Rice production is highly dependent on commune mills. - Packaged rice is mostly sold in urban areas of the country. - Retailers are hesitant to stock new products without existing demand in the market.
Uncertainty of demand	<ul style="list-style-type: none"> - There is no demand for fortified rice in the market. It is not viable to penetrate the market and make huge investments in machinery. - Despite the health benefits associated with fortified rice, the demand from consumers is highly dependent on the taste of the product.
Target audience and pricing	<ul style="list-style-type: none"> - It is estimated that only 20-30 percent of the urban population buys packaged rice from supermarkets. Thus, selling fortified rice in modern markets might not help reach more vulnerable sections of the population. - Consumer demand for fortified rice may be negligible if its price is much higher than non-fortified rice. The price increase should therefore be kept to a minimum.
Consumer awareness and demand creation	<ul style="list-style-type: none"> - Educational awareness campaigns by the Government are needed to inform consumers about fortified rice and its health benefits. This might create demand and, in turn, incentivize millers to consider investing in rice fortification. - Attractive packaging plays a role in influencing consumer's decision in trying a new product. - Quality certification and standardization by government bodies help create trust in the product. - While few millers are willing to invest in advertising, they believe it will help in creating awareness and demand for fortified rice.
Knowledge about production techniques	<ul style="list-style-type: none"> - Apart from a few large millers, most do not have knowledge about the production techniques involved in rice fortification.
Knowledge about costs	<ul style="list-style-type: none"> - It is crucial to understand the various costs involved and the possible channels to procure inputs for rice fortification. - Millers lack knowledge about the costs to produce fortified rice.
Distribution of fortified rice through social protection programmes	<ul style="list-style-type: none"> - The Government must create sufficient initial demand for fortified rice through social protection programmes.
Support needed	<p data-bbox="555 1742 863 1765">Technical support from WFP:</p> <ul style="list-style-type: none"> - Millers should be provided with information on market demand for fortified rice. - They require information about the supply channels and the costs of raw materials and the proportion of FRK for blending with rice. - They require technical training to understand the fortified rice production process.

Financial Support:

Support needed

- Millers should be provided with easy access to loans at subsidized rates to procure machinery and raw materials for rice fortification.
 - They require financial assistance to modify existing machinery and/or install new machinery for fortified rice production.
 - Government could provide relaxation on value-added tax in the initial stages to reduce the cost of fortified rice.
-

Discussion with other stakeholders –

Consultations were held with a rice export association, an FRK supplier and a development partner. The highlights of the discussions are provided below.

The successful implementation of rice fortification

requires a coordinated effort amongst key stakeholders in the supply chain and a clear understanding of the barriers faced by them. The subsequent section uses inputs from all the earlier sections, as well as inputs from the primary research (including interviews with stakeholders) to elaborate on the major barriers in scaling up rice fortification in Pakistan.

Table 6: Summary of discussion with other stakeholders

Discussion themes	Entity	Details
Barriers in the rice industry	Prospective FRK supplier/producer, Online store, Exporter	<ul style="list-style-type: none">- In rural areas, rice is primarily processed manually (threshing/pounding) without the need for machinery.- Rural population depends on self-production of rice.- Commercialization of rice is mainly limited to urban domestic consumers.- The Laotian population is extremely sensitive to the price of food products.- Majority of population prefers small grocery stores or markets where they can bargain as they do not have a high disposable income.- The rice processed at villages does not go through a whitening process. Therefore, it retains a number of nutrients and minerals, eliminating the need for fortification. (Note: even though hand processing does retain more nutrients, fortification provides a host of micronutrients otherwise unavailable.)
Availability of FRK and premix	Prospective FRK supplier/producer	<ul style="list-style-type: none">- There is no infrastructure to produce premix in Lao PDR.- If premix is produced in Lao PDR, the quantity will be small leading to high production costs.
Creation of Standards	Prospective FRK supplier/producer Exporter	<ul style="list-style-type: none">- There is no clarity on the ratio in which micronutrients must be blended into the premix to produce FRK.- Research on the retention levels of nutrients in glutinous rice after production, transport, and storage, is negligible.- There is a lack of awareness about the process involved in fortifying rice.

Need for government support	Exporter, Prospective FRK supplier/producer, Online Store	<ul style="list-style-type: none"> - Technical know-how about the machinery to produce FRK is essential. The Government should offer price support incentives to purchase blending machinery to encourage fortified rice production. - For research on rice fortification, assistance in developing technical knowledge among relevant stakeholders is essential. - The Government can raise awareness on TV and radio. In particular, the Medical Information Centre under the Ministry of Health can initiate this awareness campaign. - The Government may need to enforce production of fortified rice by millers else fortification might never work.
Awareness creation/ Lack of knowledge	Online Store, Exporter	<ul style="list-style-type: none"> - The exporter did not have much knowledge about fortified rice and technical processes required. - Consumers are not aware of fortified rice and its health benefits. - An increase in awareness will lead to an increase in demand. - Testimonials can help in increasing the demand for the product.
Willingness to launch product	Prospective FRK supplier/producer, Online Store, Exporter	<ul style="list-style-type: none"> - The online store expressed indifference towards selling the product. - The exporter was not willing to launch a fortified rice brand, saying fortified rice may not be affordable to most of the population.

