FOLATE TASK TEAM

SUPPLY CHAIN ANALYSES TO ASSESS THE FEASIBILITY OF NATIONAL FOOD FORTIFICATION PROGRAMS

KNOWLEDGE BRIEF

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ABOUT THE FOLATE TASK TEAM

The Folate Task Team comprises a group of global experts and partners under the leadership of Nutrition International (NI) through NTEAM (Nutrition Technical Assistance Mechanism), all joined together to identify priority actions to reduce folate-sensitive neural tube defects, build laboratory capacity for the assessment of folate status, support research in this critical area and to facilitate access to folate-related knowledge products.

Through NTEAM, NI shares its expertise globally to support the scale-up of nutrition for the most vulnerable. We believe that knowledge, rigorously obtained and generously shared, is key to effective progress for nutrition. NTEAM convenes global experts to tackle key nutrition issues and encourage broad use of knowledge by translating technical information and research into accessible guidance, tools and resources. We also work with countries and agencies, sharing expertise through timely and coordinated technical assistance.

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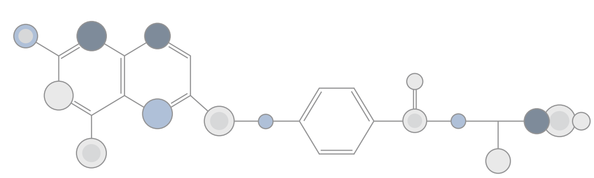


INTRODUCTION

Fortification refers to the process of adding essential vitamins and minerals to foods to prevent nutritional deficiencies. Vitamins and minerals prevent diseases, strengthen immune systems and improve productivity and cognitive development. Food fortification is considered by the World Health Organization,[1] the Food and Agriculture Organization, and the Copenhagen Consensus[2] as one of the top four strategies for decreasing micronutrient malnutrition at the global level.

Neural tube defects (NTDs) – a group of severe birth defects that affect the development of the brain or spine in a fetus – are often caused when a pregnant woman has not regularly consumed enough folate prior to conception. In 2015, it was estimated that there were 260,100 NTD-affected pregnancies throughout the world, with the largest burden in low- and middle-income countries in Africa and Asia.[3,4] In 2017, it is estimated that 59 countries around the world prevented about 50,270 NTDs through mandatory fortification policies that regulate adding at least 1.0 ppm folic acid to wheat and/or maize flour.[5] To reduce the possibility of having a NTD-affected pregnancy, women of reproductive age are recommended to consume 400 micrograms (μg)/day of folic acid, on top of the natural food folate provided by their regular diet.

This is especially important during three months prior to conception and throughout the first month of pregnancy, when the neural tube of an embryo is being formed.[6] As it may be difficult to consume enough natural folate to prevent a NTD-affected pregnancy in a typical diet, complementing a diet with foods fortified with folic acid is an effective and proven way to reach a woman's dietary needs for folate. Countries which have mandated the fortification of a food with folic acid have significantly reduced the prevalence of NTDs in their populations.[4] This brief will outline the considerations needed to implement a national fortification program to reduce the risk of NTDs, specifically focusing on how supply chain analyses can help identify the feasibility (and thus expected health impact) of fortifying any given food.

Several key pieces of information are necessary to know whether fortification is appropriate in any given population or country. When considering food fortification, it is important to ask the following questions:

- What foods are commonly eaten, and by whom?
- Where do those foods come from?
- How are those foods produced?

The answers to these questions will help inform the feasibility, population reach and monitoring protocol of fortification. When first considering whether a food should be fortified, it is crucial to conduct a supply chain analysis (sometimes called a "landscape analysis") to answer these questions.

