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Understanding the Rice Value Chain in Nepal: Defining the Way Forward for Rice Fortification

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Executive Summary

Nepal is a low-middle income country with a high prevalence of malnutrition. Twenty percent of households in Nepal are mildly food insecure, 22 percent are moderately food insecure, and 10 percent are severely food insecure (Badal Chemjong 2020) (Nepal Demographic and Health Survey 2016). Rice, the main staple food of Nepal's population, constitutes 52 percent of the total cereal consumption in the country (Dyutiman Choudhary 2022). The consumption of rice grew at a compound annual growth rate (CAGR) of 2.6 percent between 2013 and 2021. As the primary staple it is an appropriate food for fortification. As per the discussion with stakeholders, the limited presence of modern rice mills (with steam plant), insufficient supply of local paddy (rice in the husk), and availability of cheaper and better quality imported rice has affected self-sufficiency in rice production.

To improve the nutritional status of the population, the Government of Nepal is planning to introduce rice fortification in the country in phases:

1. Promotion of rice fortification as a long-term food-based strategy to address micronutrient deficiencies as part of national health/nutrition policies and plans such as the Multisectoral Nutrition Plan (MSNP).
2. Formulation of standards for rice fortification under Nepal food regulations.
3. Engagement with millers through Food Management and Trading Company (FMTC), a state-owned agency, and the private sector to educate them about the fortification process and encourage them to fortify rice for commercial use.
4. Distribution of fortified rice under existing social safety net programmes through FMTC.
5. Involvement of the private sector in the rice fortification programme.

To understand the potential of rice fortification to improve the nutritional status of the population of Nepal, detailed discussions were held with important stakeholders. Government stakeholders were interested in scaling up rice fortification and were aware of the nutritional benefits of fortified rice.

A summary of main inputs is as follows:

1. The government could provide adequate financial support in terms of subsidies on production and transportation costs of fortified rice to encourage the private sector to participate in the rice fortification initiative.
2. To create awareness of fortified rice among the population, FMTC could work with ministries such as the Ministry of Agriculture and Livestock Development, the Ministry of Health and Population, the Ministry of Education, Science and Technology and the Ministry of Industry, Commerce and Supply.
3. Endorsement of national standards and legislation for rice fortification is required to ensure quality checking and monitoring of fortified rice kernels (FRKs) and fortified rice production.
4. The Department of Food Technology and Quality Control (DFTQC) would require assistance from the World Food Programme (WFP) to strengthen the lab capacity for testing of fortified rice and FRKs.

During discussions with millers, two issues were highlighted: 1) the need to create demand, and 2) profitability. A summary of the discussions is as follows:

1. Except for a few large millers, most were not aware of the production techniques, costs, raw materials and machinery used in fortification.
2. Consumer price sensitivity and lack of knowledge about health benefits means that demand for fortified rice might be negligible if priced higher than regular rice. .
3. The government needs to create sufficient initial demand for fortified rice through social safety net programmes.
4. Government support would be essential for millers in the initial set-up of rice fortification infrastructure.

The table below summarizes the barriers to rice fortification scale-up and their corresponding recommendations:

Serial number	Barriers	Recommendations
1	Need for accreditation of laboratories for testing of fortified rice and FRK	<p>Development and implementation of a QA/QC system for rice fortification</p> <p>Strengthen the institutional and technical capacity of existing laboratories and align their accreditation as per rice fortification standards.</p>
2	High dependency on imports	<p>Enhance rice production and supply system and integrate fortification at all levels</p> <p>Enhance the rice production and supply system and explore the possibility of integrating fortification into the food system to minimize imports.</p>
3	Limited awareness among millers about production techniques, costs, and suppliers of raw materials and machinery required	<p>Advocacy with millers and awareness creation</p> <p>Organize regular workshops, training programmes and individual meetings with the rice millers and relevant government entities to educate them about rice fortification, its health and economic benefits and the technical processes involved.</p>
4	Perception of low return on investment in fortified rice production due to lack of awareness of production costs	<p>Business model - return on investment</p> <p>WFP, in collaboration with the government, to create and disseminate a technical document for millers that outlines the rice fortification processes, the costs involved and the economic returns.</p>
5	Without government support, millers are hesitant about rice fortification given the lack of consumer demand	<p>Demand creation for fortified rice</p> <p>Create demand for fortified rice through government social safety net programmes and continuous engagement with the private sector to scale up fortification.</p> <p>Conduct consumer awareness programmes through mass media and other platforms.</p> <p>Build domestic capacity for production of FRKs and fortified rice Provide necessary support and subsidies to procure the required machinery and technology for domestic production of FRK and fortified rice.</p>
6	Lack of awareness amongst the population about fortified rice and its benefits	<p>Awareness creation campaigns</p> <p>Run national government campaigns to educate the population on the health benefits of fortification. Private businesses that plan to launch a fortified rice brand should consider implementing the following suggestions:</p> <ul style="list-style-type: none"> - appropriate branding - visually appealing packaging - use of F+ label to differentiate from regular rice - visible display on supermarket shelves
7	Technical challenges faced by private millers/constraints in rice production	<p>Strengthen the competitiveness of domestic rice industry</p> <p>Improve domestic rice industry competitiveness against better quality and cheaper imports.</p>

To strengthen the rice industry and develop a sustainable supply chain for fortified rice, a clear cross-ministerial collaboration and communication strategy is required. Appropriate advocacy could bring

a change, given the government's positive actions on the fortification of other foods and the desire to reduce micronutrient deficiencies.

1. Introduction

Background

South Asian countries are weighed down by the burden of malnutrition, high stunting rates, and widespread micronutrient deficiencies. Nepal, a low-middle income country in this region, faces a high prevalence of hunger and malnutrition in the population. As per (Nepal Demographic and Health Survey 2016) NDHS, only half the households in Nepal are food secure (48 percent) and this has remained constant between 2011 and 2016 (49 percent in 2011 versus 48 percent in 2016). High rates of anaemia and stunting affect the most vulnerable groups of the population. The prevalence of micronutrient deficiencies is an indication of the insufficient micronutrient intake of the population (WFP 2021).

Micronutrient deficiencies such as iron deficiency disproportionately affect women, adolescents and children. These are contributors to poor growth, cognitive impairment and increased risk of morbidity and mortality (WFP 2021).

Carbohydrates dominate the calorie intake of the Nepalese population, mainly cereals (rice and wheat), followed by potatoes (FAO 2022). Rice is consumed daily by 90 percent of the Nepalese population (Landscape Analysis for Rice Fortification in Nepal 2016).

A diverse and balanced diet is the best way to address micronutrient deficiencies but social, economic and food security issues make this difficult to achieve. This results in an absolute necessity for large-scale nutrition intervention programmes (WFP 2021). The Nepal government is implementing multiple strategies such as micronutrient and dietary supplementation, fortification and diet diversification among its different population groups.

Nepal has pioneered the implementation of a multisectoral approach to nutrition. Recognizing its commitment to nutrition, Scaling Up Nutrition (SUN) identified the country as an 'early riser' in 2011. Nepal is one of the countries that has received support from the global initiative on Renewed Efforts Against Child Hunger (REACH) (Landscape Analysis for Rice Fortification in Nepal 2016).

To improve the nutritional status of the population, the Government of Nepal first introduced mandatory food fortification in 1973 through a salt iodization programme. Currently, salt and wheat flour (produced by roller mills) are being fortified on a large scale. The government has been exploring fortification of various food items including rice (Nepal National Micronutrient Status Survey - NNMSS 2016).

The consumption of rice is significantly high in Nepal to make it an appropriate vehicle for fortification. However, the production of 5.1 million metric tons (MT) (2021) is inadequate to meet domestic demand and the country must depend on imports. Rice imports from neighbouring India are on the rise (Kathmandu Post 2022).

In 2016, the Government of Nepal conducted a landscape analysis for rice fortification to assess its viability. The study identified rice fortification as an opportunity to address the problem of malnutrition.

Nepal's rice milling industry and supply chain are fragmented, therefore integration of rice fortification at a few central locations may not successfully cover the majority of the population. Rice consumption and production are mostly concentrated around the Terai region; by contrast sourcing of food in the hilly and mountainous regions is difficult. The prevalence of food insecurity is higher in these regions, leading to a significant need for the implementation of the rice fortification programme (Landscape Analysis for Rice Fortification in Nepal 2016). In addition, subsistence farming and consumption of informally imported rice distort the supply chain.

Based on discussions with relevant stakeholders, approximately 50 percent of the rice production in the country comes from the large rice mills. This makes successful implementation of rice fortification through the private sector a possibility, provided an effective distribution system is in place.

Nepal is currently at a nascent stage and needs optimal scale-up of the existing social safety net programmes and rice fortification. DFTQC, under the Ministry of Agriculture and Livestock Development, has finalized the standards for rice fortification.

For more than a decade, the United Nation's WFP has been working with governments, private sector and technical partners across countries in Asia-Pacific, (Pakistan, India, Bangladesh, Nepal, Sri Lanka, Myanmar, Cambodia, Indonesia, Laos, Timor-Leste, and Bhutan) to make rice more nutritious through post-harvest fortification. 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 Nepal, with support from WFP, needs to ensure that fortified rice is widely available and accessible through two main platforms: the social safety net programmes and commercial retail channels. This will reach a greater proportion of the population,

particularly those who are nutritionally vulnerable and in urgent need of micronutrient interventions. It is important to gain deeper insight into the rice milling landscape to effectively introduce fortified rice through social safety net programmes and commercial retail channels. An analysis of the rice value chain will help to identify the opportunities and challenges in engaging stakeholders and will help to identify sustainable entry points and opportunities to make fortified rice available at scale.

Objectives of the study

'Understanding the Rice Value Chain in Nepal: Defining the Way Forward for Rice Fortification' is a study that aims to understand the potential of rice fortification in Nepal.

The overall objectives of this study are to:

1. Undertake a detailed landscape analysis to identify and map the main actors across the rice value chain in Nepal and;
2. Identify and analyse the demand and supply challenges across the rice value chain in Nepal and identify opportunities for introducing fortified rice through commercial channels and government social safety net programmes.

Specific objectives

- Identify, map and document the main actors across the rice value chain in Nepal including 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.
- Identify rice millers with Food Safety or Good Manufacturing Practices (GMP) certificates.
- Study and illustrate the 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 main actors across the value chain (infrastructural, capital availability, regulatory, supply chain, import/export regulations/policy, taxation, policy and political environment) and identify opportunities for introduction and scale up of fortified rice through commercial channels and government social safety net programmes.
- Map the supply chain and trading of rice, including cost mark-ups along the chain.
- Study and recommend potential options for strengthening the supply side 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 actors that can be engaged to introduce fortified rice through commercial channels and government social safety net programmes.

- Based on the consultation and analysis of the private sector, identify those who could potentially partner with WFP to introduce and scale up fortified rice through commercial channels and government social safety net programmes.
- Identify the barriers and key factors that could enable and contribute to the scaling up of fortified rice.

WFP has engaged with ValueNotes Strategic Intelligence, India, to conduct this study.

Research methodology

A structured research process was followed.

1. 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 and experience in rice fortification initiatives in various countries.
- Preparation of project plan.

2. Secondary research and primary research design

- Intensive desk research on several topics was conducted:
 - Nutrient deficiencies in the population of Nepal;
 - Past experience in food fortification;
 - The rice industry in Nepal; size, exports, domestic consumption, etc.;
 - The rice supply chain and main stakeholders and;
 - Status of rice fortification initiatives and barriers to adoption and scale-up.
- Sources used include:
 - Available literature comprising research papers, development partners' reports, and project reports from previous pilots such as those from World Bank, WFP, etc.;
 - Reports and statistics such as those from the Government of Nepal, United States Department of Agriculture (USDA), FAO, etc. and;
 - A complete list of publication references is provided in the bibliography.
- The initial secondary research helped to identify information gaps and stakeholders that could provide valuable inputs.
- For each type of respondent an appropriate discussion guide was developed.
- During this process, the ValueNotes team had several discussions with WFP stakeholders to refine the list of likely respondents and discussion points, and focus on information relevant to each of them.

3. Primary research

- The list of entities and the respondents were identified by an iterative process.
 - The reports and available literature used in secondary research helped to identify the important stakeholders in the government and the rice industry in Nepal.
 - The websites of some large millers were scanned to find important details such as their milling capacity, their production levels, etc., and they were classified based on their production capacities.
 - A list of relevant stakeholders and people in these organizations was developed through additional desk research.
 - Detailed discussions were held with these stakeholders from government and the private sector, giving a diversity of opinions and ensuring equitable representation of views.
- Experts referred by respondents in the initial interviews were contacted and included in discussions.
- Where necessary, clarity was sought in further interviews.
- The discussions helped to:
 - Flesh out gaps in understanding of the industry and ecosystem;
 - Get real-world inputs from stakeholders on barriers to large-scale rice fortification and;
 - Understand the constraints of different stakeholders and possible future actions that might help reduce or remove some of the barriers.
- Respondents:

Type of entity	Names of entities	Designation
Large rice millers and traders	Rohini Agro	Owner
	Jayshree Foods	CEO
Rice importers	New Om Khadya Udyog	CEO
	Suva Shree Mills	CEO
	Bohora Rice Mill Pvt. Ltd.	Owner
Government entities	Shivam Agro	Director
	Tarun Agro Industries	CEO
	Shivam Agro	Director
	Agrawal Enterprises	CEO

4. Analysis and report writing:

- All inputs were collated, analysed and distilled to create this report.
- Where necessary, clarification was sought.
- The analysis and report were discussed with the WFP team and their inputs and feedback were incorporated in subsequent versions.



Report Structure

The report is divided into eight chapters, each focused on a particular aspect.