6.2 Findings from the landscape analysis conducted by WFP (2017)

Based on the rice landscape analysis conducted in 2017, several challenges pertaining to the rice industry were identified. A few of the key points highlighted were:

1. Rice Production:
 - Farmers practicing rain-fed agriculture customarily use rice for household consumption, with only 10 to 20 percent being traded commercially. This will make it difficult to introduce mandatory rice fortification in the domestic rice industry.
 - The rice milling industry in Lao PDR is highly fragmented causing logistical hindrances.
 - Rice mill associations are in the early stages of development and they lack sufficient advocacy skills.
2. Regulatory barriers:
 - There are no government policies and regulations to provide an enabling environment to produce FRK and fortified rice. There is a lack

of standards for rice fortification in Lao PDR.

Based on the challenges outlined, the landscape report recommended the following:

1. The National Nutrition Committee secretariat must closely supervise and guide FFTWG to facilitate the development of a food fortification policy/strategy.
2. FFTWG must continue to facilitate an enabling environment for fortification.
3. The integration of fortified rice in the school feeding programme and other social protection programmes must be expanded.
4. When the Government plans to hand over the school meals programme to communities, the initiative could be supported with blending at local rice milling facilities.

The following activities were proposed to be implemented as per defined timeframes:

Short term (2018-2020):

- Fortified rice should be used for social protection and emergency programmes.

- The Government should develop a regulatory environment to facilitate rice fortification.
- An inter-ministry technical working group should be created to develop and coordinate activities on rice fortification (including standards for fortified rice and fortified kernels).

Medium term (2021-2025):

- Production of domestic non-fortified rice should be increased.
- The efficiency of the rice milling industry to meet export demand from neighbouring countries should be improved.

Long term (2026-2030):

- National, provincial, and district food quality

systems should be strengthened for effective monitoring.

- Eventually, export-driven demand is likely to result in increased consolidation of the rice supply chain for domestically consumed rice in Lao PDR.
- Advocacy for fortification should be done regularly to ensure fortification activities are running smoothly.

While the reports provided a baseline to our analysis, our discussion with stakeholders helped to understand the status of rice fortification in the country. The Government has made considerable efforts but several barriers remain to the scaling up of rice fortification.

6.3 Barriers to Scaling up Rice Fortification

Lao PDR is not new to the concept of fortification as it has already implemented salt fortification. However, despite having mandatory fortification of salt since 1995, the outcome has not been entirely successful. This can be attributed to the challenges of importing inputs and the lack of a regulatory framework to ensure effective implementation. Keeping this in mind, it is crucial to understand all the aspects of the rice industry in Lao PDR and the challenges faced by stakeholders at different stages of the value chain.

Barrier 1

Lack of coordination among government entities involved in rice fortification

During interviews with government stakeholders, it was evident that there was minimal awareness regarding the activities undertaken by different ministries with respect to fortification. There is no efficient reporting system on the progress of rice fortification, leading to ineffective communication among different departments and ministries involved in FFTWG.

The development of a sustainable supply chain for fortified rice will require a clear, cross-ministerial collaboration and communication strategy. A well-coordinated organizational structure will benefit the implementation of a large-scale rice fortification programme, and in turn, improve the nutrition and health status of the population.

Barrier 2

Relatively low priority given to budgets for rice fortification

While the Government has shown interest in addressing MNDs in the population, the budget for rice fortification is inadequate. With ASEAN having minimum standards for large scale food fortification and Lao PDR assuming the Chairmanship of ASEAN in 2024, the budget contribution to implement rice fortification may be improved in coming years.

Since food fortification was institutionalized through NPAN 2021-2025, there has been no further funding apart from the contribution from USDA for the school feeding programme until 2024.

The scale up of the salt fortification programme in Lao PDR was also similarly hindered due to lack of financial support. To ensure that the rice fortification programme avoids the same issues, adequate budgetary support to the fortification programme is essential.

Barrier 3

Absence of national standards for fortified rice and FRK

The country does not have fortification standards. While the process for standardization has begun, the absence of well-defined standards is a significant structural impediment. Without standardization, it will be extremely difficult to ensure the consistency and quality across all fortified products in the market. Without standards and compliance, it is not be

possible to guarantee safety for human consumption. It is imperative that the Ministry of Industry and Commerce, in coordination with other government entities, formulates the required legislative framework to assist government programmes and speed up commercialization of fortification. / FRK or their likely costs and the machinery (blending/extrusion) needed for rice fortification.