KEY MESSAGES

- Food fortification refers to the addition of vitamins and minerals to prevent nutrition deficiencies.
- NTDs affected an estimated 260,100 pregnancies worldwide in 2015, with a significant impact in low- and middle-income countries in Africa and Asia.[3]
- Food fortification with folic acid has significantly reduced the prevalence of NTDs in countries which have successfully implemented mandatory fortification.[4]
- Food fortification is effective and low-cost because it uses commonly eaten foods as vehicles for vitamins and minerals and leverages the large-scale efficiencies of industrial food production to reach large numbers of people.
- When foods are fortified through a national mandate, consumer behaviour change to drive demand for a fortified food is unnecessary.
- Supply chain analyses apply business logic to identifying the feasibility and opportunity for fortification.
- Supply chain analyses aggregate data from several sources to answer the following questions:

    - How much food can realistically be fortified in-country?
    - What are the limitations to fortification?
    - Who will benefit from food fortification?
- A supply chain analysis is an important assessment tool that should be conducted when considering fortification of a new food.

WHAT WE KNOW

Fortification Improves Health

The efficacy of food fortification in improving public health outcomes is widely known and has been demonstrated repeatedly in the last 100 years.[7]

Around the world, salt is commonly fortified with iodine to avoid affecting a child's mental capacity and iron is regularly added to cereal grains to prevent iron deficiency anaemia. Vitamin A is often added to oil, sugar and rice to prevent vitamin A deficiency and its consequences such as childhood blindness and increased risk of death due to infectious diseases. Often several B-complex vitamins are simultaneously added to cereal grains to prevent conditions that were once common, including beri-beri and pellagra.[7]

One of the most important public health successes attributable to fortification is the prevention of NTDs by adding folic acid (the synthetic form of vitamin B9) to cereal grains. Lower rates of NTDs have been repeatedly documented in countries after folic acid was first added to wheat flour in Oman in 1996,[8] in the USA in 1998,[9] and in Canada in 1997-98.[10]

Supply Chain Analyses Inform Feasibility of Fortification

Supply chain analyses evaluate each stage of a product, from raw material to methods of delivery to customers. In a business setting, the goal of such analyses is to improve efficiency by identifying opportunities to improve operations. When applied to fortification, supply chain analyses broaden the view to include an entire industry's supply chain for a potential fortification vehicle.

Applying a supply chain analysis to fortification requires thinking about nutrition opportunities in fortification as well as practical elements:

- How a fortified food will be produced and delivered to a population
- How much food will be fortified
- How many people will be reached

Stakeholders should identify foods that are commonly eaten and industrially produced in centralized, automated manufacturing facilities. Industrial production has several features that benefit the implementation of food fortification.

Foods industrially produced are typically		**Benefit to fortification**
Manufactured consistently	→	Important in quality control of nutrient levels
Produced in a smaller number of high-capacity facilities	→	Reduces the resources required for governments to monitor fortification
Produced in high volumes	→	Allows fortification to benefit from lower input costs due to economies of scale
Operated by the private sector	→	Production and availability of fortified foods not dependent on government funds

Supply chains are relevant for identifying fortification opportunities in mandatory, voluntary or social safety net settings. In social safety net programs, industrial production may not be as important as the amount of the food being considered for fortification. In this case, a supply chain of that program should be closely examined to identify opportunities for incorporating fortification.

Conducting a Supply Chain Analysis

Overview

One of the main goals of a supply chain analysis is to identify a centralized place where fortification should occur, because it is easier to fortify a lot of food in one place rather than small amounts of food in many different places. When fortification occurs in a centralized place, less equipment is needed, and transportation and premix delivery are simplified. At each stage of assessing a food, consider, would fortification be most efficiently done at this stage? A supply chain analysis should also answer:

1. What proportion of food available or consumed in the country is industrially processed, and thus could be fortified?
2. What population(s) consumes foods that are industrially processed and are likely to benefit from fortification? How many people does this represent?
3. Where and how much of a food is already being fortified. Existing fortification practices for a food may help inform whether certain supply chain inputs (for example, fortified kernels) are available in a country.

Separate supply chain analyses for fortification are needed for each food being considered for fortification. Do not try to conduct a combined supply chain analysis for wheat flour and oil – these foods likely have very different journeys from field to table and it will be too complicated to do both at once. Commonly fortified staple foods, such as maize flour, oil, salt, rice, and wheat flour are strong candidates for supply chain analyses. Increasingly condiments such as sugar, bouillon cubes and tomato paste are being considered for fortification.