Chapter	Title	Details
1	Nutrition profile of Nepal	<p>Focuses on the diet composition, the current undernourishment levels and micronutrient deficiencies in the population of Nepal.</p> <p>Helps understand the scale of the problem, and the need and urgency for improving nutrition inputs in Nepal.</p>
2	Food fortification in Nepal	<p>Gives background to the existing food fortification programmes in Nepal, including assessment of past experiences in fortification, difficulties faced while scaling up, and success stories on food fortification.</p> <p>Provides an understanding of institutional experience and lessons learned from previous initiatives with other food items.</p>
3	Overview of Nepal rice ecosystem	<p>Elaborates on the rice industry including historical production trends, consumption, exports, imports, production clusters, millers' capacities, rice varieties in demand, etc.</p> <p>Helps to understand the size and scale of the rice ecosystem in Timor-Leste, and its implications for rice fortification scale-up.</p>
4	Rice supply chain	<p>Details the existing rice supply chain in the country.</p> <p>Provides an initial understanding of the main stakeholders who need to be involved in rice fortification initiatives.</p>
5	Fortified rice supply chain	<p>Details the current fortified rice supply chain in the country.</p> <p>Provides an understanding of the main stakeholders currently involved in rice fortification initiatives.</p>
6	Main stakeholders in rice fortification	<p>Provides further details of critical stakeholders and their respective roles.</p> <p>Helps to understand which government entities, regulatory bodies and non-government and private actors are important to scale up rice fortification in Nepal.</p>
6	Barriers to scaling up rice fortification	<p>Focuses on the barriers faced by various stakeholders when scaling up rice fortification efforts.</p> <p>Helps to give a clear picture of the bottlenecks in scaling up rice fortification in Nepal, crucial for suggesting remedial measures or effective solutions.</p>
7	Recommendations for scaling up rice fortification	<p>Synthesizes the findings from previous chapters and suggests specific recommendations to address or mitigate the barriers to scale-up. Identifies the main stakeholders that need to be brought on board to address different issues.</p> <p>Provides a detailed road map for the successful implementation of scaling up rice fortification in a measured and comprehensive manner.</p>
8	Annex	<p>Supplementary information and relevant statistics</p> <p>Provides essential information to support the analyses throughout the report, including:</p> <ul style="list-style-type: none"> • Government efforts to address micronutrient deficiencies • Main seasons for rice planting and harvest • Selling price of rice • Varieties of rice produced • Main rice mills operating in Nepal • Role of different entities in the rice supply chain • Cost mark-up of rice across the rice value chain • Three year Plan of Action for rice fortification • Technologies for rice fortification.

1. Nutrition profile of Nepal

Nepal is a low-middle income country with a high prevalence of malnutrition. With its remote mountain and hill areas, food security in Nepal remains a challenge (National Planning Commission 2019). Food insecurity in Nepal is also associated with susceptibility to natural disasters (such as drought, earthquakes, floods, and landslides), vulnerability to fluctuations in global prices, civil turmoil, and inadequate infrastructure. (Badal Chemjong 2020).

Hill and mountain terrain comprise 85 percent of the land, and agriculture in Nepal is highly dependent on the fertile southern plain known as the Terai. Nepal has the greatest altitude change of any location on Earth. The lowlands are at sea level and the mountains of the Himalaya are the tallest in the world, including the world's highest peak, Mount Everest (National Geographic). Food insecurity seems to be more prevalent in the mountain and hilly zone (14 percent) compared to the Terai zone (9 percent) (Badal Chemjong 2020).

Rice is the main staple of Nepal's population. It constitutes 52 percent of the total cereal consumption in the country (Dyutiman Choudhary 2022). The annual per capita consumption of rice in Nepal is 130 kg (Times 2021). The Nepalese diet consists of cereals (mainly rice and wheat) and vegetables (particularly potatoes). Food consumption patterns in Nepal indicate that cereal intake is declining, whereas intake of vegetable oil, animal products, starchy roots, milk, vegetables and fruit is increasing (FAO, Global Nutrition Report 2020). The consumption of red meat is far above the recommended food intake and dietary recommendations of the World Health Organization (WHO), whereas that of fruits, nuts,

milk and milk products, and fish is much lower than the recommended intake.

The Zero Hunger Strategic Review conducted in 2017-2018 indicated that the country suffers from serious food insecurity and malnutrition despite continuous efforts from organizations like WFP (Nepal Country Brief 2021). To understand how fortification of food (particularly rice) could aid in meeting the dietary guidelines for better nutrition in the population, it is essential to understand the micronutrient deficiencies in the country and their effects.

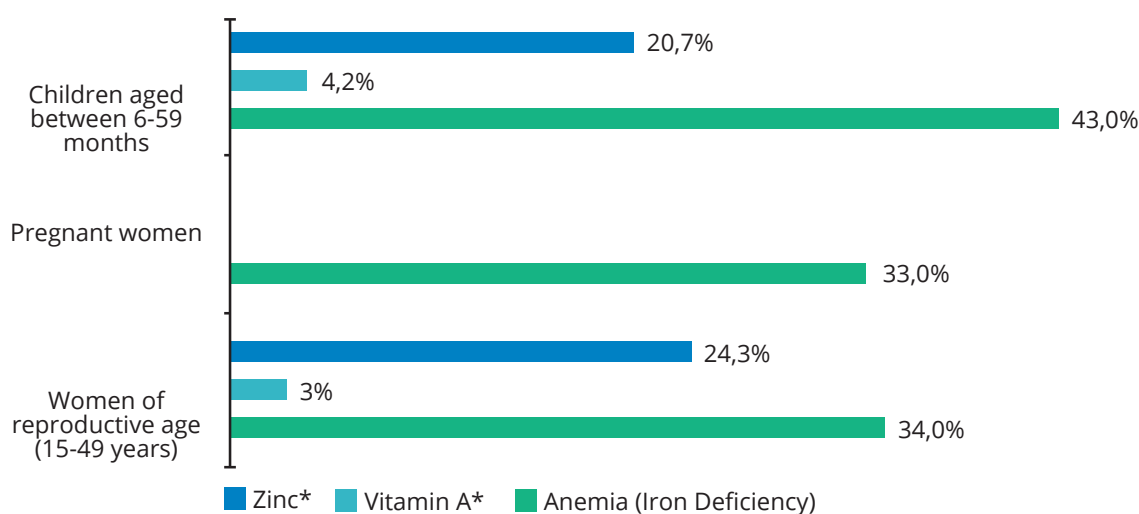
1.1 Micronutrient deficiencies

The incidence of anaemia and malnutrition is very high in Nepal. Although the country has reduced the prevalence of stunting (from 57 percent in 1996 to 25 percent in 2022), the widespread prevalence of micronutrient deficiencies is still a significant concern for the government (Nepal Demographic and Health Survey 2022). It has resulted in the following effects in the most vulnerable groups in the population:

- As per NDHS (2022), 34 percent of women aged 15 to 49 years suffer from anaemia.
- As of 2016, 43 percent of children aged between 6 and 59 months suffer from anaemia, as do 65.7 percent of children aged 6 to 23 months.
- 25 percent of children aged between 6 and 59 months suffer from stunting; 8 percent suffer from wasting.
- 19 percent of children aged between 6 and 59 months are estimated to be underweight.
- In 2019, 8 percent of the Nepal population was estimated to be undernourished (Schneiderman 2020).

Iron, zinc, and vitamin A are the crucial micronutrient deficiencies among children aged between 6 and 59 months, pregnant women, and women of reproductive age.

Figure 1: Micronutrient deficiencies (%) among the vulnerable population groups in Nepal (2022)



Source: NDHS (2022), *NNMSS 2016

The Government of Nepal, in collaboration with development partners, has undertaken multiple

initiatives over the years to combat the prevalence of micronutrient deficiencies.

Table 1: Initiatives to address micronutrient deficiencies in Nepal

Year	Programme/ Initiative	Entities involved	Description
1997-2017	Second Long-Term Health Plan	Ministry of Health and Population	<ul style="list-style-type: none"> Launched to create successive periodic and annual health plans that would lead to improvement in the health status of the population. Aimed at implementation of programmes to control micronutrient deficiencies (anaemia, vitamin A and iodine deficiency) in women and children.
1998	Iodized Salt (Production, Sale and Distribution) Act, 2055	Ministry of Health and Population	The act was introduced to mitigate the effects of iodine deficiency. Its objective was to regulate the production, import, supply, sale and distribution of iodized salt in the country.
2002 to date	National School Meals Programme (NSMP) and Food for Education	The Government of Nepal, Ministry of Education, Science and Technology, WFP	<ul style="list-style-type: none"> School meals are provided to improve access to education and student health, nutrition and educational outcomes. The programme initially ran from 2002 to 2006 and was extended in 2007 to cover around 194,000 students across the country. In 2014, Midday Meals were provided for Grades 1-5 of selected schools from 10 districts (1,608 schools). The programme provided corn and soya blend (110 g), flour (90 g), sugar (10 g,) and ghee/oil (10 g) per student per day (Department of Education 2015).
2006 to date	National School Health and Nutrition (SHN) Strategy	Department of Health Services (DoHS)	<ul style="list-style-type: none"> The programme focuses on enhancing the health, nutrition, and education status of children aged 5-17 years. It aims to increase availability and access to SHN services such as physical checkup, minor treatment and referral.
2011-2016	National Communication Strategy for Maternal, Newborn and Child Health	DoHS	<ul style="list-style-type: none"> The strategy was formulated to address malnourishment in children. The programme aimed at improving immunization and the integrated management of childhood illnesses.
2011	National Standard for Wheat Flour Fortification by the roller mills	The Government of Nepal, Nutrition International (NI)	The Government of Nepal decreed flour fortification mandatory to reduce anaemia and iron deficiency in the population.
2011 to date	Scaling Up Nutrition Movement	National Planning Commission (NPC), SUN Business Network (SBN), Global Alliance for Improved Nutrition (GAIN), WFP	<ul style="list-style-type: none"> SBN's priority commitments in Nepal are to implement and scale up evidence-based, cost-effective nutrition programmes outlined in the MSNP and National Nutrition Strategy 2020. Develop and implement a long-term National Food Security and Nutrition Action Plan. Strengthen main sectors to implement and monitor these programmes.

2013 - 2017	Multisector Nutrition Plan	The Government of Nepal, NPC, UNICEF, USAID, WFP, the ministries of Health and Population; Education, Science and Technology; Agriculture and Livestock Development; Industry, Commerce and Supplies	The plan aimed to strengthen the capacity of NPC and main ministries on multisector nutrition programme policy planning, implementation and monitoring for improved maternal and child nutrition.
2013 - 2017	Health Sector Strategy for Addressing Maternal Undernutrition	DoHS	The objective of the strategy was to accelerate and sustain a reduction in micronutrient deficiencies in women of reproductive age.
2013 - 2023	Food and Nutrition Security Plan	Ministry of Agriculture and Livestock Development	<ul style="list-style-type: none"> This plan comes under the Agricultural Development Strategy for the decade 2013-23. The objective is to reduce hunger, malnutrition and poverty by improving sustainable agriculture-based livelihoods.
2018 - 2022	Multisector Nutrition Plan-II	Ministry of Health and Population, the Government of Nepal	The plan seeks to improve maternal, adolescent and child nutrition by scaling up essential nutrition-specific and -sensitive interventions and creating an enabling environment for nutrition.
2020 to date	National Nutrition Strategy	Ministry of Health and Population	Based on the National Health Policy (2019), the objective is to address malnutrition and provide strategic and programmatic direction by implementing nutrition specific interventions through the health sector (DoHS 2021).

2. Food fortification in Nepal

Fortification was first introduced in Nepal in 1973 through the universal salt iodization programme. Salt and wheat flour are the two main food items that are currently being fortified on a large scale in the country.

Legislation

The Department of Food Technology and Quality Control (DFTQC) of the Ministry of Agriculture and Livestock Development is responsible for regulating and monitoring fortified foods for quality and safety. It monitors factory and retail outlets and regularly analyses food samples (Nepal National Micronutrient Status Survey - NNMSS 2016 2016).

Table 2: Fortification of food items in Nepal

Food item	Mandatory legislation	Year of mandatory legislation	Micronutrients added
Salt	✓	1999	Iodine
Vegetable ghee	✓	1999	Vitamin A and D
Wheat flour	✓	2011	Iron, folic acid and vitamin A
Rice	✗	-	-

Source: NNMSS 2016

Other food items which are voluntarily fortified in Nepal are edible oil with vitamin A, and cereal-based fortified blended food (wheat, soya blend with sugar) with vitamins A, B, C, D, E, K, pantothenic acid, folic acid, niacin, biotin, iodine, iron, zinc, potassium, calcium and phosphorous.

Salt fortification

The Universal Salt Iodization programme was initiated in Nepal in 1973. In 1998, the Iodized Salt (Production, Sale and Distribution) Act, 2055, was passed. It outlined the control, licensing, standards and oversight for importation of iodized salt, and made iodization of all salt intended for human consumption mandatory

(Naveen Paudyal 2020). The Government of Nepal authorised the Salt Trading Corporation (STC) to import and distribute iodized salt across the country. It is mandatory to iodize household salt at a minimum of 15 ppm.

Wheat flour fortification

Wheat is the second most consumed staple in Nepal after rice. The per capita wheat flour consumption in Nepal is 78 g per person per day. Consumption in processed forms (such as bread, biscuits and instant noodles) has been increasing over time, making it a suitable vehicle for micronutrient fortification (Pramod Koirala 2015).

In 2011, the Government of Nepal mandated the fortification of all flour milled by roller mills (mills with cylindrical rollers) with iron, folic acid and vitamin A. However, small-scale chakki (wholegrain wheat flour) and water mills were not included in the mandate, considering the higher cost associated with fortification. The government has extended continuous support to the wheat flour industry. Millers were provided with training and technical support, free fortification premix, as well as the machinery required for fortification (World Bank 2012). DFTQC is responsible for monitoring wheat flour fortification in the country (Nepal National Micronutrient Status Survey - NNMSS 2016 2016).

According to NNMSS 2016, the percentage of household wheat flour samples meeting Nepal's food standard for iron content (>60 mg/kg) in all purchased flour samples was 36.8 percent (Nepal National Micronutrient Status Survey - NNMSS 2016 2016).

Cereal-based blended food fortification

In 2002, the Government of Nepal, with the help of WFP, implemented the stunting prevention programme 'Mother and Child Health Care' in the Karnali region to

address the high prevalence of chronic undernutrition. The programme distributed 100 g of cereal-based fortified blended food (wheat soya blend with sugar) per person per day to children aged 6-23 months and pregnant and lactating women (WFP 2016).