Barrier 4

Lack of awareness of millers' capabilities to produce fortified rice

In 2022, WFP visited a number of rice mills to assess the feasibility of rice fortification and share knowledge on technical processes. Government entities and development partners have a clear understanding about the size and capacity of rice mills in the country. However, potential roadblocks arising from the lack of blending infrastructure have not been assessed in detail. It is essential to evaluate such roadblocks to understand what specific assistance individual millers need to scale blending capacity.

Barrier 5

Limited knowledge among millers about the production techniques, costs involved, and suppliers of raw materials and machinery required for rice fortification

While a number of medium and large millers in Lao PDR are aware of the health benefits of rice fortification and production techniques, most are unaware of the technical processes involved. They are not aware of the raw materials required (such as premixes/FRK) and their likely costs. They also do not know about the machinery (blending/extrusion) or machinery modifications needed for rice fortification.

As a result, millers are unable to assess the amount of investment needed, and their likely returns if they invested in rice fortification, adding to their hesitancy. Most prominent millers believe that the required investment in machinery and maintenance, training of personnel, obtaining permits, etc. would be substantial, even though they were unable to quantify this. The need to build in these costs will make fortified rice more expensive than non-fortified and depending on this cost differential, is likely to impact demand.

Additionally, they are not aware of the appropriate channels to purchase the necessary inputs. Addressing such knowledge gaps is an essential step in establishing a sustainable and efficient supply chain for fortified rice in Lao PDR.

Barrier 6

Millers are unsure about the return on investment in fortified rice production due to lack of consumer demand

Given the prevailing production and consumption patterns in Lao PDR (discussed in Barrier 1), millers do not expect significant demand for fortified rice. There is also a lack of awareness (among some millers) about fortified rice and its benefits.

As a result, the lack of significant demand and the absence of government support result in a reluctance to invest in rice fortification. It falls upon the Government to initiate a market mechanism by creating initial demand through its social protection programmes.

Barrier 7

Underdeveloped QA/QC system to monitor standards of fortified rice

The QA/QC system in Lao PDR is still underdeveloped, with only one National Laboratory (established in 2017). In addition, it is important to learn the lessons from the implementation of salt fortification where salt producers falsely labelled salt as iodized due to costs imposed on them and the lack of effective monitoring by responsible government entities.

To ensure that the QA/QC system is robust and there is effective implementation of rice fortification, it is imperative to improve the testing mechanisms of fortified rice.

Barrier 8

Lack of awareness amongst the population about fortified rice and its benefits

Although WFP and organizations like USDA have introduced fortified rice in the school feeding programme, efforts have been limited. As a result, there is still a lack of awareness among consumers. Fortified rice is not commercially available and it is therefore difficult to raise awareness. Given this chicken and egg situation, as long as consumers remain unaware of fortified rice and its benefits, demand creation will be very difficult.

Barrier 9

Lack of domestic availability of FRK

Currently, Lao PDR does not have any FRK producers. That means millers, at least initially, will need to import FRK from other countries to blend and produce fortified rice. During discussions with stakeholders, concerns

were raised over the prospective impact on the final price of fortified rice of importing FRK. Developing local capability to produce FRK will ensure a smooth supply and may reduce production costs, in particular when producing at a scaled level. However, the technology to produce FRK by coating is patented. Prospective FRK producers will need to either purchase the patent or invest in the machinery for extruded FRK production

6.4 Commercialization by private sector

In conversations with private sector stakeholders, it was clear that the vast majority of the millers and other players were not willing to invest in rice fortification without any clarity on the available market.

The stakeholders require basic understanding of the return on their investment. At the moment, these players do not believe that the commercial sale of fortified rice would generate any profits. Hence, financial support or guaranteed take-off of fortified rice through Government-led procurement programs is required to provide initial economies of scale to manufacturers.

The prospects of consumer-driven market demand

to produce FRK locally. Local producers may require support from the Government and development partners for this.

These impediments need to be addressed through a series of interventions and coordination between different entities across the value chain which must be sustained over a period of time.

are also not encouraging due to the price differential between fortified and non-fortified rice as well as negative perceptions about the taste and/or colour of fortified rice.

Essentially, our research indicates that commercialization (by private sector) at this stage does not seem viable. In the next chapter, recommendations to accelerate the scale-up of rice fortification are highlighted.

A feasible initial start might be to begin production of fortified rice for government programmes with a move to the next stage of commercialization when demand has been built.



7. Recommendations for Scaling Up Rice Fortification

The Government of Lao PDR is implementing fortification in its government programmes, together with WFP's support. However, national nutritional standards for fortification are not yet established.

