Feasibility of Wheat Flour Fortification in Bangladesh: *An assessment of the wheat flour milling industry and regulatory monitoring system*

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Cover photo: Men having tea break in Dhaka, Bangladesh. Wheat flour-based foods such as breads and biscuits are commonly consumed during tea breaks. Photo: Becky Tsang

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Executive Summary

On behalf of Nutrition International, the Food Fortification Initiative (FFI) conducted a mission trip to assess the feasibility of wheat flour fortification in the milling industry and regulatory monitoring system in Bangladesh. FFI's key conclusions were:

Fortifying all industrially milled flour through mandatory fortification is expected to primarily reach the urban population of 59 million individuals (37% of the country's population). Approximately 78% of the wheat flour in Bangladesh will be industrially milled in 1-2 years and can be feasibly fortified by its large, modern mills. The remainder of the wheat flour is milled by small village stone-grinding mills on behalf of farmers growing wheat for their own consumption. This wheat flour cannot be fortified in a cost-effective, sustainable manner.

Within the urban population, wheat flour is also consumed by the urban poor and slum populations. Although wheat flour is consumed in higher-quantities by the urban non-poor (88 grams per capita per day (g/c/d)), consumption quantities are adequate enough in the urban poor (70 g/c/d) to benefit from the additional nutrient intake, if flour is fortified at WHO 2009 recommended levels. If fortification is made mandatory, existing 2008 Bangladesh Standards and Testing Institute (BSTI) voluntary fortification standards should be reassessed to consider nutrients included and levels.

Social safety net fortification of wheat flour is currently possible under two mechanisms: Open Market Sales (OMS) and Vulnerable Group Feeding (VGF). Fortifying OMS flour could reach a potential 8.1 million individuals (4.9% of the population), while fortifying VGF flour could reach its 14.25 beneficiaries; however, VGF does not necessarily provide wheat grain on an annual basis.

Today, BSTI is the lead government agency responsible for conducting regulatory monitoring of foods that must follow mandatory standards. However, within the next 10 years, this responsibility is expected to transfer to the Bangladesh Food and Safety Authority. The success (and clarity) of this transfer is key to the success of implementing food fortification. The Food Safety Act of 2013 provides BFSA the legal mandate over other existing regulatory agencies regarding food safety activities. However, despite the Act having been passed 7 years prior, FFI found BFSA under-developed, lacking sufficient staff, offices, and protocols. If by 2030 (the deadline under the Prime Minister's directive), BFSA continues to lack the capacity to conduct its regulatory role, there will likely continue to be overlapping roles and mandates of BSTI, BFSA, and the Institute of Public Health.

Based on these conclusions, FFI's recommendations are:

- Enact mandatory wheat flour fortification in Bangladesh by making the BSTI standard mandatory. The standard should also be reviewed and updated for nutrient levels and compounds.
- Explore opportunities to support the Ministry of Food to fortify flour sold through Open Market Sales (710,553 USD for premix costs).

- Identify whether BFSA would welcome technical support as it operationalizes its food safety and food quality mandate, ensuring its role is integrated with existing government agencies responsible for food safety and quality.
- Provide technical support to national laboratories to develop protocols and testing validation for analysis of fortified wheat flour.

Micronutrient status in Bangladesh

The last micronutrient survey was the National Micronutrient Survey (NMS) of 2011/2012[1]. Results for pre-school age children, school-age children, and non-pregnant, non-lactating (NPNL) women are shown (Table 1). Since large-scale fortification is targeted at the general adult population, sub-national results for NPNL rural, urban, and slum populations is also shown.

Key conclusions from the NMS 2011/2012 are:

- Micronutrient deficiencies are relatively similar across NPNL populations, at national and subnational levels, indicating a general need for micronutrient interventions across all populations.
- NPNL women living in slums women have higher vitamin B12, vitamin A, and zinc deficiencies, but NMS did not report whether these differences were statistically significant.
- Prevalence of iron deficiency anemia is considered relatively low across national and subnational populations of NPNL women (≤5%). The prevalence of iron deficiency is only slightly higher (≤8.7% across groups). The results of NMS called into question whether there is a need for population-level iron interventions in Bangladesh. The low prevalence of iron deficiency has been attributed to naturally occurring levels of iron in groundwater, which is consumed by the population through widespread use of wells for drinking water[2].
- Prevalence of vitamin A deficiency was also relatively low across national and subnational populations of NPNL women (≤5.4%). NMS 2011/2012 took place after the introduction of a national oil fortification program.
- The prevalence of vitamin B12, folate, and zinc deficiencies indicate a public health need for food fortification with these nutrients.
    - Folate deficiency was measured in NMS 2011/2012, which is indicative of a population's risk for megaloblastic anemia, not risk for serious birth defects of the brain and spine (neural tube defects, NTDs). Dietary requirements for folate is higher for reducing risk for NTDs than for reducing risk of megaloblastic anemia. Therefore, even though NPNL women's prevalence of folate deficiency ranges from 7.9-11.4%, this is indicative that a much higher percentage are at risk of NTD-affected births.