In 2020, WFP's Emerging Donors Matching Fund supported the Nepal government's contribution of cereal-based fortified blended food to improve nutrition in Karnali District and Province 2 (Madhes Pradesh). During 2020 and 2021, the Maternal and Child Health and Nutrition programme helped WFP distribute cereal-based fortified blended food among 93,688 children aged 6-23 months and 58,733 pregnant and lactating women (DoHS 2021), (Nepal Annual Country Report 2020).

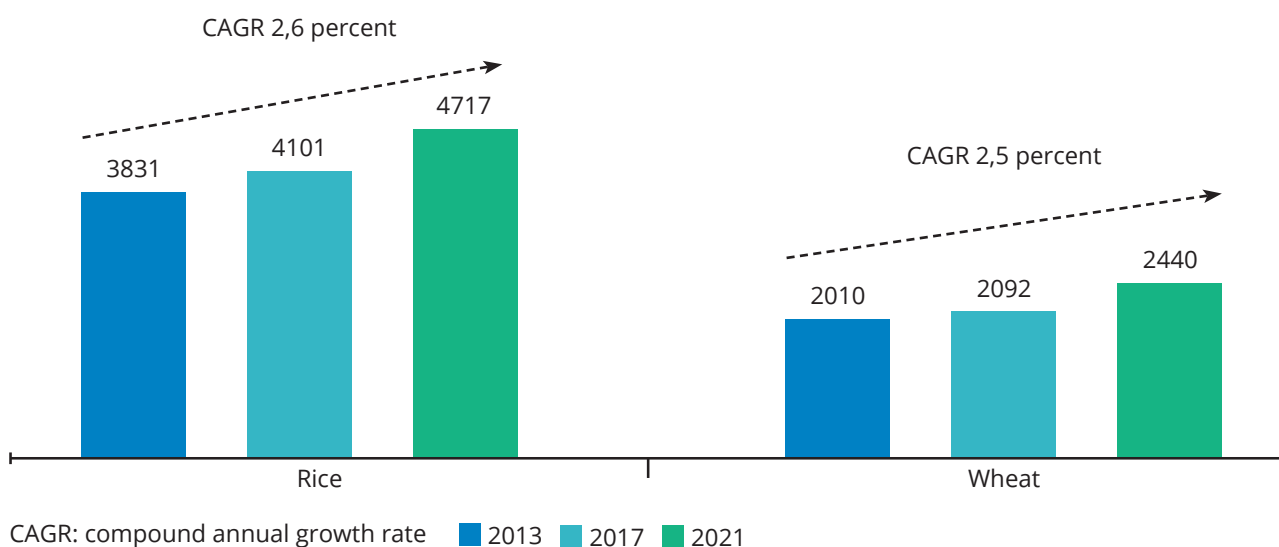
Fortification of these items alone is insufficient to improve the overall micronutrient intake. The inclusion of fortified rice would be an additional and important step to increase coverage of fortified staples and enhance nutrient intake and diets.

2.1 Consumption of main cereals in Nepal

As the most consumed staple in the country, rice contributes 52 percent to the total cereal consumption (Dyutiman Choudhary 2022). The annual per capita consumption of rice is 138 kg per person, whereas per capita consumption of wheat is 50 kg per person, mostly in processed form such as bread, biscuits and instant noodles.

Between 2013 and 2021, the consumption of rice and wheat flour has grown at similar rates (2.6 percent and 2.5 percent respectively). Wheat flour (produced by roller mills) is already being fortified in the country. The fortification of rice is essential to improve nutrition status across the population of Nepal.

Figure 2: Domestic consumption of main cereals in Nepal ('000 MT)



Source: Index Mundi

2.2 Rice fortification status in Nepal

Rice fortification is at a nascent stage in Nepal. In 2016, the Government of Nepal, with technical support from WFP, commissioned a landscape analysis of rice fortification to identify challenges and opportunities.

The government and WFP signed a memorandum of understanding (MoU) in 2019 to introduce rice fortification through a social safety net programme. The timeline for rice fortification in Nepal is detailed in Figure 3.

Figure 3: Timeline for rice fortification in Nepal

2015

The Government of Nepal, with technical support from WFP, commissioned a landscape analysis of rice fortification.

2017

First national conference on rice fortification convened in Kathmandu by DoHS, DFTQC and FMTC in association with WFP.

2019 - 2020

MoU signed between WFP and the Government of Nepal to introduce fortified rice through social safety net programmes.

Rice fortification standards developed and shared with the the government.

2020 - 2021

Trial run initiated in one of the mills owned by FMTC.

2021-2022

DFTQC issued updated rice fortification standards after success of the trial run.

With the support of WFP, Fair Price Shops established in remote districts, crucial for the distribution of fortified rice.

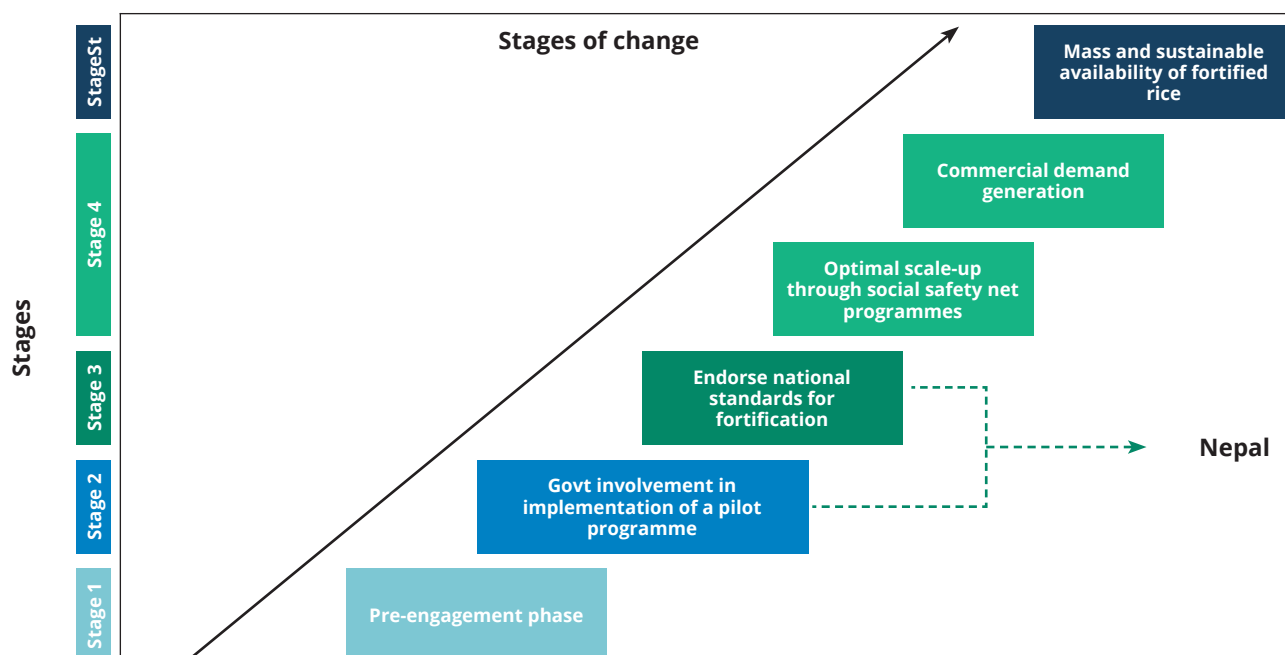
The national standard for fortified rice was endorsed by the food standard fixation committee of the government and posted for World Trade Organization notification.

Source: WFP, ValueNotes analysis

As shown in Figure 3, Nepal is in the process of endorsing a national standard for fortified rice and fortified rice kernels (FRK) to develop a proper monitoring and enforcement environment. Millers that are producing fortified rice or FRK are required to follow these standards. However, there is no mandatory legislation for rice fortification in Nepal yet.

To scale up rice fortification in Nepal the participation of government and the private sector is essential. In 2021, WFP supported the government by providing technical assistance to develop several important national documents. A trial run for rice fortification was carried out by one of the rice mills owned by FMTC. Its success helped DFTQC to finalize the standards for rice fortification (WFP, Annual Country Report 2021). Continuous efforts by the government and WFP will be crucial to scale up Nepal's rice fortification programme.

Figure 4: Stages of rice fortification scale up in Nepal



Source: ValueNotes analysis

2.3 Plan of Action to initiate and scale up rice fortification

According to the MoU signed between the Government of Nepal and WFP, a three-year Plan of Action has been devised to expedite the rice fortification programme. It includes the development and endorsement of standards for rice fortification and focuses on implementation of recommendations provided in the 'Rice Fortification Landscape Analysis 2016' and 'The Resolution of National Conference on Rice Fortification' held in 2017 to scale up rice fortification.

Scale up will be executed in two phases:

Phase I (2019–2020 to 2021–2022): Distribution of fortified rice primarily under appropriate social safety net programmes of the government and implementation of a three-year Plan of Action.

Phase II (2022–2023 to 2024–2025): Focus on social safety net programmes, followed by partnership with the commercial sector and appropriate legislation. Activities undertaken in this phase would depend on the successful implementation and experience of fortification activities in Phase I.

To enable rice fortification on a large scale, it is crucial to understand in detail the rice industry, rice processing capacity, roles of the various stakeholders, the supply chain, and barriers to fortification.

3. Overview of the Nepal 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.

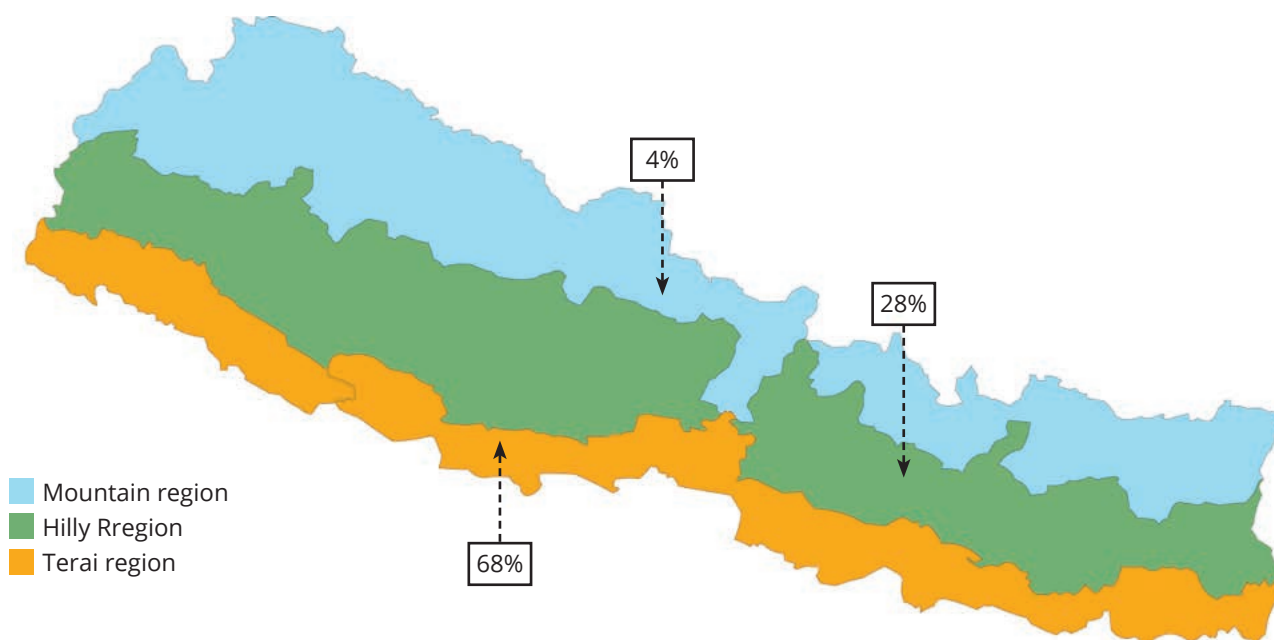
3.1 Rice producing clusters in Nepal

Rice is cultivated in three agro-ecological regions: primarily Terai (the Gangetic plains) and, on a smaller scale, hills and mountains. The Terai region has the highest production and consumption rates of rice in Nepal and contributes 68 percent of the total rice production in the country. (Dyutiman Choudhary 2022)

The major rice producing clusters in Nepal are depicted in Figure 5.



Figure 5: Rice producing clusters in Nepal and total percent of rice production (2020)



Source: International Rice Research Institute, Nepal

Within the Terai region, three clusters (Eastern, Central and Western) contribute 41 percent, 38 percent and 21 percent respectively to the total rice production (Scientific Research Publishing Inc. 2020).

The various rice varieties and their share in total milled rice in the Terai region are shown in the Table 3.

Table 3: Share of rice varieties in the total milled production (Terai)

Rice variety	Share in total milled rice
Coarse	42%
Medium	34%
Medium fine	17%
Fine	7%

Source: IRRI Nepal 2020

3.2 Classification of rice mills

Rice mills can be classified as large, medium and small, based on their tonnage capacity per hour (Figure 6). In Nepal, there are around 1,000 rice mills, most of which are operated by private companies and approximately 40 of which are classified as large (WFP 2017). Based on discussions with millers and miller association representatives, 15 new mills will be operational by next year.

Large millers have a production capacity greater than five tons per hour. They could have sufficient financial resources to become a part of the fortified rice supply chain with support from government and development partners.

The state-owned FMTC, formerly known as Nepal Food Corporation (NFC), is a significant entity involved in the collection and distribution of rice in Nepal. FMTC owns two mills with a capacity of 1-2 MT/hour (WFP, Logistics Capacity Assessment 2019). Their rice mill in Rajapur is currently involved in the fortified rice pilot programme (WFP, Annual Country Report 2021).

FMTC has an important role in supplying subsidized food commodities to people in food insecure and food deficient areas. The organization has a presence in 30 of the country's 75 districts and usually sells rice 15–30 percent cheaper than market prices (Kathmandu Post 2018), as shown in Table 4.