In 2018, WFP provided technical support to the FFTWG to develop the Food Fortification Strategic Action Plan (FFSAP) which laid down the strategy to implement food fortification in Lao PDR. This included an acceptability study which saw the distribution of imported fortified rice in target schools; private sector engagements to assess the feasibility of locally blending fortified rice; and implementation of the rice landscape analysis. The FFSAP has not been implemented and there is no clear plan to implement rice fortification. In addition, there is no clear plan to have rice fortification integrated in the national budget allocation plan, even though food fortification was mentioned as a priority intervention in the NPAN 2021-2025.

The recommendations are broken down into three phases to highlight the immediate focus and long-term strategy. This phased approach is in alignment with the FFSAP in 2018. Recommendations provide a detailed roadmap to successful scale-up, including subsidized distribution of fortified rice under social protection programmes as well as commercialization by the private sector.

The three phases are described below:

Phase 1 (short term): The focus will be on engaging with government bodies to ensure coordination while simultaneously facilitating the development of national

nutritional standards for fortified rice and FRK. This would ensure an effective regulatory environment. Additionally, the Government and WFP must initiate a pilot blending operation with a few millers to understand the feasibility of rice fortification.

Phase 2 (medium term): Assuming a successful pilot, the Government should advocate with more leading millers, initiating technical assessment and setting up blending infrastructure at their premises. Simultaneously, it is crucial that the Government starts distributing fortified rice in social protection programmes. This would ensure that there is reasonable demand for fortified rice production and encourage more millers to participate. At the same time, WFP and respective government entities should strengthen the regulatory environment to ensure that the quality of fortified rice produced meets the food safety standards in the country.

Phase 3 (long term): The long-term focus will be to increase private sector capacity for fortified rice production. Commercialization of fortified rice will be possible provided there is a level of demand. Once sufficient demand is created through government schemes, private sector millers will be more willing to utilise excess capacity to help commercialise fortified rice. Therefore, in this phase it is essential to spread awareness about fortified rice among consumers. More millers will engage in fortified rice production given the market demand of fortified rice creating significant requirement for FRK.

PHASE

1

- Advocacy with government bodies
- Develop standards for fortified rice and FRK
- Pilot a blending operation

PHASE

2

- Advocacy with millers
- Demand creation through government programmes
- Strengthen the regulatory environment

PHASE

3

- Awareness creation campaigns and advertising
- Develop the domestic production capacity for FRK

Phase 1

Recommendation 1: Advocacy with government bodies

1.1 Ensure smooth and continuous operations within the FFTWG

Indicative timeline: short term (ongoing process)

To ensure efficient communication with government decision makers, FFTWG must actively advocate with the Government for its support for food/rice fortification interventions. The FFTWG must streamline the processes of the essential ministries involved. A well-coordinated organizational and formal reporting structure will ensure efficiency and clarity in the implementation of rice fortification programmes.

Recalling that the FFSAP is an addendum to NPAN, rice fortification should be annually reported together with other intervention priorities of NPAN to the NNC. Reporting to the chair and steering committee of the FFTWG needs to be established on a semi-annual basis.

1.2 Conduct meetings with government entities to ensure rice fortification is a priority in the budgetary allocation process

Indicative timeline: short term (on-going process)

Sustained advocacy with government departments and regulatory authorities is an indispensable step to scale up rice fortification. FFTWG should coordinate with development partners such as WFP for support in conducting meetings with relevant government entities (i.e., Ministry of Finance) to set the budgetary allocation for the rice fortification programme.

1. FFTWG, in collaboration with other development partners, can advocate for multiple sources of budgetary allocations to scale up social protection programmes involving fortified rice.
2. FFTWG should establish and maintain its facilitation support to strengthen domestic and international supply chains for fortified rice.

Given the lack of clarity regarding finances, WFP can provide inputs based on case studies of other countries (such as Cambodia). This will help spark interest and engagement of important government and private stakeholders and provide a big push for fortification efforts.

Recommendation 2: Develop standards for fortified rice and FRK

2.1 Advocate with FFTWG to develop the national nutritional standards for fortified rice and FRK

Indicative timeline: short term (should begin within a year)

Comprehensive food safety standards are essential to avoid any inconsistency in the quality of fortified rice and the micronutrients to be added to the FRK. WFP and the Nutrition Council must help FFTWG set standards for fortified rice, building on the international guidelines set by WFP. The standards for fortified rice must be centered around the recommendations by the Nutrition Council under the Ministry of Health regarding the micronutrient composition based on deficiencies in micronutrients in the population.

Recommendation 3: Pilot a blending operation

3.1 Initiate the pilot of a blending operation with contracted millers to produce fortified rice

Indicative timeline: short term

WFP could conduct blending assessments with contracted millers to assess the requirement of blending machinery – whether new machinery is needed or existing machinery can be modified.

Once the initial assessment is completed, WFP, with the help of the Ministry of Industry and Commerce, can install blending machinery. A pilot blending operation can be set up, where millers provided with imported FRK and training produce fortified rice. The fortified rice would then be bought by the Government for its social protection programmes. Simultaneously, WFP could train mill employees in the processes needed.