A 2020 nutrition survey for Dhaka Division is complete and the final report is pending (delayed by Covid19). Pending funding, the survey may be rolled out to the remaining divisions in order to provide an updated national nutrition survey.

[1] National Micronutrient Survey 2011/2012. icddr,b, UNICEF-Bangladesh, GAIN, Institue of Public Health and Nutrition. January 2013.

[2] Merrill R, et al. Iron Status of Women Is Associated with the Iron Concentration of Potable Groundwater in Rural Bangladesh, *The Journal of Nutrition*, Volume 141, Issue 5, May 2011, Pages 944–949, https://doi.org/10.3945/jn.111.138628

Table 1: Micronutrient status results of the National Micronutrient Survey 2011/2012

Nutrient status	P-SAC, %	SAC, %	NPNL, %			
			National	*Rural*	*Urban*	*Slum*
B12 deficiency	--	--	23	21.5	23.5	24.6
Folate deficiency	--	--	9.1	8.6	11.4	7.9
Median urinary iodine	--	Sufficient (145.7 µg/L)	Sufficient (122.6 µg/L)	--	--	--
*Iron deficiency**	10.7	--	7.1	6.7	8.7	7.4
Iron deficiency anemia	7.2	--	4.8	5	4.1	4.1
Vitamin A deficiency	20.5	20.9	5.4	5.4	4.9	6.9
Zinc deficiency	44	--	57	57.5	54.5	66.4

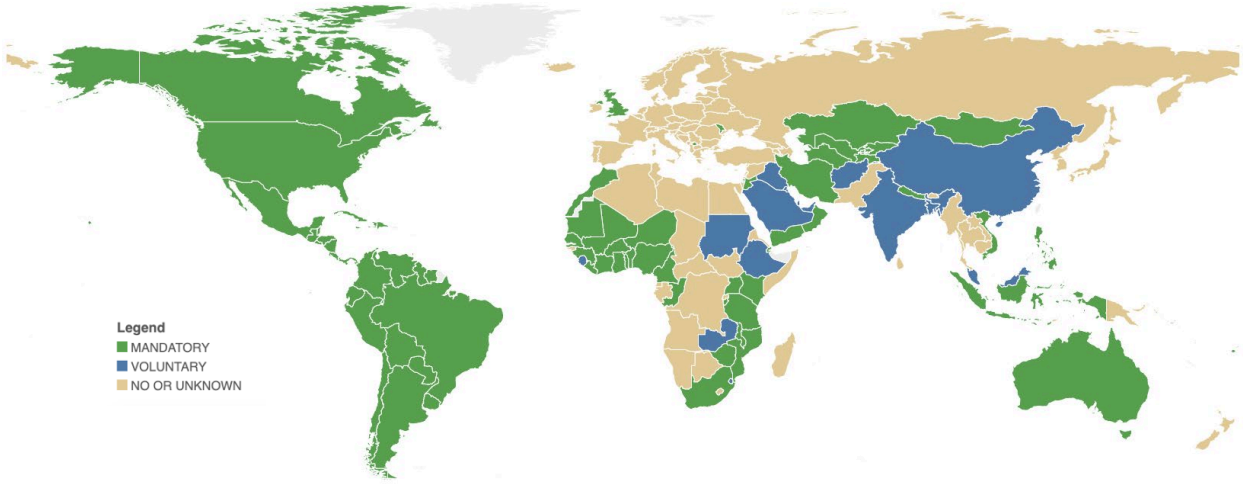
--, not measured; NPNL, non-pregnant, non-lactating women; P-SAC, pre-school age children; SAC, school-age children
*Measured as serum ferritin

Status of wheat flour fortification globally and in the Asia region

According to the Global Fortification Data Exchange (GFDx), 83 countries have mandatory legislation requiring fortification of wheat flour[3]. Sixteen of these countries are in Asia. In addition, Fifteen countries (ten in Asia) have voluntary standards (including Bangladesh) for wheat flour fortification globally. Voluntary standards hold a producer accountable to the type and amount of nutrients that must be included *if* wheat flour is fortified, but fortification is not required. In many countries, producers may be allowed to fortify wheat flour without following any standard, which is not considered voluntary fortification under the GFDx's definition.