Figure 6: Classification of rice mills by tonnage capacity



Source: Logistics Capacity Assessment, WFP 2022

Table 4: Price of rice sold by FMTC and private millers (Nepalese Rupee (NPR)/kg)

District	FMTC (NPR/kg)	Market price (NPR/kg)
Jira Masino	51	60-70
Sona Mansuli	41	45-50

Source: Surkhet (2018), Kathmandu Post

3.3 Domestic rice production, imports and exports

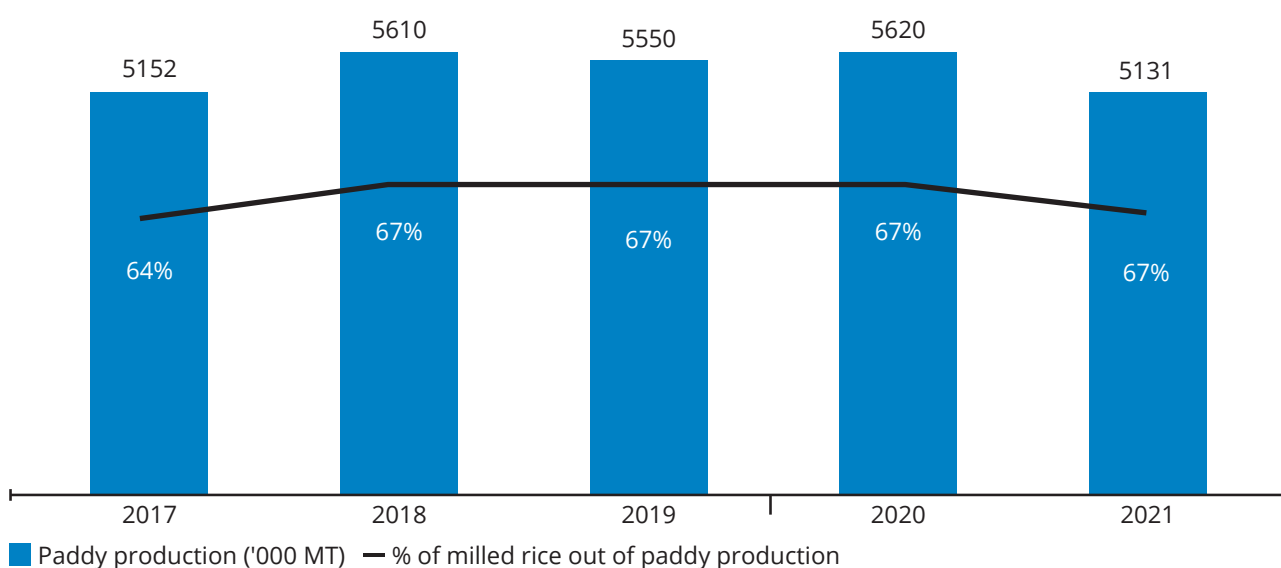
Rice production

The Terai region fulfils a considerable portion of Nepal's rice requirement. The average yield is 3.5 MT/ha on 1470 ha area under production. However, unplanned urbanization, crop diversification and road construction are leading to diminishing paddy fields across the country. Lack of irrigation, low yields, and labour

shortages extend the decline (Kathmandu Post 2019). Between 2018 and 2020, paddy production in Nepal was stagnant, before falling to 5.1 million MT in 2021. This is primarily due to the damage caused by unseasonal rains in the month of October, resulting in huge losses in Lumbini and Sudurpaschim provinces (Kathmandu Post 2021).

As shown in Figure 7, approximately 67 percent of the paddy produced in 2021 was milled (USDA 2022).

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



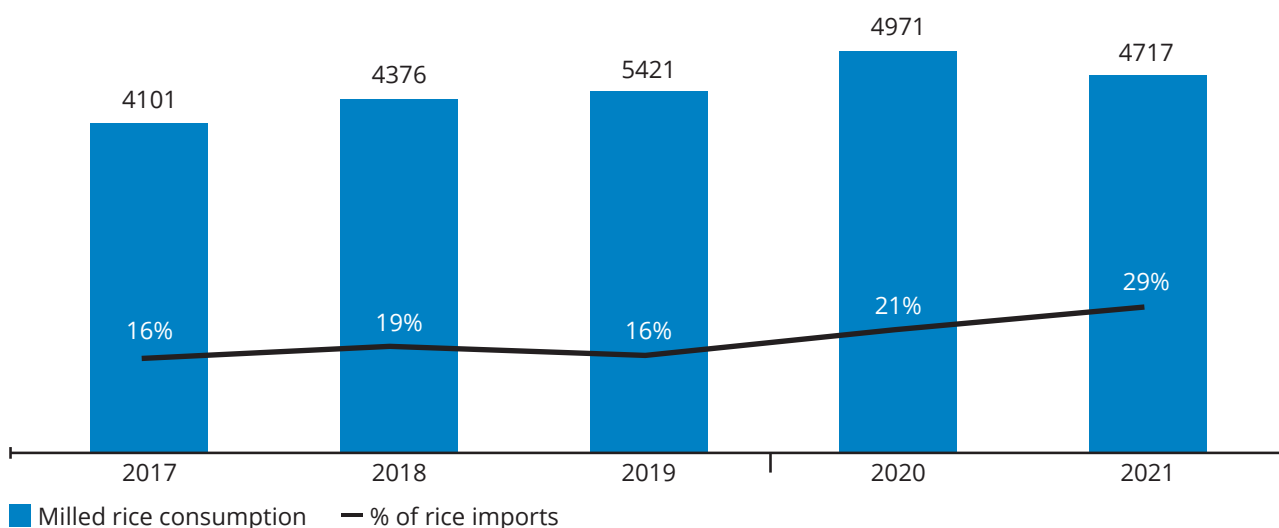
Source: USDA

Imports

Rice imports have been rising in Nepal because of the lower cost of imported rice. According to the Trade Association of Nepal, cheaper imports are affecting

the domestic paddy production in the country as farmers are not getting financial value for their crops (Kathmandu Post 2022). Figure 8 shows the percentage of rice imports between 2017 and 2021 (29 percent of total rice consumed was imported in 2021).

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



Source: USDA, Trademap

Total rice imports include 40 percent paddy, 55 percent milled rice and 5 percent brown and broken rice. Table

5 showcases Nepal's import markets.

Table 5: Rice imports by country (2021)

Country	Region	Imported quantity (MT)	Share of imports out of total
India	Asia	1,362,592	99.76%
The United States of America	America	3,107	0.23%
China	Asia	206	0.02%
Thailand	Asia	10	0.001%
Total		1,047,739	100%

Source: Trademap

Nepal's main rice supplier is India which contributed 95 percent to Nepal's total rice imports in 2021 because of its lower prices and better quality. The average cost of rice production in Nepal at USD 0.26 per kg is higher than India at USD 0.16 per kg (Dyutiman Choudhary 2022) (Economic Survey 2021-22 Statistical Appendix). The demand for aromatic and imported fine rice varieties has increased substantially in Nepal, hence long-grained aromatic rice varieties such as basmati being imported from India (Kathmandu Post 2020) (Gateway Media 2021). The United States of America, China, and Thailand contribute less than 1 percent to Nepal's total rice imports.

Exports

Exports have been negligible in Nepal, accounting for less than 1 percent of domestic production in

2021. Given the continuous increase in domestic consumption of rice by the Nepalese population, rice fortification could open multiple opportunities for the domestic rice industry. To determine the appropriate distribution channel for selling fortified rice to consumers, an understanding of market segmentation is necessary.

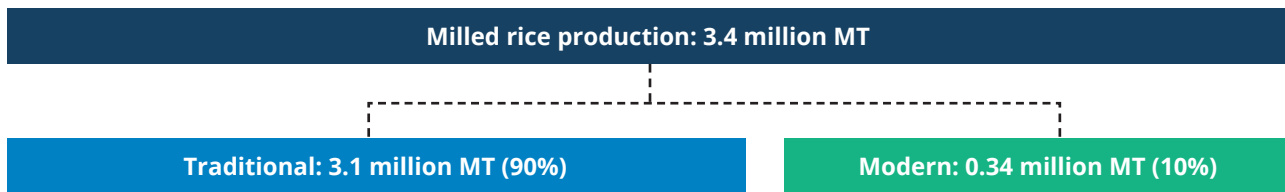
3.4 Market segmentation

Consumers purchase rice from two channels:

1. Traditional channel – Kirana Pasals (traditional grocery stores)
2. Modern channel – offline (supermarkets, hypermarkets, etc.) and online platforms (daraz.com.np, thulo.com, etc.)

Figure 9 shows the proportion of each channel.

Figure 9: Milled rice production and imports ('000 MT) in Nepal (2017-2021)



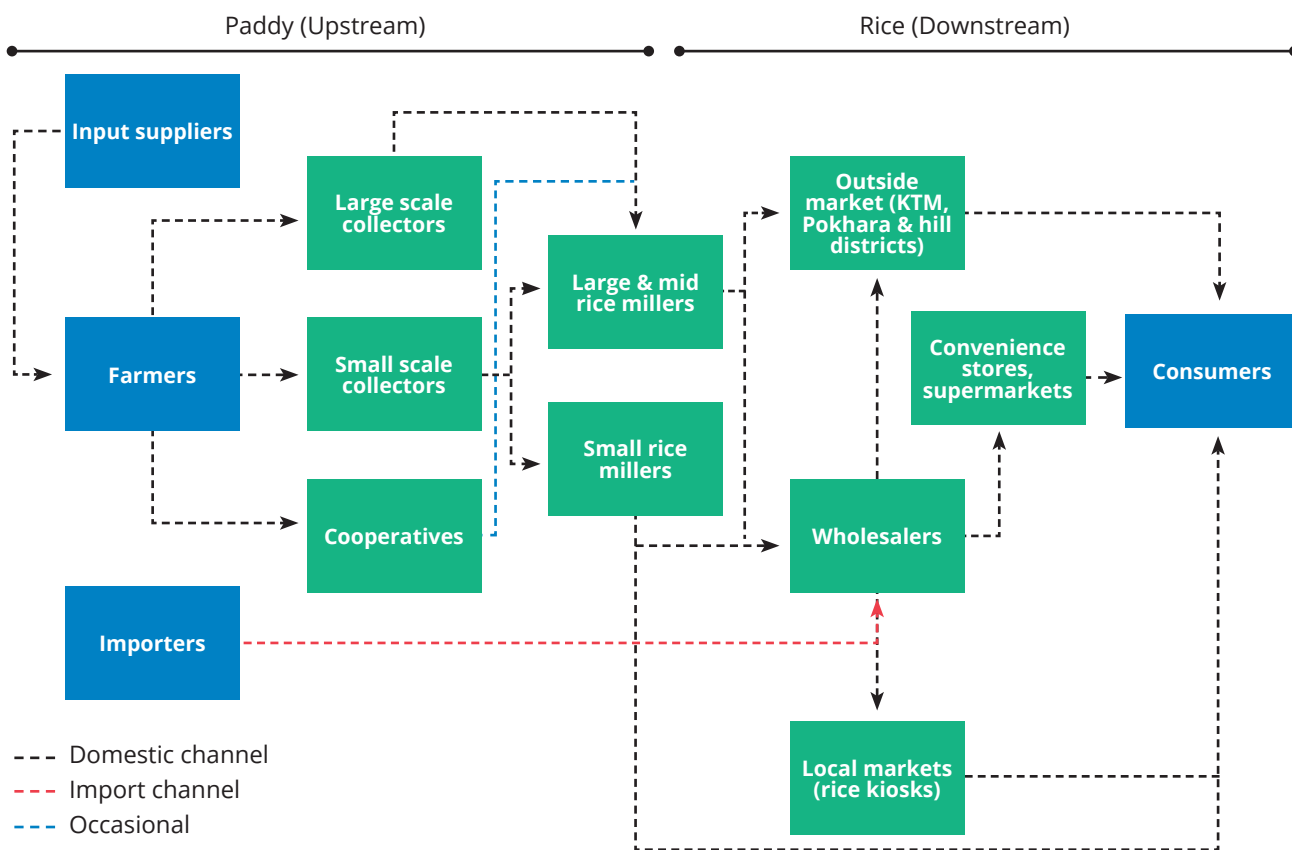
Source: UN Capital Development Fund, ValueNotes analysis

4. Rice supply chain

A significant portion of net rice production does not enter the commercial supply chain but is milled in smaller mills and consumed by the producers.

In Nepal, there are separate supply chains for the distribution of rice by private millers and by the government network. The rice value chain for the private sector is shown in Figure 10.

Figure 10: Private millers rice value chain in Nepal^{1,2}



Source: Oxfam Research Reports, ValueNotes analysis

¹ Role of Different Entities in the Rice Supply Chain
² Cost Mark-up of Rice across the Rice Value Chain

The rice distributed by government is used for various social safety net programmes such as the school meal programme and relief measures during disasters and epidemics.

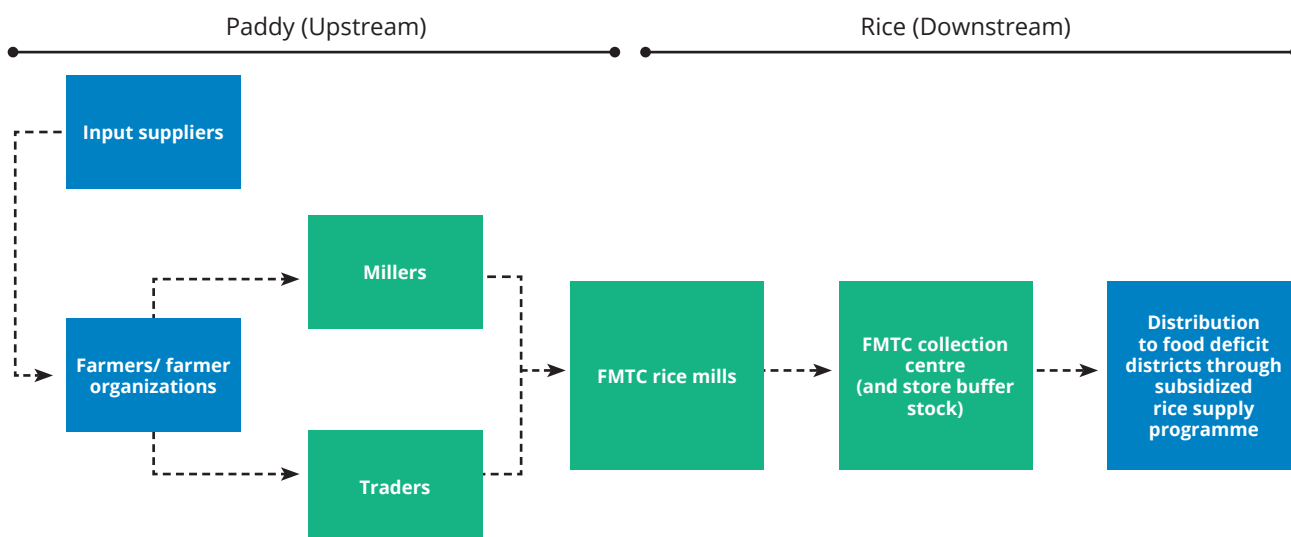
The government rice value chain is shown in Figure 11.