Initiating a pilot blending operation with millers will help WFP and the Ministry of Industry and Commerce better understand costs and operational issues around rice fortification. Accordingly, the Ministry can support millers by subsidizing the costs of fortification and WFP can provide technical assistance to tackle any operational issues. WFP must also provide the millers with information related to import channels of FRK to ensure that they can continue the production of fortified rice. Additionally, a public-private partnership between the Government, FRK and blending machinery suppliers must be strengthened to ensure smooth local blending

operations of fortified rice. These steps could be scaled up to include more millers in fortified rice production in the second phase of the scale-up process.

Phase 2

Recommendation 4: Advocacy with millers

4.1 Conduct periodic workshops and individual meetings ensuring continuous engagement with the leading rice millers to improve their knowledge of rice fortification, its health and economic benefits, and the technical processes involved

Indicative timeline: medium term

While some large millers have some understanding about fortification and its benefits, they are not aware of the technical know-how of the processes and the costs involved and economic returns in selling fortified rice. WFP, in partnership with FFTWG, can conduct workshops and individual rice miller meetings to disseminate information about rice fortification in detail. They can also create a technical report to inform the millers of these aspects in detail, sharing it with the top millers to garner interest and to help them understand the business aspect of producing fortified rice.

These workshops/meetings can include discussions on:

1. Technical processes involved in rice fortification;
2. Guidance around the financial viability of producing fortified rice; and
3. Success stories of rice fortification in other countries through existing case studies of WFP.

The information about these basic financial variables (cost of raw materials, investment needed for machinery, and expected demand) will help the millers understand their likely profitability (return on investment). This will also help to create a business plan which will be essential in securing funds for investment if they sense an opportunity.

4.2 Initiate blending assessments with leading millers (assessing the requirement of new machinery or whether their existing machinery can be modified)

Indicative timeline: medium term (should begin after initial meetings are conducted)

WFP has already been visiting millers (such as Sayboua

and Southat) to assess existing machinery and their milling capacities. Similar assessments with more millers will identify how many millers are willing and have the capacity to begin producing fortified rice in the initial stages of commercial scale up of rice fortification.

Details about the raw materials (FRK) and machinery (blending machinery) used in rice fortification and the techniques of production must be explained to the millers. Information such as the details of modifications needed to existing machinery (control feeder) to perform the functions of blending machinery must be conveyed to millers through these workshops. Initially, FRK will have to be imported from other countries by these millers.

4.3 Provide technical and financial support to interested millers for installation of blending machinery

Indicative timeline: medium term (after awarding tenders to interested millers)

Once interested millers are identified, WFP (through SBN) should collaborate with the Ministry of Industry and Commerce to support millers by providing them access to its business assistance fund and other subsidy schemes. This will help rice millers buy machinery and raw materials required for rice fortification. Loan schemes for millers could be explored to help upgrade existing machinery or procure new machinery.

WFP could disseminate information on how to ensure safety standards and procure certifications for the quality of rice products which will be required for production of fortified rice. The Government can also provide small- and medium-scale millers with financial assistance for such certifications. Technological advances that meet food safety standards will significantly help millers to scale up their production capacities, thereby ensuring a sustained supply of fortified rice.

Recommendation 5: Demand creation through government programmes

5.1 To grow the demand for fortified rice in the market, invite tenders from leading millers to procure fortified rice for institutional feeding programmes and offer subsidies to millers to fund the fortification process

Indicative timeline: medium term

WFP included fortified rice as part of the school meals programme launched in 2002 to check its acceptance by consumers. The acceptability study showed that fortified rice was accepted by children, their parents, and teachers. It is recommended that the FFTWG assess the possibility of including fortified rice in all its government programmes involving food distribution. This will require technical assistance from WFP and financial assistance from the Government and international funding partners.

To meet demand, the FFTWG could start procuring fortified rice by inviting tenders from private millers. The Ministry of Industry and Commerce could offer subsidies to these millers to procure machinery and raw materials to produce fortified rice, which would enable existing and new players to produce fortified rice on a larger scale and initiate the development of a market mechanism for fortified rice.

Recommendation 6: Strengthen the regulatory environment

6.1 Provide technical assistance to FDQCC to support the development and implementation of a QA/QC system for rice fortification

Indicative timeline: medium term (should begin after the development of standards)

WFP, in partnership with the Food and Drug Administration of the Ministry of Health, can provide technical assistance to support the regulatory authorities in the effective integration of a quality assurance and quality control (QA/QC) plan for rice fortification.

Lao PDR's existing laboratories are not equipped to analyse fortified rice and FRK. WFP could provide technical assistance to support FDQCC and other regulatory authorities in the effective integration of a QA/QC plan for rice fortification. These laboratories need to be equipped with adequate systems for testing and ensure that quality standards are followed.