Process and Potential Data Sources

1. Once you have decided on the food of interest, ask where the food's production process begins in the country of interest. Next, ask how much of that food is grown or produced domestically, how much

is imported, and what form is imported (e.g. as a raw ingredient, processed food that requires further processing, or a finished ready-to-eat food) . If substantial amounts are imported, where is it imported from? In the case of an imported food, sometimes the most centralized opportunity for fortification occurs before it is imported into its destination country – for example, when rice is milled in large rice mills in Asia before it is exported.

Potential sources for food production and import information: Food and Agriculture Organization, United States Department of Agriculture's Foreign Agriculture Service, Ministries of Agriculture, United Nations COMTRADE, customs authorities, private sector records.

2. After being produced or imported, food typically goes through various brokers and wholesalers. Ask where it goes for processing or collection? If the food is imported as a final good, already packed and labelled, there are fewer steps from import to retail distribution. But more commonly, after a food is produced or imported, it must go through additional steps before it reaches the consumer. Wheat grains may be sold by a farmer to a broker, who aggregates wheat for sale to a wheat flour miller. Even rice, which is most commonly imported as a milled grain, sometimes undergoes further polishing, blending and packing before it goes for sale.

   The stage of food processing – for example, grain milling (either into flour or polished rice), oil refining or salt refining – is the most common place for fortification to occur because the food is already undergoing several processes and fortification can be incorporated as another step. However, in a supply chain analysis, all food processing is not considered equal. Grinding wheat at home with a stone mill is not the same as wheat flour milling in a facility with capacity of 1,000 metric tons of wheat a day. A supply chain analysis should categorize food processing facilities based on features that impact fortification feasibility, such as:

- Industrial capacity
- Technical ability to fortify
- How many food processing facilities exist and are operational in each production capacity category
- And how much food is being processed
- How much is available for human consumption; with wastage or byproducts, sometimes the amount of food going into processing is not the same as the amount coming out

Using this information, identify where fortification can be done most efficiently. For example, consumers can buy wheat flour and use it to prepare foods at home or they can buy wheat flour in the form of cookies, cakes, biscuits, crackers, noodles, pasta, bread, etc. On the technical side, it is possible to add fortification as a step in bakeries, but it is easier and more efficient to conduct regulatory monitoring checks at 11 flour mills, as opposed to four cookie companies, six noodle and pasta factories and 200 local bakeries, all using flour coming from the 11 flour mills. For rice fortification, if rice is centralized in a small number of warehouses after milling (for example, prior to distribution), then the warehouse location may be a more efficient fortification location than the rice mill. The key is to identify a fortification location that eases regulatory monitoring while also being logistically practical and central.

Sourcing fortification inputs

A supply chain analysis focuses on identifying where, when, and how much food can be fortified. But what about the ingredients for fortification – the vitamins and minerals?

For some foods, such as rice, the feasibility of sourcing inputs can be just as important as identifying the supply chain of the food. In other countries, identifying domestic availability of these vitamins and minerals may be mandatory. In these cases, a separate supply chain analysis should focus on identifying how vitamin and mineral premix and fortified kernels are procured.

Potential sources for food processing information: The private sector is the best source of this data, but sometimes Ministries of Industry or Commerce will also track information about food processors. Where no government or secondary data exists, primary data collection (e.g. interviewing brokers, wholesalers, food processors, etc.) will be necessary to identify food routes and processing steps.

3. After food processing, food is distributed to consumers – but where and which consumers? This question is important to answer because it helps identify whom fortification benefits. This helps estimate the expected health impact and identifies populations who are not accessing fortified foods and may need alternative nutrition interventions.

Potential sources for consumer access information: The private sector is a good source of regional or distribution data and may have demographic information about key consumers. Household consumption surveys will provide individual or household level information about food consumption, but it can be difficult to identify which foods are industrially milled.