A fortified rice supply chain does not currently exist in Nepal. There are no domestic suppliers of FRK and machinery, i.e. blenders and extruders. As part

of the rice fortification initiative, the rice fortification equipment was procured in 2021 and installed in an FMTC rice mill with the support of WFP (WFP, Annual Country Report 2021).

A robust domestic supply chain for fortified rice will have to be developed to build a sustainable ecosystem for rice fortification. This would require the involvement of stakeholders.

Figure 11: Government rice value chain in Nepal



Source: Oxfam Research Reports, ValueNotes analysis

5. Fortified rice supply chain

Multiple stakeholders would be crucial to build a fortified rice supply chain in Nepal:

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

5.1 Fortified rice manufacturers

Millers play a crucial role in the rice fortification supply chain. They must either procure FRK from suppliers in the import or domestic market or produce FRK on their own using extrusion machinery. Fortified rice manufacturers need to install a blending machine at their rice mills to blend FRK with normal milled rice. They are also responsible for packaging the product with certified labels, logos and nutritional information.

During a trial run in 2021, fortification equipment was installed in one of the mills owned by FMTC. However, the production of fortified rice has not yet started commercially in Nepal because the regulatory standards have not been finalized by the government.

FMTC (state-owned enterprise)

With the help of WFP, blending machinery for producing fortified rice has been installed in an FMTC rice mill in Rajapur, Nepalgunj.

Currently, they supply rice to consumers via two channels:

- Distribution programmes in partnership with government entities such as the Ministry of Health and Population, the Ministry of Industry, Commerce and Supplies and the Ministry of Agriculture and Livestock Development and;
- Modern retail channels.

These channels could be used to distribute fortified rice once FMTC starts production.

5.2 Government entities

Multiple government entities are involved across functions such as production, standardization, regulation, sale and distribution of fortified rice. Scaling up rice fortification will require efficient coordination among them. Their roles are detailed in Table 6.

Table 6: Government entities involved in scaling up rice fortification in Nepal

Authority	Role
DoHS, Ministry of Health	<ul style="list-style-type: none"> Involved in the initiation and scale up of the rice fortification programme. Conducted feasibility study on rice fortification with the help of FMTC.
Department of Food Technology and Quality Control (DFTQC), Ministry of Agriculture and Livestock Development	<ul style="list-style-type: none"> Responsible for monitoring fortified foods for quality and safety. Carries out monitoring at factory and retail levels and regularly analyses food samples. Supports the Ministry of Agriculture and Livestock Development's Agriculture and Food Security Project. Responsible for developing rice fortification standards.
Ministry of Industry, Commerce and Supplies	<ul style="list-style-type: none"> Makes provision for the budget to cover the cost of FRKs. Provides transport subsidy for distribution of fortified rice in remote districts through FMTC. Recommends exemption of taxes/duties applicable on equipment, premix, and other materials imported and purchased locally by WFP and FMTC.
FMTC	<ul style="list-style-type: none"> Initiated trial run for rice fortification with support from WFP. Responsible for distribution of fortified rice as part of the rice fortification plan. Working with WFP to establish Fair Price Shops in food insecure and food deficit areas to supply subsidized food commodities. Coordinates with private millers for procurement of rice. Influences market demand by procuring and encouraging production of indigenous food.

Source: WFP, UNICEF, DoHS

5.3 Other stakeholders

Rice fortification through the process of extrusion requires FRK, blending machinery and extrusion machinery (if FRK is produced by the millers

themselves). The role of rice associations and technical partners is crucial in disseminating information to millers. Their roles are discussed in Table 7.

Table 7: Other stakeholders in rice fortification in Nepal

Stakeholders	Role
FRK suppliers	<ul style="list-style-type: none"> Supply FRK directly to millers or the respective government bodies for distribution among millers at little or no cost. International suppliers of FRK include DSM-Firmenich and BASF. For the 2019 consumer acceptability study, FRK was provided by WFP, Bangladesh (supplied by Igloo Foods Ltd). For the trial run of producing fortified rice in an FMTC rice mill, FRK was imported from JVS Foods (India). To initiate the production of fortified rice in Nepal, the government plans to import FRK from other countries.
Blending machinery suppliers	<ul style="list-style-type: none"> Supply blending machines to millers. In 2021, WFP imported blending machinery from Indian manufacturer JVS Foods (JVS EXIMPORT) for a trial run.
Extruder suppliers	<ul style="list-style-type: none"> Supply extrusion machinery to produce FRK. International machinery suppliers include BUHLER and Satake.
Rice associations	<ul style="list-style-type: none"> The Association of Nepalese Rice, Oil & Pulses Industries (ANROPI) engages with millers and other stakeholders to make improvements in the milling industry. It supports initiatives such as the Knowledge-Based Integrated Sustainable Agriculture in Nepal (KISAN) II Project to promote favourable policies that boost investment in Nepal's rice mills.
WFP and other development / technical partners	<ul style="list-style-type: none"> WFP is supporting FMTC and DFTQC in the implementation and scaling of the rice fortification programme and establishing contracts with private sector mills. In 2021, WFP assisted FMTC in the installation of rice blending equipment, provision of technical training and procurement of FRK USAID has been financing various food and nutrition and food security programmes in Nepal. They made an in-kind donation of fortified rice for the school meal programme run by WFP.

Source: FNCCI, USAID, WFP, World Bank

6. Discussion and analyses

6.1 Stakeholder discussion: Summary of findings

Detailed discussions were held with important decision makers in the government and relevant stakeholders in the rice supply chain.

Discussion with government stakeholders

Interviews with government stakeholders showed that they want to establish the rice fortification process in Nepal. Discussions focused on progress, the ongoing social safety net programmes in the country, the status of fortification standards, implementation challenges, and the need for demand generation to incentivize investment by millers. Highlights are shown in Table 8.

Table 8: Summary of discussions with government stakeholders

Discussion themes	Entity	Details
Endorsement of fortification standards	Ministry of Health and Population, FMTC, DFTQC	<ul style="list-style-type: none"> The standards for rice fortification have been formulated and will be endorsed by the government after obtaining cabinet approval. The Ministry of Agriculture and Livestock Development has discussed the packaging and labelling requirements with other entities involved in the programme. As the fortification standards have not been endorsed yet, the technical implementation process has been delayed. Without the endorsement of food safety standards, it will be impossible to evaluate the quality of fortified rice.
Support required	Ministry of Health and Population, FMTC, DFTQC	<ul style="list-style-type: none"> The government provides subsidies on the transportation cost incurred in supplying commodities to certain remote districts in mountainous regions. Subsidies could also be provided for distributing fortified rice. FMTC maintains a buffer stock of food items at strategic locations and ensures price stability in the market. With financial support from the government, they could use their existing distribution channels to distribute fortified rice. FMTC engages with political parties, local affairs ministries, and urban and rural municipalities to raise consumer awareness of government-run programmes, which require ongoing cooperation and support. The price of fortified rice should not increase significantly as consumers may be reluctant to buy it at higher prices. The commercialization of rice fortification could be more effective if the government subsidizes the excess cost of fortification.
Need for scientific evaluation and survey	FMTC	<ul style="list-style-type: none"> FRKs combined with certain micronutrients such as vitamin A and retinol (a derivative of vitamin A) might be harmful to humans. Excessive intake of vitamin A often surpasses recommended dietary allowances (RDA) and it gets accumulated in the liver. This can potentially cause issues such as osteoporosis and hip fractures, even when intake is only twice the current RDA. Assessing vitamin A status in individuals with sub toxicity or toxicity is complex due to nonsensitive serum retinol concentrations which gets stored in the liver. Therefore, a thorough evaluation is necessary to determine the added proportion accurately (The Journal of Nutrition, 2014). A scientific investigation could be conducted to understand the addition of essential micronutrients for fortification in the required proportion.
Strengthening the laboratory capacity for rice fortification	DFTQC	<ul style="list-style-type: none"> The National Food and Feed Reference Laboratory operates under DFTQC. However, the laboratory is not fully equipped to analyse the parameters included in rice fortification standards. Once rice fortification standards are approved, DFTQC will upgrade the laboratory capacity and apply for the accreditation of parameters.

Consumer education and awareness	FMTC, DFTQC, various ministries	<ul style="list-style-type: none"> • Educating consumers about fortified rice is essential for success. • As a member of SBN, FMTC could help to organize awareness campaigns, seminars and programmes on rice fortification at district and provincial levels. • As per the MoU signed for rice fortification, DFTQC will have to develop information, education and communication materials once the production of fortified rice begins. • For the benefit of technical experts, WFP has created the terms of reference for developing these materials. • Nepalese consumers clean rice by removing paddy kernels or rice kernel smut before cooking. To avoid the removal of FRK from rice during the cleaning process, it is essential to educate consumers about FRK's physical characteristics and health benefits. • Several organizations are responsible for creating awareness about fortified rice: the ministries of Agriculture and Livestock Development, Health and Population, and Education, Science and Technology, the National Health Education, Information and Communication Center, and FMTC. • A DFTQC official suggested that the MSNP II programme could be used to promote the nutritional benefits of fortified rice. The private sector could also be included in such programmes.
Need for strict monitoring of FRKs being imported	DFTQC	<ul style="list-style-type: none"> • Since FRK will be imported in the initial phases of rice fortification, it is essential to ensure that the standards are being followed by the exporting country. • FRKs will be mixed with a particular variety of rice, therefore the shape and size of FRK must be similar. • The amount of fortificant included in FRK must be monitored.
Support required from WFP	DFTQC	<ul style="list-style-type: none"> • After cabinet approval of fortification standards, DFTQC will need WFP's support in upgrading laboratory facilities. Training will be required for those involved in the testing of FRKs and fortified rice. • DFTQC could apply for accreditation of its nine laboratories and upgrade them to ensure their place in the rice fortification programme.

Discussion with millers

Large millers were aware of rice fortification and its health benefits but they were hesitant to invest in the initiative because they knew nothing about the expected demand for fortified rice and its profitability. Nor were they aware of the production techniques

involved, the costs and return on investment, and the raw materials and machinery used.

A summary of main inputs received during these discussions is shown in Table 9.

Table 9: Summary of discussions with millers

Discussion themes	Details
Health benefits of fortified rice	<ul style="list-style-type: none"> • Most of the population of Nepal is not aware of fortified rice and its nutritional benefits.
Lack of knowledge about production techniques	<ul style="list-style-type: none"> • A few large millers such as Jay Shree Food Pvt Ltd and Bohora Rice Mill are aware of fortified rice and its production process. However, most are not, especially small and medium millers.
Barriers in the rice industry	<ul style="list-style-type: none"> • Because of insufficient supply of local paddy, modern steam rice mills are dependent on paddy imports to use their full production capacity. • The demand for steam rice produced by modern steam mills has been increasing. Consequently, many small and traditional mills are closing down as they do not have the required infrastructure to set up a steam plant.

Lack of demand from consumers	<ul style="list-style-type: none"> Large millers said that increased production costs would increase the price of fortified rice, thus resulting in low demand from consumers. The Nepalese population prefers to buy cheap varieties of rice. In Kathmandu, only 40 percent of the population consumes long grain rice (which is expensive and mostly imported from India). It seems higher priced rice would be difficult to sell. Consumers lack knowledge of fortification. One way to introduce fortified rice could be to have it prescribed by doctors or dieticians. However, this might only work in the high-middle income groups who typically consult dieticians and nutritionists. Large millers are averse to introducing fortification because they do not expect the demand to increase in the short term. For instance, the population of Nepal is still largely unfamiliar with brown rice (a nutritious variety) despite it being available in the market for quite some time.
Concerns raised by the millers related to market potential and expected returns	<ul style="list-style-type: none"> The millers would be interested in producing fortified rice if there was adequate demand and the opportunity to make a profit. According to them, fortified rice would sell among premium consumers only. In that case, the demand would be too low to cover the increased cost of production and would not reduce micronutrient deficiencies as it would not reach the target segment. A lack of knowledge left most millers unable to comment on any other challenges except to say that there is no market demand for fortified rice at present. It is crucial to evaluate and finalize the rice variety for fortification, as it will have an impact on production costs.
Government support required	<ul style="list-style-type: none"> Endorsement of national standards for rice fortification is necessary to encourage private sector participation. If the government endorses a set of regulations and supports millers in setting up the infrastructure required for fortification, it will encourage them to invest in the initiative. The primary obstacles to rice fortification are higher production costs and lack of government subsidies. The government could offer concessional rates for fortification equipment and interest subsidies for building warehouses for rice storage, etc., as done by countries like India. The government could provide tax rebates and subsidies to the millers for distributing fortified rice to the vulnerable population that have low purchasing power.
Need for awareness programmes	<ul style="list-style-type: none"> Distribution of fortified rice through school feeding programmes could increase consumer knowledge about its health benefits. The government could include fortified rice in police and army canteens. This would create a regular customer base and ultimately help to scale up the programme. Advertising and promotional efforts are minimal even for large millers. To create a market for fortified rice, the government needs to intervene and create public awareness. To create awareness, fortified rice should be packaged and labelled differently. It should be visible on the shelves of supermarkets such as Bhatbhateni and Bigmart. If fortified rice is differentiated from unfortified rice with clear nutritional benefits, consumers will be more likely to try it.