FDQCC should develop a robust mechanism where samples of fortified foods are tested regularly to effectively monitor the standards and quality of fortified rice FRK. This will help in monitoring the quality of fortified rice and imported FRK. In the long run, this will also help in monitoring any FRK produced locally.

Phase 3

Recommendation 7: Awareness creation campaigns and advertising

7.1 Campaign to generate awareness about the benefits of consuming fortified rice among the population and conduct surveys to understand perceptions about fortified rice

Indicative timeline: long term (ideally to be start along with the distribution of fortified rice through institutional programmes)

The consumption of fortified rice will require campaigns to disseminate health information and facts about fortified rice. Consumer surveys, including distribution of fortified rice samples, could be employed in government distribution programmes. The population rely heavily on word of mouth, and initial nudges could lead to a positive cascading effect. Sensitization campaigns should be implemented, focussed on the target community who have received fortified rice through government distribution programmes. Once the Government understands the perceptions of consumers towards fortified rice, it will be essential for the Government to invest in mass-awareness campaigns. The Ministry of Health could run campaigns for the public across media – TV, print and social - about fortified rice and its benefits.

In addition, once Lao PDR has a regulatory mechanism in place, the food regulation authority could use the food fortification logo on packaging labels to indicate fortification of the product⁴. This will also aid in spreading awareness and assurance about fortification by utilizing the Lao PDR food fortification logo which was endorsed in February 2022.

In parallel, it is essential for millers and importers who are looking at launching fortified rice brand to be aware that:

- The brand should be associated with health.
- The packaging should be visually appealing to attract customers.

The food fortification logo on brands should be displayed on supermarket shelves and on online websites. Packaging and other means of communication need to ensure that fortified rice brands are clearly identified with health benefits.

As described above, the key success factors in scaling

4. For example, in India, F+ logo is created for fortified products, by the Indian food regulator FSSAI.

up rice fortification in Lao PDR include: a nudge from the Government to create initial demand; the belief by all stakeholders that rice fortification is beneficial; the establishment of a viable business model for importers and millers; and a sustained campaign to build awareness among consumers.

In the long run, a combination of government support and gradual rising acceptance by the public will help create a sustainable ecosystem that will help significantly in reducing MNDs in Lao PDR.

Recommendation 8: Develop the domestic production capacity for FRK

8.1 Provide necessary support to procure the patented technology for domestic production of FRK, aiming to reduce cost and sustain an effective supply chain

Indicative timeline: long term (after sustained demand is established in the market)

Initially, large millers could be partners for the introduction of rice fortification. Large millers could begin by importing FRK from nearby countries including Myanmar, Thailand, and the Philippines where FRK is already produced to help establish the model and create an initial supply chain. As demand for fortified rice increases, large millers could begin producing FRK which would provide a track record for further capacity expansion. In the long term, the programme could be expanded to include medium- and small-scale millers. Given the geographic challenges and wide dispersion of milling capacity in Lao PDR, a hub and spoke model might be suitable – with hubs around major consuming centres (towns and cities) and selected smaller millers to be able to cover as much of the population as possible.

As the demand for fortified rice increases, the demand for FRK will also increase. To keep the production costs for fortified rice minimal, it is essential to ensure that FRK is locally manufactured⁵ and at a large scale.

The development of the domestic supply chain for FRK can happen in stages as follows:

1. FRK could be initially imported by large millers until the supply chain is developed. FRK could be imported from Myanmar, Thailand, and the Philippines where FRK is already produced.
2. Once demand for fortified rice is established, WFP

could provide technical assistance to procure the patent for producing FRK locally.

3. The Government and funding partners (such as the International Fund for Agricultural Development) could provide financial assistance to prospective FRK producers to procure the patent for local production of FRK.
4. Once the patent is purchased and as more millers start fortifying rice, local production of FRK could be initiated in specific regions (hubs) to cater to the demand for those millers.
5. As the demand for FRK grows, FRK production could be expanded to other regions. This would ensure greater viability, as it will bring down the logistics and transportation costs.

Scaling up the rice fortification programme requires effective coordination among all stakeholders coupled with long-term commitment. Eventually, a combination of government support and rising acceptance by the public will create a sustainable ecosystem. This will help significantly in reducing MNDs in Lao PDR.