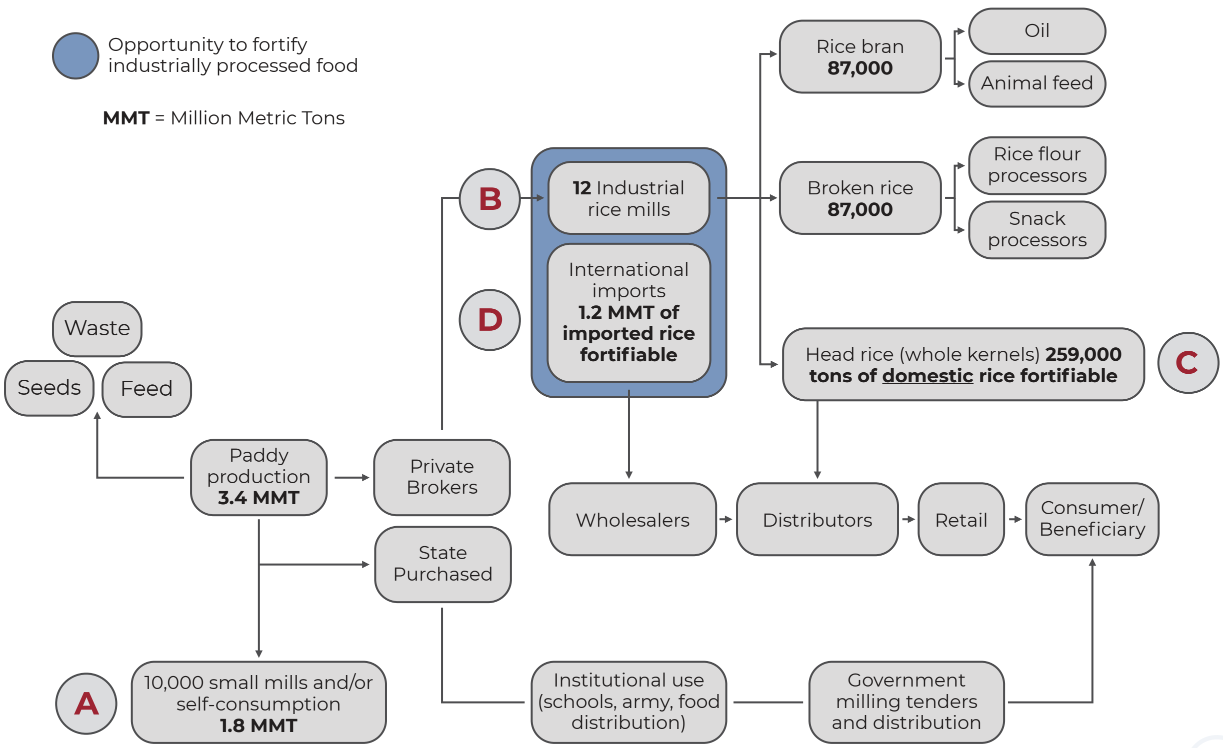
Interpreting Results

Once the necessary information is collected, it can be interpreted to inform fortification opportunities. Below are examples of data collected in a supply chain analysis for rice, as well as interpretations of this data. In the example, it appears that imported rice is an opportunity for fortification. Before the country could move forward, they would have to address other questions, such as whether the customs authority has the capacity to monitor imports for fortification. Such questions are outside the scope of a supply chain analysis; ideally a national food fortification committee would address such questions.