Discussion with other stakeholders

Discussions were held with rice importers, FRK suppliers and funding partners to understand the market potential for rice fortification and the

challenges that might be faced by all stakeholders during the process. The highlights of the discussions are in Table 10.

Table 10: Summary of discussion with other stakeholders

Discussion themes	Entity	Details
WFP initiatives	WFP Nepal Country Office	<ul style="list-style-type: none"> An MoU has been signed with FMTC to initiate rice fortification in Nepal. WFP has made investment in fortification equipment for one of the FMTC mills. Distribution of fortified rice (received in kind from USDA) is ongoing through the school meal programme, implemented in collaboration with the Government of Nepal.
Development of standards	WFP Nepal Country Office	<ul style="list-style-type: none"> Endorsement of standards for rice fortification is still under process. It is difficult to initiate a rice fortification programme without these standards.
Laboratories for testing FRK	WFP Nepal Country Office	<ul style="list-style-type: none"> Due to the unavailability of laboratories for testing FRK in Nepal, lab testing for imported FRK is conducted at Indian laboratories.

Challenges faced by millers	WFP Nepal Country Office	<ul style="list-style-type: none"> • Only a few large millers are aware of rice fortification. • Millers might not foresee a target market for fortified rice as it requires additional investment and may not attract a larger section of the population. • There are no import restrictions on FRK, yet large rice millers have not invested in it because of negligible demand.
Support required from the government	WFP Nepal Country Office, Importer	<ul style="list-style-type: none"> • Awareness programmes for millers and consumers is essential to create demand for fortified rice. • Initially, the government needs to take an active part in educating the public about the health benefits of fortified rice. • To create a local market for fortified rice, the government could intervene at policy level by offering tax subsidies and levying higher tax on imported rice to encourage local production.
Distribution channel	WFP Nepal Country Office, Importer	<ul style="list-style-type: none"> • Introduction of fortified rice through FMTC might be more viable. • Distribution of fortified rice could be linked with the subsidies provided by the government, as part of FMTC's social safety net programme.
Creation of demand by the government/WFP	Importer	<ul style="list-style-type: none"> • There is a need for government support to create demand for fortified rice and encourage private millers to invest in rice fortification. • To introduce rice fortification, fortified rice could be initially distributed to the target population free of charge under government schemes.
Price related challenges	Importer	<ul style="list-style-type: none"> • Before introducing fortified rice in Nepal, it is essential to understand its affordability. • If the price increase is more than 10 percent, middle class consumers might refrain from buying fortified rice.
Awareness creation	WFP Nepal Country Office	<ul style="list-style-type: none"> • Awareness of fortified rice should be created throughout the value chain, including small retailers. • As large numbers of the population shop at their local retail shops (Kirana Pasals) monthly, educating these retailers about fortified rice would aid in spreading awareness.

The successful implementation of rice fortification requires a coordinated effort among stakeholders in the fortified rice supply chain and a clear understanding of the challenges faced by them.

6.2 Recent developments impacting the domestic rice industry

India is a prominent rice exporter to Nepal. In September 2022, the Indian Government imposed a 20 percent duty on husked brown varieties and semi- and wholly-milled white rice, and banned the export of broken rice. However, parboiled and basmati rice were excluded from these curbs (T.K. Post 2022).

According to the President of ANROPI, these decisions will significantly impact the rice industry in Nepal and lead to the closure of rice mills, adversely impacting domestic rice consumption (AgFlow 2022). Nepal has also experienced a shortage of chemical fertilizers (from supplying countries Russia and Ukraine) during its paddy season, causing harvest disruption (Mendelson and Associates 2022). Considering such supply constraints and other environmental concerns, such as droughts and heatwaves, Nepal might face a supply crunch that could cause a surge in food prices.

To address these issues, ministries in Nepal such as the Ministry of Agriculture and Livestock Development,

are discussing possible solutions with relevant ministries in India.

In terms of rice fortification, Nepal's initial focus could be to evaluate local production of fortified rice and rice imports from other countries. In both cases support will be required from the government to meet rice fortification objectives.

6.3 Barriers to scaling up rice fortification

Nepal has successfully implemented salt and wheat fortification despite facing several challenges in both fortification programmes. To ensure effective scaling up of the rice fortification programme, it is crucial to understand the rice industry and the challenges faced by stakeholders at different stages of the value chain.

The Government of Nepal conducted a landscape analysis for rice fortification in 2016 to assess the viability of launching the initiative. The report noted several challenges in the rice processing industry which could possibly impact on the implementation of rice fortification. The main challenges were:

1. Fragmented rice milling industry and supply chain, making it difficult to reach a large share of the population;
2. Informal rice imports;

3. Subsistence farming in the Terai region where land is needed for rice production and;
4. Absence of an efficient monitoring system for fortified rice production.

The landscape analysis outlined the following recommendations to overcome these barriers in three phases:

Phase 1:

- Use of FMTC for production and procurement of rice;
- Formulation of an MoU between the government and WFP to initiate a pilot distribution of fortified rice in one or two districts and;
- Private sector production of approximately 300,000 MT of fortified rice per annum to cater for 2.3 million people.

Phase 2:

- Initially FMTC should prioritize rice fortification, followed by leading rice millers and;
- Bring importers under the scope of voluntary fortification.

Phase 3:

- Organize media campaigns to create awareness about rice fortification and;
- Public-private partnership to generate awareness of fortified rice.

To achieve the desired outcome, a comprehensive approach is required with the coordination of the government decision makers and leaders in the rice value chain.

Despite these recommendations and a favourable political environment, the progress of the rice fortification programme is relatively slow. It is important to understand challenges still impacting the adoption of rice fortification and recommendations which can help to overcome barriers.

Barrier 1

Need for accreditation of testing laboratories for fortified rice and FRK

The standards for rice fortification have been developed by DFTQC but have not yet been endorsed by the government. Once the standards are ready to be implemented, it will be necessary to test the micronutrients before proceeding with fortification. There is an absence of certified laboratories in Nepal to test the micronutrients added to FRKs.

Barrier 2

High dependence on imports

Discussion with millers highlighted prominent issues with respect to rice imports:

1. The supply of local paddy is insufficient to support the full production capacity of modern mills. Local paddy supports production for eight to nine months of the year, and for the remaining months millers depend on imported paddy. Of the total rice imports in 2020, approximately 40 percent was paddy (Customs 2020).
2. Paddy imported from India is cheaper due to subsidies provided by the Indian government to their farmers. Indian rice is better in quality and taste, which has resulted in increased demand for imports. In 2021, around 29 percent of the milled rice consumed in Nepal was imported.
3. Informal rice imports across the India-Nepal border impacts the price of local rice in Nepal. Markets are highly influenced by the lower prices offered by the large Indian mills near the border. Informal imports are estimated to be more than 50 percent of total rice imports from India.

Jeera Masino and Sona Mansuli are the most consumed rice varieties in Nepal. They are mainly imported from India and are most suitable for fortification because of their popularity. However, if they are used for fortification, they will initially have to depend on Indian imports.

Addressing these technical barriers is crucial to make local production more efficient.

Barrier 3

Limited awareness among millers of the health benefits of rice fortification, production techniques, machinery required, suppliers of raw materials, costs, etc.

The majority of rice millers in Nepal are not aware of rice fortification and its health benefits, which could help to improve the nutritional status of the population.

Except for a few large millers, most do not know about the technical processes involved in rice fortification, the raw materials such as premixes and FRK, the machinery (blending/extrusion) required, and likely costs. Addressing such knowledge gaps is essential to establish a sustainable and efficient supply chain for fortified rice. This will require coordinated efforts from international agencies such as WFP, donors, government entities and industry stakeholders.

Barrier 4

Perception of low return on investment in fortified rice production due to lack of awareness of production costs

Given the limited knowledge of fortification production processes, millers are unable to assess the level of investment needed, and the likely returns. Based on the inputs received during miller interviews, most believed that the required investment in machinery and

the increased cost of production would be substantial, though they were unable to quantify this.

Educating millers about costs and return on investment will provide a framework to enable them to seriously evaluate the option.

Barrier 5

Without government support, millers are hesitant about rice fortification given the lack of consumer demand

The lack of demand for fortified rice is a prominent factor hindering millers from investing in rice fortification. A few large millers are open to the idea, provided the government is ready to support them with setting up the initial infrastructure and developing the market.

Barrier 6

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

Although WFP and the Government of Nepal have distributed fortified rice through social safety net programmes, they have been confined to certain parts of the country. As a result, there is still a lack of awareness among consumers. Fortified rice is not commercially available and without a product it is difficult to raise awareness.

Very few millers spend money on promoting their brands, depending on agents and dealers to do so. Given the limited channels for promotion, the introduction and uptake of fortified rice may take substantial effort and time. For instance, nutritious brown rice is now more widely available in the country but most of the population is still either unfamiliar with it or reluctant to buy it.

These challenges need to be addressed by a series of interventions, coordinated between different entities across the value chain and sustained over a period of time.

Barrier 7

Technical challenges faced by private millers/ constraints in rice production

The following challenges in Nepal's rice industry have serious implications for millers, rendering them non-competitive:

1. Most mills in Nepal operate in single shifts (8 hours/day), underutilizing their capacity. Usually, they run at only 30-40 percent capacity because:
 - Shortages in the supply of raw material such as chemical fertilizers impact the supply of paddy;
 - There is a single season of rice harvest for most of the rice producing areas and;
 - The irregular and interrupted supply of electricity. Small mills rely on the Nepal

Electricity Authority for electricity and large mills (such as JK Mill) use diesel generators, incurring additional costs.

2. Lack of advanced milling technologies for long, extra-long and steamed rice varieties.
3. Lack of investment and financial support from government to modernize rice mills.

These challenges have hindered the growth of the domestic rice industry in Nepal. Addressing them will be imperative to build domestic capacity for the production of fortified rice.

6.4 Commercialization by private sector

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

Manufacturers require an understanding of the return on their investment. They do not believe that the commercial sale of fortified rice would generate any profits. Financial support or guaranteed off-take by government-led procurement programmes is required to provide initial economies of scale.

Discussion with millers suggests that the leading and large rice mills are dependent on imports for at least 3-4 months of their paddy requirement. The prospects of consumer-driven market demand are not encouraging either because of the likely price difference between fortified and non-fortified rice and low acceptance of expensive rice.

Research indicates that commercialization by the private sector does not seem very likely or viable in the short term. However, in the long term, agriculture-based projects such as KISAN II, Sahaj, CASA and PMAMP could be used to increase rice production and distribution.

7. Recommendations for scaling up rice fortification

Nepal is at the stage of finalizing food standards for fortification. In the past, the government and development partners have conducted feasibility trials and pilot studies through school feeding programmes, using fortified rice received in-kind from USDA and distributed by WFP.

These programmes covered seven districts where food insecurity levels were high and showed the potential of rice fortification to address micronutrient deficiencies. Other countries at different stages of large-scale rice

fortification have had similar experiences, leading to optimism that a well-designed programme can succeed. This will require coordinated efforts from all stakeholders.

The recommendations that follow provide a detailed roadmap to successful scale-up, including commercialization and subsidized distribution of fortified rice under social safety net programmes.

Recommendation 1: Develop and implement a QA/QC system for rice fortification

Strengthen the institutional and technical capacity of existing laboratories and align their accreditation with rice fortification standards

Indicative timeline: Short term (advised to begin within a year)

DFTQC's accredited laboratory, National Food and Feed Reference Laboratory, is responsible for testing food items. However, during our discussions officials highlighted that the testing parameters of the laboratory need to be upgraded for rice fortification standards. Once the standards are approved by the cabinet, DFTQC must upgrade the technical capacity and apply for accreditation of parameters.

WFP could provide technical assistance to support DFTQC and other regulatory authorities to develop a quality assurance and quality control (QA/QC) mechanism for rice fortification. The laboratories need to be equipped with adequate systems for testing and must ensure that the quality standards are being followed.

In parallel, a scientific investigation could be conducted to understand the required proportion of essential micronutrients to be added for fortification.

Recommendation 2: Strengthen rice production and distribution system and in-country production of FRK

Indicative timeline: Long term (ongoing process – ideally to be started along with the enforcement of fortification standards)

Nepal imports a significant portion of its rice from other countries. To minimize imports and ensure domestic production is sufficient to fulfil demand, it is crucial to increase production and improve the supply system of rice.

As the production of FRK is not initiated in Nepal, importing fortified rice is a possible option in the short term. This will also help to create an initial market for fortified rice until domestic production capacity is developed.

The government and WFP could reach out to rice traders/importers to educate them on:

1. Regulatory standards to be followed for imported FRK as per specific Nepal guidelines;
2. Social safety net programmes that include the distribution of fortified rice;
3. Suppliers of FRK in neighbouring countries and;
4. Steps taken to create awareness and develop a market for fortified rice.

Recommendation 3: Advocacy with millers

Conduct periodic workshops, training programmes and individual meetings with the rice millers to educate them about rice fortification, its health benefits and the technical processes involved

Indicative timeline: Medium term (ongoing process once rice fortification standards are endorsed)

Given the lack of awareness among millers about the health benefits of rice fortification, the Ministry of Health and Population and WFP can conduct workshops and individual meetings for disseminating information about rice fortification. These can include:

1. The health benefits consuming fortified rice. Millers are an important link to consumers, hence the need to educate them to enable them to promote fortified rice in the market.
2. Guidance about the financial viability of producing fortified rice. Creating a detailed business case and explaining the expected return on investment.
3. Success stories of rice fortification in other countries through existing WFP case studies.
4. Technical processes involved in rice fortification.

WFP, in collaboration with the Ministry of Agriculture and Livestock Development, could employ a technical team to explain the processes involved in rice fortification through technical workshops conducted by the Departments of Agriculture in different provinces.

Details about the raw materials and machinery used in rice fortification must be explained to millers, including information such as modification of existing machinery (control feeder) to perform the functions of blending machinery. The government must ensure that there is continuous engagement with millers, rather than single meetings or workshops, to help them at all stages of production and resolve queries.