5. Minimum capacity of FRK production is 0.15 MT FRK per hour



Annex:

LIST OF STAKEDHOLDERS

Table 7: List of stakeholders in Lao PDR

Type of entity	Name of entity	Designation
Medium and large rice millers and traders	Sayboua Rice Mill	Owner
	Southat Rice Mill	Owner
	Shopping D	Owner
Large rice miller and rice exporters	IDP Rice Mill	Owner
Medicine producer and supplier	Pharmaceutical number 3	Director
	MAF	Head of Processing and Nutrition Division
	MOF	Deputy Head of Department
	NC	Director of Nutrition Centre
	NAFRI	Deputy Director of Agriculture Research Centre
Government entities	MOIC	Head of Production Division

KEY SEASONS FOR RICE PLANTING AND HARVEST

Lao PDR is divided into two regions – North (highland) and South (lowland). Almost 90 percent of rice production in Lao PDR occurs during the wet season as only about 12 percent of the cultivated rice area is irrigated. There is no irrigated acreage in the highland area, limiting the region's rice farmers' growing season to one crop per year (April-November). The lowland being more fertile has two crops sowed per year. (United States Department of Agriculture (USDA) 2020).

Table 8: Planting and harvest seasons of rice in Lao PDR

Region	Season	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
North	Wet												
	Dry												
South	Wet												
	Dry												

Planting	
Harvest	

Annex:

MARKET PRICE OF RICE

The table below provides the selling prices of rice sold by NFA.

Table 9: Average prices of rice in Lao PDR

Year	Glutinous rice- First Quality (LAK/kg)	Glutinous rice - Second Quality (LAK/kg)
2017	6,850	5,820
2018	6,550	5,590
2019	9,065	7,800
2020	8,900	7,250
2021	8,500	7,360
2022	10,380	9,300

Source: WFP

RICE IMPORTING COUNTRIES

Table 10: Top countries from which rice is imported (2020)

Country	Region	Imported quantity (1000 MT)	% of imports out of total
Thailand	Asia	58.45	74.9%
Vietnam	Asia	17.80	22.8%
USA	North America	1.47	1.9%
Myanmar	Asia	0.24	0.3%
China	Asia	0.06	0.1%
India	Asia	0.04	0.1%
Total		78.05	100%

Source: Trademap

Annex:

ROLE OF DIFFERENT ENTITIES IN THE RICE SUPPLY CHAIN

Table 11: Supply chain participants and their role

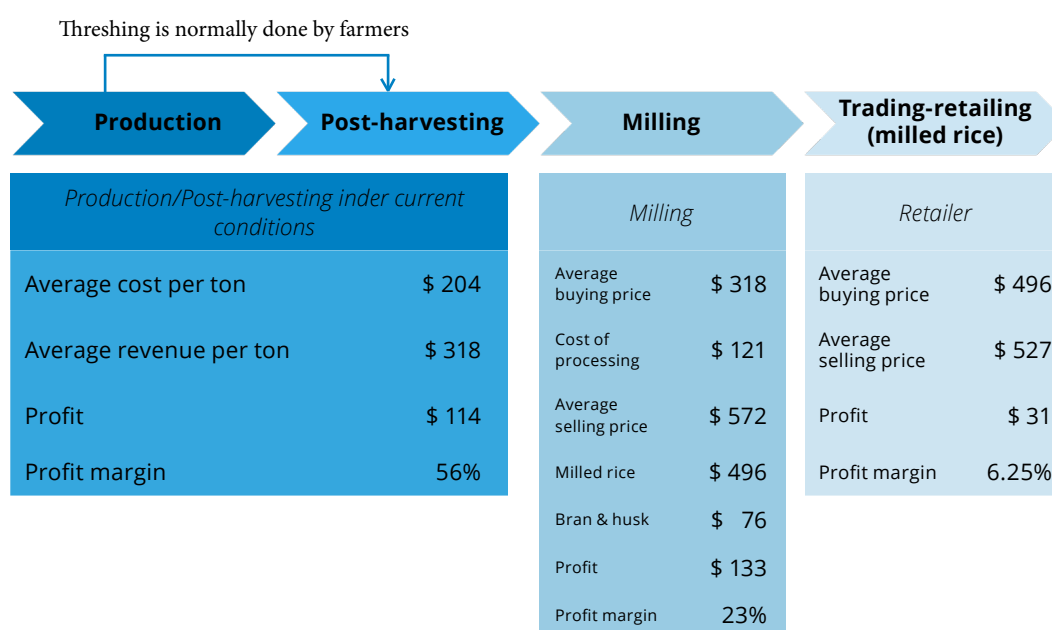
Serial Number	Key players	Step involved in
1	Input suppliers	Supply of inputs such as seeds, fertilizers, and pesticides to farmers. They also provide inputs and technical advice to farmers.
2	Farmers	Production of paddy and selling the produce to any of the following: <ul style="list-style-type: none">• Paddy traders• Cooperatives• Marginal farmers sell their produce to intermediaries who sell to paddy traders• Few large farmers sell paddy rice in bulk to large millers.
3	Paddy traders	Buy rice from farmers and perform the husk removal (primary processing) of rice before selling it to large miller traders. Paddy traders also lend advance credit to farmers to ensure a steady supply of paddy.
4	Cooperatives	The Department of Rural Development and Cooperatives is responsible for supporting and overseeing all agricultural cooperatives, farmer and production groups within Lao PDR. Cooperatives supply farmer members with inputs to aid in agricultural production like seeds, fertilizers, etc.
5	Millers	Millers perform collection, de-husking, grading, packaging and labelling. They process milled rice and sell it in domestic and export market through wholesalers, traders, etc. They achieve a lower efficiency and higher cost than mills in neighbouring countries. Milling efficiencies range from 55 to 65% depending on the mills and paddy sourced.
6	Wholesalers	Wholesalers supply milled rice to retailers or sell it directly to consumers.
7	Retailers	Retailers buy rice from millers or wholesalers and sell at traditional grocery stores or in modern supermarkets
8	Consumers	Consumers are the end users who can buy rice from multiple channels such as traditional grocery stores, e-commerce websites, and retail stores.