Table 1: Collecting and interpreting information for a supply chain analysis

	QUESTIONS TO ASK	EXAMPLE: ASSESSING RICE	INTERPRETATION
A	How many small mills exist and how much do they produce?	An estimated 10,000 small mills produced approximately 1.8 million metric tons of rice.	1.8 million metric tons of rice cannot be fortified through industrial production of rice.
B	How many industrial mills exist and are functioning?	Approximately 12 rice mills are considered industrial, with at least 5 metric tons/hour capacity.	12 industrial mills will be the likely points of fortification and regulation.
	What is an industrial mill's installed capacity (often called "capacity")?	Ideally, the installed capacity for each mill is identified. If not, an average can be used (if known). In this example, assume 10 metric tons/hour capacity.	A mill running 24 hours a day, 300 days a year can be considered 100% utilization (a mill's maximum operation ability). 12 mills with an average of 10 metric tons per hour, 24 hours a day, 300 days a year = 12 * 10 * 24 * 300 = 864,000 metric tons of paddy rice capacity across all 12 mills.
	What is an industrial mill's capacity utilization (often called "utilization")?	Ideally, the capacity utilization for each mill is identified. If not, an average or estimate can be used (if known). In this example, assume 50% utilization. Capacity utilization can be reported in hours/day and days/year.	50% utilization of all mills' total capacity: 50% of 864,000 metric tons = 432,000 metric tons of paddy rice utilization across all 12 mills.
C	What is an industrial mill's conversion rate from raw ingredient to final product?	Ideally, the conversion rate for each mill is identified. If not, an average or estimate can be used (if known). If poor quality rice is used or a mill is inefficient, it may be 60% of rice paddy converted into milled rice.	60% of 432,000 metric tons of paddy rice = 259,000 metric tons of milled rice. 259,000 metric tons of milled rice is the total national opportunity for domestically milled, fortified rice.
	Are there further processing steps that use this food?	After milling, sometimes rice is made into flour, rice snacks or other foods. Ideally the rice volume used for these foods is known.	95% of the rice available in the country is used as head rice (milled whole kernels), 3% as rice flour and 2% in rice snacks.
D	How many importers exist?	Five major rice importers control approximately 90% of the total 1.2 million metric tons imported rice market, and an unknown number of small rice importers.	At least 5 rice importers would be required to import fortified rice under a fortification mandate.
	How much do each of these importers import annually, and from what countries?	Ideally, the import volume for each importer is available. If not, market share can be used.	Unlike wheat grain, rice is typically imported as a milled product; understanding volumes of imported milled rice represents how much imported rice is an opportunity for fortification.

Example results from Table 1 visualized in a supply chain flow diagram



TAKE AWAY MESSAGES

FOR FORTIFICATION STAKEHOLDERS

- As a result of insufficient folate levels in women of reproductive age, NTDs affected an estimated 260,100 pregnancies worldwide in 2015.
- Food fortification is an effective and low-cost public health intervention to prevent nutrient deficiencies.
- Supply chain analyses should be utilized to inform the feasibility of food fortification in a country.
- Supply chain analyses should identify how much food can be fortified in the country, which represents the total amount of food that offers an opportunity for fortification.
- Supply chain analyses should also identify where foods are being consumed or accessed and by whom; this represents the expected beneficiaries of food fortification.
- Supply chain analyses require broad multi-sector support to aggregate relevant data, including various national agencies responsible for agriculture, trade, health, and customs, development partners and private sector players in a particular food's production, trade and sale.
- Supply chain analyses can also facilitate interpretation of health impact monitoring and/or evaluations due to fortification.

ACKNOWLEDGEMENTS

NTEAM would like to acknowledge the contributions of the Food Fortification Initiative in producing this Knowledge Brief, including (listed in alphabetical order) Scott Montgomery, Executive Director; Becky Tsang, Asia Region Technical Officer; Sarah Zimmerman, Communications Coordinator.

NTEAM would also like to express its gratitude to the Folate Task Team (Homero Martinez, Senior Technical Advisor and Jessica Poulin, Knowledge Translation Officer) and Manpreet Chadha, Senior Technical

Advisor Food Fortification at Nutrition International, for their support in the development of this Knowledge Brief.

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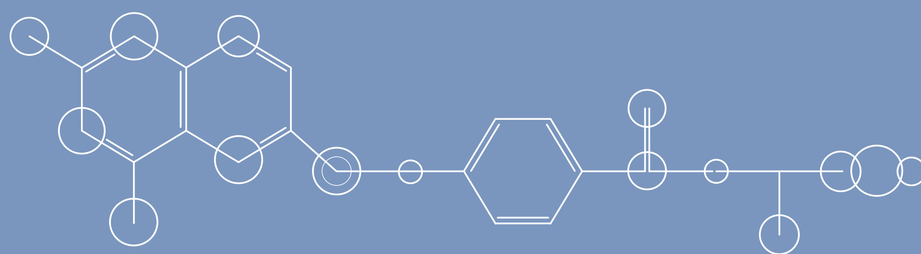

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