Recommendation 4: Business model and return on investment

Create and disseminate a technical document for millers outlining the technical know-how of rice fortification processes, the costs involved and the economic returns on selling fortified rice

Indicative timeline: Medium term (advised to begin within a year)

Millers and rice associations are not aware of the technical processes of rice fortification, the costs involved and the economic returns. WFP could partner with the Ministry of Health and Population, DFTQC (under The Ministry of Agriculture and Livestock Development), and the Ministry of Industry, Commerce and Supplies, to develop a detailed technical document for all the main millers, to garner interest and to help them understand the business aspects of producing fortified rice.

Indicative contents of the document:

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. Regulatory food standards to be followed during fortified rice production.
5. Costs involved in:
 - Importing FRK
 - Blending machinery
 - FRK for local production (including the cost of extrusion machinery)
 - Testing the quality of fortified rice
 - Other associated costs.
6. Investment needed and expected returns whether imported or produced locally:

- FRK (a separate study needs to be conducted)
- Blending machinery
- Extrusion machinery.

A separate study needs to be conducted on investment and returns if subsidies are provided by the government for importing FRK or machinery.

7. Financial viability of producing fortified rice – expected return on investment.
8. Existing WFP case studies or reports on successful rice fortification projects in other countries.

This document will also help to create a business plan which will be essential in securing funds for investment.

To scale up rice fortification, WFP will be providing technical and financial support to initiate the programme in Nepal, as described in the three-year plan of action. The Government of Nepal also plans to educate stakeholders on various aspects of rice fortification.

Educating millers is a crucial step in effective implementation of rice fortification. India is Nepal's close ally and trade partner, as well as an established rice fortification market. Nepal could consider replicating India's journey.

DFTQC (or any other department from relevant ministries) could explore options to create awareness among stakeholders and could provide dedicated support on various aspects of rice fortification.

Steps taken by Food Safety and Standards Authority of India (FSSAI) to educate millers about rice fortification and engage them in scaling up of the programme.

- FSSAI has a designated Food Fortification Resource Centre (FFRC) to function as a resource hub for rice fortification.
 - FFRC facilitates training and meetings with stakeholders (millers, food business operators, state government representatives, etc.)
 - It aids in capacity building and monitoring and evaluation of the programme, with support from development partners such as WFP (Prasar Bharati 2022).
 - FSSAI videos that showcase the detailed process of fortified rice production are available on social media platforms and YouTube.
 - FFRC publishes a Q&A booklet and brochures that include technical information and updates (FSSAI 2022).
- FSSAI has created a dedicated online 'Knowledge Hub' which contains numerous audio and video resources and catalogues that can be accessed by stakeholders. The website also includes a chat box where stakeholders can get real time clarification.
- State governments are advised to connect millers with banks to access the Atma Nirbhar Bharat Package for Micro, Small & Medium Enterprises (National Informatics Centre 2021).
- The Department of Food and Public Distribution has formulated and issued a standard operating procedure for fortified rice and FRK manufacturers/millers. It outlines the process of procuring FRKs and helps to ensure that fortification standards are being followed (National Informatics Centre 2022).

Recommendation 5: Demand creation for fortified rice

Creation of demand for fortified rice in the market

Indicative timeline: Medium-long term (ideally to be started after the endorsement of national fortification standards)

The involvement of government is crucial to effectively scale up the rice fortification programme in Nepal. It requires a phased approach.

Phase 1: Government pro-activity

- The government could invite tenders from importers and interested millers to procure and distribute fortified rice under government social safety net programmes.
- The relief on import duties and taxes could be provided on import of fortified rice and FRK to incentivize importers in the short term.
- The government could promote rice fortification through its nutrition-related initiatives such as MSNP II and through awareness campaigns by engaging the private sector.

Phase 2: Sourcing funds for the scale up of the rice fortification programme

- The Ministry of Health and Population and the Ministry of Industry, Commerce and Supplies

could approach development partners for funding support to assist in building the technical capacity of millers who are interested in rice fortification.

Phase 3: Assistance to millers in installation of blending machinery and procurement of FRK

- WFP could conduct training and technical workshops for rice millers and help them to set up blending facilities.
- Details about FRK and blending machinery and the techniques of production must be explained to the millers.

Phase 4: Development of a domestic supply chain for FRK

- Initially, FRK will have to be imported from other countries (as during the trial run for rice fortification in the FMTC mill).
- After gaining some initial traction, the domestic production of FRK could be explored in the long run.

The case studies of rice fortification scale-up in India and Bangladesh shed some light on the efforts of their governments and show that government involvement is essential to efficiently scale-up rice fortification.

India: In August 2021, the Indian Prime Minister announced the distribution of fortified rice throughout the public distribution system and other government schemes in all states and union territories by 2024 in a phased manner (CCEA 2022).

In 2022, Food Corporation of India (FCI) announced the procurement of fortified rice from private millers in multiple states, e.g., the procurement of 260,000 MT of fortified rice from private millers in the state of Telangana as part of 'PM Poshan' (midday meal programme).

The rice would be distributed in pre-primary education centers and then expanded to include distribution among schoolchildren. The Indian Food Ministry advocated with the relevant entities to provide financial assistance to rice millers for installing blending machinery. Currently, 600 of the 900 major rice mills in the state have installed the required equipment.

To ensure that the millers are provided with FRK, multiple state governments invited tenders from manufacturing companies. The tender requirements were:

- Availability of extrusion machinery to produce FRK.
- Ability to transport the FRK to the designated rice millers for a definite period, as instructed in the tender (Odisha 2021) (Corporation 2021) (TaxScan 2021).

These efforts of the government have led to a significant increase in FRK suppliers in the country. In May 2020, before the government announcement, there were 13 FRK suppliers (FSSAI, List of Fortified Rice Kernel Manufacturers 2020). By April 2022 there were 157 FRK suppliers in multiple states (FSSAI 2022).

Bangladesh: The Government of Bangladesh has integrated the distribution of fortified rice through national social safety net programmes, helping to create a sustainable FRK market for manufacturers. The scale-up of domestic production of FRK can be attributed to the unrelenting support of WFP, NI, GAIN, and other partners (WFP, How WFP supported the Government of Bangladesh to Introduce and Scale up Rice Fortification 2019). Initially, FRK was being imported but with technical support from WFP three local privately funded FRK facilities were set up in 2019. This resulted in significant cost reduction. These facilities have reached an annual production capacity of more than 1,500 MT of FRK and there are now 8 FRK producers in the country (WFP 2019).

WFP is also providing technical assistance to the government in establishing an FRK factory (production capacity of 200 kg per hour) and a laboratory facility for kernel testing (WFP 2019). More than 50 blending units (rice mills) are operational in Bangladesh.

Recommendation 6: Awareness creation campaigns

Campaign to generate awareness of the benefits of consuming fortified rice among the population

Indicative timeline: Long term (ongoing process)

Once the government is able to generate awareness of fortified rice through its distribution programmes, it would be essential for the relevant entities to invest in mass awareness campaigns.

The Ministry of Health and Population could provide support in designing and distributing communication materials on fortified rice primarily through the National Health Education, Information and Communication Center. The ministry can partner with state-owned broadcasters and other media channels to advertise the benefits of consuming fortified rice. Millers are unlikely to be able to bear the costs of mass education, making it very important for the government to provide funding and support on this scale.

Innovative digital outreach could supplement awareness efforts and help reach the digitally active, younger population at lower cost.

The food regulation authority could ensure that the F+ logo is used in the packaging of fortified rice. This will also aid in spreading awareness.

In parallel, packaging, and other means of communication need to ensure that fortified rice brands are clearly identified with health benefits. The fortified brands should be stocked by supermarkets such as Bhatbhateni and Bigmart. With clear labelling differentiating it as healthy, consumers may be willing to try the product and maybe pay a small premium.

The main success factors in scaling up rice fortification in Nepal include the government creating initial demand, the understanding among all stakeholders that rice fortification is beneficial, establishment of a viable business model for millers and importers, and a sustained campaign to build awareness among consumers.

In the long term, a combination of government support and rising acceptance from the public will help create a sustainable rice fortification ecosystem that will help significantly in reducing micronutrient deficiencies in Nepal.

Recommendation 7: Build domestic capacity for production of FRK and fortified rice

Provide necessary support to procure the required raw materials and machinery for domestic production of FRK and fortified rice

Indicative timeline: Long term (after a sustained demand is established in the market).

To start the production of fortified rice in Nepal, WFP plans to import FRK from India. Although this will help to create an initial supply chain, capacity expansion will be required in the long term. As large millers contribute around 50 percent of total domestic rice production and have the required infrastructure, they could be encouraged to initiate production. WFP could provide the technical guidelines and required training and help them in the production process.

In the long term, medium and small millers could be included in the programme. As the demand for fortified rice increases, so the demand for FRK will increase. To keep production costs low, it will be essential to ensure that FRK is locally manufactured and is available in large quantities.

The FRK supply chain can be developed in stages:

1. FRK could be initially imported from other countries by large millers such as Jayshree Foods, KL Dugar, Bohara Group, etc, until the supply chain is developed.
2. Different ministries (such as the Ministry of Agriculture and Livestock Development and the Ministry of Industry, Commerce and Supplies) could coordinate to understand the feasibility of domestic production of FRK. A study can be conducted to identify the regions where FRK production must take place to keep procurement and distribution costs low.

3. Once the demand for fortified rice is established, WFP could provide technical assistance to procure the patent for production of FRK locally.
4. Once the patent is purchased and as more millers start fortifying rice, local production of FRK could be initiated in the identified regions.
5. As the demand for FRK grows, FRK production could be expanded to other regions. This would ensure greater viability as it will minimize logistics and transportation costs.

Recommendation 8: Strengthen the competitiveness of the domestic rice industry

Improve domestic rice industry competitiveness to enable millers to compete with rice imports

Indicative timeline: Long term (ongoing process – ideally to be started with the enforcement of fortification standards).

To increase the competitiveness of the domestic rice industry, existing challenges need to be met:

1. Regulating the informal import of rice - WFP must engage with the Ministry of Industry, Commerce and Supplies to consider the impact of unaccounted imports on domestic rice prices.
2. Addressing the technical challenges in the rice industry - The Ministry of Agriculture and Livestock Development and the Ministry of Industry, Commerce and Supplies need to understand the technical challenges faced by millers in the rice industry, and provide potential solutions including improved policies and regulations to help them scale up production capacity.

3. Improvement in rice quality - The quality and cost of domestic rice has to be made more competitive with imports. Once these challenges are solved, millers could be encouraged to focus on rice fortification.
4. Modernizing the traditional rice mills – Upgrading inefficient methods with modern technology will strengthen the production capabilities of rice mills. Technological advancement would significantly help them scale up their production capacities and compete with cheaper imports.

Addressing these challenges would require a proper funding infrastructure with the help of the Ministry of Agriculture and Livestock Development and banks. Loan schemes for millers can be explored to build the capacity of domestic rice mills.

Conclusion: Possible roadmap to scale up rice fortification

Given the lack of knowledge about rice fortification and hesitance of the private sector to invest without support from the government, commercialization of fortified rice will take time and needs all important aspects to fall into place first. With ongoing production constraints in the domestic rice industry, the next steps for effective implementation of rice fortification could be to assess the viability of importing FRK from countries where the market for fortified rice is comparatively well established and engage with private millers to scale up rice fortification.

The following roadmap to commercialization of fortified rice is based on the recommendations in section 7.



Figure 12: Possible roadmap to commercialization of fortified rice



The scale-up of 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 to reduce micronutrient deficiencies in Nepal.

Annex

Initiatives to address micronutrient deficiencies

Table 11: Planting and harvest seasons of rice in Timor-Leste

Year	Programme/ Initiative	Entities involved	Description
1998	Iodized Salt (Production, Sale and Distribution) Act, 2055	Ministry of Health	<ul style="list-style-type: none"> This act regulates the production, import, supply, sale and distribution of iodized salt, fortified in the correct quantity, to mitigate the effects of iodine deficiency. The act prohibits the import, purchase and sale of iodine-free salt without obtaining permission from the relevant committee.
2004	National Nutrition Policy and Strategy	DoHS	<ul style="list-style-type: none"> The policy includes 13 strategic nutrition approaches (short- and long-term) to reduce micronutrient deficiencies in the population. The programmes with short-term objectives are Protein-Energy Malnutrition (PEM), Iron Deficiency Anaemia (IDA), Iodine Deficiency Disorder (IDD), Vitamin A Deficiency (VAD), Intestinal Worm infestation, Low Birth Weight (LBW), Infectious Diseases and Nutrition in Exceptionally Difficult Circumstances. The strategy also includes the 'monitoring' objective that strengthens the system for analysing, monitoring and evaluating the nutrition situation in the country.
2006	SHN	DoHS	<ul style="list-style-type: none"> The school health and nutrition programme focuses on enhancing the health, nutrition and education status of children aged 5-17 years. The main objectives are: <ul style="list-style-type: none"> To increase availability and access of SHN services (physical checkup, minor treatment and referral; deworming; iron supplementation; vitamin A as needed and; screening for hearing, vision and dental); Build the capacity of the different levels of actors involved in school health and nutrition services; Reduce anaemia and worm infestation rates among schoolchildren and; Prevent and control communicable diseases and nutritional deficiencies.
2011 - 2016	National Communication Strategy for Maternal, Newborn and Child Health	DoHS	<ul style="list-style-type: none"> The strategy seeks to address the issues related to childhood malnourishment in Nepal. Its main objectives are: <ul style="list-style-type: none"> Maternal and Newborn Health: promote knowledge and improve access to maternal and newborn health services; Expanded Programme for Immunization: educate families about the schedule for vaccinations and increase demand for childhood immunizations; Integrated Management of Childhood Illness: promote knowledge on hygiene and sanitation and methods of prevention of these illnesses; Nutrition: improve breastfeeding knowledge, the importance of growth monitoring, use of iodized salt, the importance of vitamin A, being able to identify the signs of undernourishment, and when to seek care.