Annex:

COST MARK-UP OF RICE ACROSS THE RICE VALUE CHAIN

The cost mark-up of milled rice in Lao PDR is depicted in the table below.

Figure 11: Value chain and relative financial position of players



Source: WFP (2017)

Table 12: Value chain and relative financial position of players (USD/Kg)

	Farm-gate	Assembly	Milling	Wholesale	Retail
Price	2.64	2.84	3.55	6.08	7.91
Cost	2.33	2.73	3.02	5.11	6.71
Purchase of intermediate Product		2.33	2.84	4.86	6.08
Incremental costs	2.33	0.4	0.18	0.25	0.63
Profit	0.31	0.11	0.53	0.97	1.2

Source: World Bank (2018)

Annex:

TECHNICAL DOCUMENT FOR MILLERS

The technical document that could be provided to millers might contain the following indicative contents:

1. Different processes of rice fortification and the most feasible technology
2. Raw materials and machinery required
3. Process innovation in FRK and machinery through case studies in other countries
4. Costs involved:
 - Cost of importing FRK
 - Cost of blending machinery
 - Cost of FRK for local production (includes the cost of extrusion machinery)
 - Any other associated costs
5. Investment needed and expected returns under different scenarios:
 - Whether FRK is imported or produced locally (a separate study needs to be conducted to dive deeper into this aspect)
 - Whether blending machinery is imported or produced locally
6. Financial viability in producing fortified rice – expected return on investment
7. Case studies of successful rice fortification projects across other countries through existing WFP reports

Technologies for Rice Fortification

Rice can be fortified using multiple technologies, such as dusting, coating, cold extrusion, warm extrusion and hot extrusion. In this report, we will focus on rice fortification through extrusion.

Extrusion is a fortification technique in which FRK is added to the polished rice in ratios ranging from 1:50 to 1:200. The extrusion process for rice fortification can be either cold or hot.

Cold Extrusion: This process, also called “shape forming”, uses no additional heat except that generated during the mechanical processing of the rice dough. The product temperature during the entire processing operation remains below the melting temperature of the rice starch (30–40 °C), and hence gelatinization of the starch does not take place.

Hot Extrusion: In this process, additional heat is applied normally through steam heated barrel jackets and the melting temperature of starch is exceeded (80 to 110 °C). The dough containing micronutrient premix in the required concentration and other optional additives are pressed through the extruder tube where steam and water are added. The pasta shaped extrudate is cut into rice size pieces at the exit and the wet FRK is subsequently dried. The process results in fully or partially pre-cooked simulated rice kernels that have similar appearance to normal polished rice.

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Annex: Acronyms

AFN	Agriculture for Nutrition
DRDC	Department of Rural Development and Cooperatives
FAO	Food and Agriculture Organization
FDA	Food and Drug Administration
FDQCC	Food and Drug Quality Control Centre
FFSAP	Food Fortification Strategic Action Plan
FFTWG	Food Fortification Technical Working Group
FRK	Fortified Rice Kernel
GMP	Good Manufacturing Practices
IDD	Iodine Deficiency Disorder
IFAD	International Fund for Agricultural Development
Lao PDR	Lao People's Democratic Republic
MAF	Ministry of Agriculture and Forestry
MICT	Ministry of Information, Culture and Tourism
MMG	Minerals and Metal Group
MMT	Million Metric Tons
MND	Micronutrient Deficiency
MPI	Ministry of Planning and Investment

MoES	Ministry of Education and Sports
MoF	Ministry of Finance
MoH	Ministry of Health
MoIC	Ministry of Industry and Commerce
MoLSW	Ministry of Labour and Social Welfare
NAFRI	National Agriculture and Forestry Research Institute of Lao PDR
NC	Nutrition Centre
NNC	National Nutrition Committee
SBN	SUN Business Network
USDA	United States Department of Agriculture
WFP	World Food Programme
WHO	World Health Organization
WRA	Women of Reproductive Age
VAD	Vitamin-A deficiency
WFP	World Food Programme
WHO	World Health Organization
WRA	Women of reproductive age



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