2011	Mandatory Flour Fortification	The Government of Nepal, NI	<ul style="list-style-type: none"> With the assistance of NI, the Government of Nepal announced the decree to make flour fortification mandatory in the country. All flour processed in mills must contain iron, folic acid and vitamin A with the aim of reducing anaemia and iron deficiency among the population.
2011	Scaling Up Nutrition Movement	SBN, GAIN, WFP	<ul style="list-style-type: none"> SUN's priority commitments in Nepal are to implement and scale up evidence based, cost-effective nutrition programmes outlined in the MSNP and National Nutrition Strategy 2020; develop and implement a long-term National Food Security and Nutrition Action Plan; strengthen main sectors to implement and monitor the MSNP II, National Nutrition Strategy, and National Food Security and Nutrition Plan.
2013 - 2017	Multisector Nutrition Plan	The Government of Nepal, Ministry of Health and Population, Ministry of Education, Science and Technology, Ministry of Agriculture and Livestock Development, Ministry of Agriculture and Livestock Development, Ministry of Industry, Commerce and Supplies, National Planning Commission, UNICEF, USAID	<ul style="list-style-type: none"> The vision of the multisector nutrition plan is to improve maternal and child nutrition which will result in a one third reduction of Maternal Infant and Young Child undernutrition in terms of maternal body mass index and child stunting. The purpose is to strengthen the capacity of the National Planning Commission and ministries in multisector nutrition programme policy planning, implementation and monitoring for improved maternal and child nutrition at all levels of society.
2013-2023	Food and Nutrition Security Plan	The Ministry of Agriculture and Livestock Development	<ul style="list-style-type: none"> This falls under the Agricultural Development Strategy for the decade 2013-23. The objective is to reduce hunger, malnutrition and poverty among the poorest households by improving sustainable agriculture-based livelihoods.
2013 - 2017	Health Sector Strategy for Addressing Maternal Undernutrition	DoHS	<ul style="list-style-type: none"> The strategy aims to accelerate and sustain reductions in chronic undernutrition and micronutrient deficiencies in adolescent girls and pregnant and lactating women, particularly among disadvantaged and vulnerable groups.
2014 - 2020	Multisectoral Action Plan for the Prevention and Control of Non-Communicable Diseases	Ministry of Health and Population	<ul style="list-style-type: none"> This entails the strategy to reduce preventable morbidity, avoidable disability and premature mortality due to non-communicable diseases
2016 - 2022	Nepal Seed and Fertilizer Project (2016-2022)	USAID	<ul style="list-style-type: none"> The project aims to increase the availability of technologies to improve productivity in agricultural produce such as cauliflower, lentils, maize, onions, rice, and tomatoes. It facilitates sustainable increases in Nepal's national crop productivity, income, and household food and nutrition security by promoting improved seeds and integrated soil fertility management technologies, with effective and efficient extension across 20 districts.

2017 - 2022	KISAN II Project	USAID	<ul style="list-style-type: none"> The project aims to reach up to 900,000 rural Nepalese by working with 200,000 farm households through agriculture interventions that improve food security and increase income in the target geographic areas. The activity focuses on small farmers in districts with the highest prevalence of food insecurity.
2018 - 2022	Multisector Nutrition Plan-II	Ministry of Health and Population, the Government of Nepal	<ul style="list-style-type: none"> The plan seeks to improve maternal, adolescent and child nutrition by scaling up essential nutrition-specific and sensitive interventions and creating an enabling environment for nutrition. Its objectives are: <ul style="list-style-type: none"> To increase the number of service delivery institutions to improve access to, and use of, nutrition-specific services; To increase access to, and use of, nutrition sensitive services including improving health related behaviour and; To improve policies, plans and multisectoral coordination at federal, provincial and local government levels to create an enabling environment to improve nutrition.

Main seasons for rice planting and harvest

The planting and harvest seasons are similar across the major rice producing regions of Nepal. Rice is planted in two seasons, i.e. wet (primary crop season) and dry.

Table 12: Planting and harvest seasons of rice in Timor-Leste

	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Wet season												
Dry season												

■ Planting ■ Harvest

Source: The Ministry of Agriculture and Livestock Development

Selling price of main rice varieties

Table 13: Prices of the top rice varieties in Nepal (2021)

Variety	Commercial rice price (NPR/kg)	Imported rice price (NPR/kg)
Coarse	43-45	
Long grain (basmati)		120-200
Jeera Masino	65-90	
Sona Mansuli	45-60	55-70
Sonam	70-80	
Pokhareli	80-140	
Katarni	70-80	
Taichin		160-200
Anadi	230-300	

Source: WFP, ValueNotes Analysis



Varieties of rice produced

Table 14: Rice varieties in Nepal (2021)

Type of rice	Sub-varieties
Coarse	Sarju-52, Radha-4, Radha-12, other
Medium	Sona, Kanchhi Mansuli, Hardinath-1, Swarna-Sub1, other
Medium fine	Katarni, Gorakhnath, Ranjit Mansuli, Sonam, Sabitri, other
Fine	Mansuli, Jira Masino, Sawa Masuli-Sub1, other
Fine and aromatic	Basmati

Source: Scientific Research Publishing Inc

Main rice mills operating in Nepal

Table 15: Main rice mills in Nepal

Rice mill/company	Rice volume (MT per year)	Milling capacity (MT per hour)	Main brand	Good Manufacturing Practices certificate
Agam Food Industry	-	-		ISO Certification in process
Annapurna Rice Mill	-	-		(Agam Foods 2022)
Bhudeo Khadya Udyog	-	-		
Bohra Group	25,000 - 30,000	-		Not available (NA)
Hardik Rice Mill	3,000 - 3,500	-		ISO certified
Jay Shree Foods	-	-		(Bhudeo Khadya Udyog 2022)
KL Dugar Group	34,000	-		
Nandani Khada Udhyog	-	5		NA
Nepal Food Products	7,500	-		NA
Pratibha Rice Mill	-	5		NA
Puja Rice Mill	-	5		NA
Rashmi Trade Group	25,000	-		NA
Sarda Group	16,000	-		NA
Shiv Shakti Group	15,000	-		NA
Shyambaba Enterprise Group	19,000	-		NA
Tarun Agro	-	-		NA

Source: ValueNotes Analysis, Nepal Rice Fortification Landscape Analysis

Roles of different entities in the rice supply chain

Table 16: Supply chain participants and their roles

Serial Number	Main actors	Step involved in
1	Input suppliers	<ul style="list-style-type: none"> Input suppliers are agro-vets, agricultural tool dealers, fertilizer dealers and financial institutions. They supply inputs and also provide technical advice to farmers on application methods.
2	Farmers	<ul style="list-style-type: none"> Seed selection, land preparation, crop establishment, crop care and maintenance, harvesting, threshing, and hauling. Farmers sell their produce to: <ul style="list-style-type: none"> paddy traders; cooperatives and; intermediaries who sell to paddy traders.
3	Paddy traders	<ul style="list-style-type: none"> Paddy traders sell the rice procured from farmers to large millers. Their activities include drying, trucking, handling, and storing rice. They also advance credit to farmers to ensure a steady supply of paddy.
4	Cooperatives	<ul style="list-style-type: none"> Cooperatives supply farmer members with finance to invest in inputs such as seeds, fertilizers, etc. They also help farmers to access loans and other services.
5	Millers	<ul style="list-style-type: none"> Millers execute different activities such as collection, de-husking, grading, packaging and labelling. Large millers sell to wholesalers; small millers sell to wholesalers and retailers.
6	Wholesalers	<ul style="list-style-type: none"> Wholesalers supply milled rice to retailers or sell directly to consumers.
7	Retailers	<ul style="list-style-type: none"> Retailers buy rice from millers or wholesalers and sell rice through traditional retail stores and modern retail stores (supermarkets, hypermarkets, websites, etc.).
8	Government Entities	<ul style="list-style-type: none"> FMTC (formerly NFC) maintains food security and manages price fluctuations. FMTC provides transport-subsidized rice to food-deficit districts.
9	Importers	<ul style="list-style-type: none"> Import rice to fulfil unmet demand. Usually fine and long slender parboiled rice are imported by traders and rice millers mainly from India via all borders, formally and informally.
10	Consumers	<ul style="list-style-type: none"> End users who influence the demand for rice.

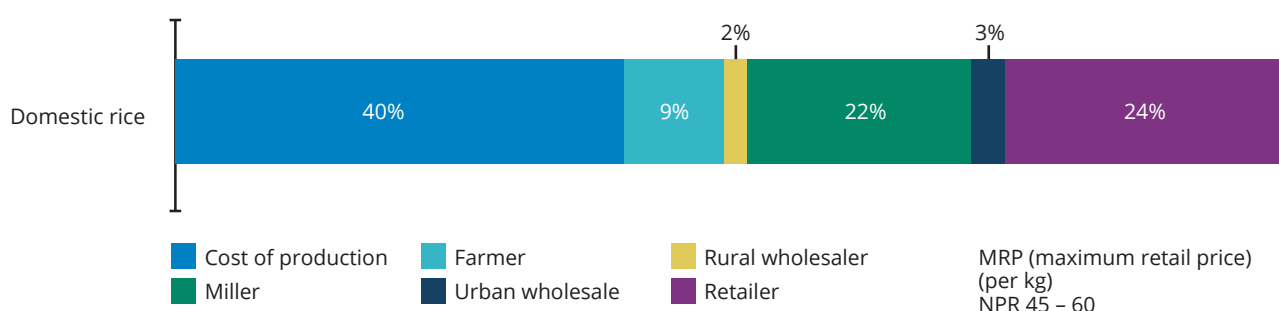
Cost mark-up across the rice value chain

In Nepal, the farmers' cost of production (40 percent) is comparatively high.

Local traders have strong bargaining power compared to urban wholesalers who sell domestic rice as a cheap product and earn profits from volume rather than value.

Millers capture a bigger share (22 percent) than wholesalers in the value chain and tend to make substantial profits compared to their processing costs. This reflects their growing influence in the rice value chain in Nepal.

Figure 13: Cost mark-up for domestic rice



Source: OXFAM

Three-year Plan of Action for rice fortification

The Government of Nepal has devised a three-year Plan of Action to implement a rice fortification programme in the country. The plan will be implemented in two phases. For Phase I, the following general policy guidelines will be followed:

- To promote rice fortification as a long-term food-based strategy to address micronutrient malnutrition and promote it as part of national health and nutrition policies and plans (MSNP-II).
- To formulate standards for fortified rice for voluntary fortification under Nepal food regulations in addition to the existing standard for non-fortified rice.
- To distribute fortified rice under existing social safety programmes focusing on distribution in remote and food-insecure districts at subsidized prices through FMTC phased as follows:
 - **Year 1:** Fortified rice to be produced by blending imported hot extruded FRKs with regular rice at the rice mill of FMTC located in Rajapur, to be distributed in a few remote districts at subsidized rates.
 - **Year 2:** Fortification activity to be expanded to FMTC rice mill in Janakpur on successful completion of year 1.
 - **Year 3:** Distribution of fortified rice to be expanded by FMTC to more targeted remote districts, with a focus on Karnali region. FMTC will also contract with private rice mills to procure fortified rice.
- The Government of Nepal/Ministry of Industry, Commerce and Supplies to subsidize the additional fortification of rice distributed by FMTC under social safety net programmes without making a significant change in the existing price. FMTC will receive the fortification subsidy in addition to the existing transport subsidy.
- From the year 2 onwards, FMTC to start selling fortified rice produced in its Janakpur rice mill through its sales depots in Province 2 and Province 1 (where micronutrient deficiency is high) under its commercial marketing scheme.
- On the promulgation of standards for fortified rice, private sector mills will be encouraged to fortify their rice for commercial use. The government will support promotion of fortified rice by creating

awareness among consumers, which will help to increase the demand for fortified rice.

Based on the recommendations of the Rice Fortification Landscape analysis 2016 and the resolution of the National Conference on Rice Fortification in Nepal 2017, the three-year Plan of Action aims to implement the following strategies:

- **Strategy 1:** Development of standard for fortified rice.
- **Strategy 2:** Capacity building and establishing capacity for monitoring rice mills.
- **Strategy 3:** Distribution of fortified rice under social safety net programme (planned under three-year period)
- **Strategy 4:** Distribution of fortified rice in Province 2 and Province 1.
- **Strategy 5:** Monitoring and review.
- **Strategy 6:** Information, education, and communication.
- **Strategy 7:** Programme evaluation.

Technologies for rice fortification

Different technologies for fortifying rice include dusting, coating, cold extrusion, warm extrusion and hot extrusion. Extrusion is most appropriate for rice fortification in Nepal. In extrusion, FRKs are added to polished rice in ratios ranging from 1:50 to 1:200.

Cold extrusion is also called 'shape forming' and uses only the heat generated during mechanical processing of the rice dough. The temperature during the entire processing operation remains below the melting temperature of rice starch (30–40 °C), hence avoiding gelatinization.

Hot extrusion applies additional heat through steam-heated barrel jackets and the melting temperature of starch is exceeded (80–110 °C). The dough containing micronutrient premix in the required concentration and other optional additives is 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 a similar appearance to normal polished rice (Georg Steiger 2014).



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Abbreviations

ANROPI	Association of Nepalese Rice, Oil & Pulses Industries
CAGR	Compound annual growth rate
DFTQC	Department of Food Technology & Quality Control
DoHS	Department of Health Services
FFRC	Food Fortification Resource Centre
FMTC	Food Management and Trading Company
FRK	Fortified rice kernels
FSSAI	Food Safety and Standards Authority of India
GAIN	Global Alliance for Improved Nutrition
GMP	Good manufacturing practices
KISAN	Knowledge-Based Integrated Sustainable Agriculture in Nepal
LBW	Low birthweight
MCHC	Mother and child health care
MT	Metric tons
MoU	Memorandum of understanding
MSNP	Multisectoral Nutrition Plan
NA	Not available
NFC	Nepal Food Corporation
NI	Nutrition International
NNMSS	Nepal national micronutrient status survey
NPC	National Planning Commission
QA/QC	Quality assurance and quality control
SBN	SUN Business Network
SHN	National School Health and Nutrition Strategy
STC	Salt Trading Corporation
USAID	U.S. Agency for International Development
USDA	United States Department of Agriculture
WFP	World Food Programme

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