[3] Global Fortification Data Exchange. Fortification Legislation. https://fortificationdata.org/interactive-map-fortification-legislation/

Figure 1: 98 countries have mandatory or voluntary fortification of wheat flour[3]



Mandatory standards for several types of oil/fat and salt already exist in Bangladesh[4]. Mandatory oil fortification with vitamin A began in 2013; as of 2017, approximately 61% of oil is fortified. Mandatory salt fortification with iodine was established in 1989; as of 2018, 97% of salt is iodized. Fortification of cereal grains should be complementary with existing food fortification activities in Bangladesh; given pre-existing fortification of oil with vitamin A, and supply chain considerations and higher premix costs with the inclusion of vitamin A in cereal grains, fortification standards without vitamin A added to cereal grains could be considered.

Although rice fortification is not mandatory, there are considerable social safety net activities in fortified rice. Partners such as the World Food Programme and Nutrition International are supporting the Bangladesh government to distribute fortified rice in the Food Friendly Program (FFP) and Vulnerable Group Development (VGD) social safety nets and increase availability of fortified rice in the commercial marketplace. Bangladesh is one of only five countries globally with voluntary standards for rice[3], with five domestic fortified kernel producers[5]. Currently, through voluntary fortification and social safety net programs, 89,500 MT of rice is fortified, reaching 2.3 million beneficiaries in 2019.

From all consumption/availability sources, rice would appear to be a more opportunistic food to fortify. However, the following should also be taken into consideration when selecting a food to fortify: coverage of the food in the population, whether subpopulation consumption differs from the average, and industrial milling of a food. Examining the feasibility of rice fortification in Bangladesh is outside the scope of this report; if rice fortification is feasible on a mandatory basis through a centralized milling industry, the need for fortification of other cereal grains should be assessed. Food fortification programs with multiple food vehicles providing the same nutrients are complementary (not duplicative) if subpopulations have differing food access or

[4] Global Fortification Data Exchange. Bangladesh Country Dashboard. https://fortificationdata.org/country-fortification-dashboard/?alpha3_code=BGD&lang=en
[5] Personal Communication with Rezaul Karim, World Food Programme – Bangladesh. February 2020.

consumption patterns. Where multiple foods are fortified on a mandatory basis, standards should be developed considering nutrient contribution through combined fortified foods intake.

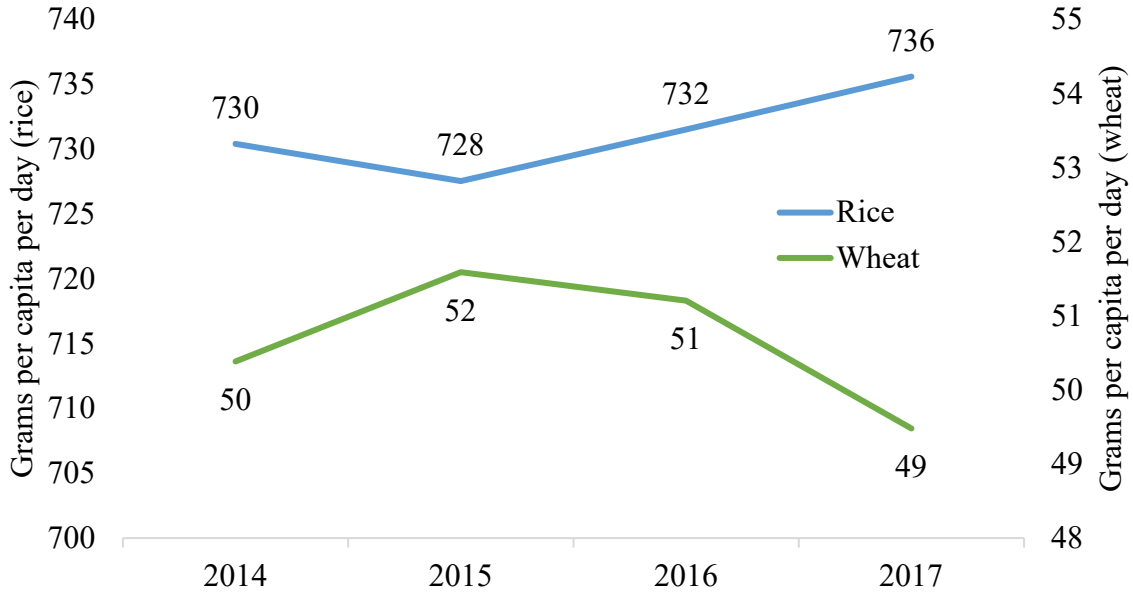
The rest of this report delves into the opportunity for fortifying wheat flour, considering populations that may benefit and the feasibility of implementation.

Wheat flour consumption, coverage, and expected nutrient contribution from fortification in Bangladesh

Cereal grain consumption[6]
The two main cereals available for consumption in Bangladesh are rice and wheat; zero or inconsequential amounts of other cereal grains (oats, rye, barley, sorghum, maize) are available.

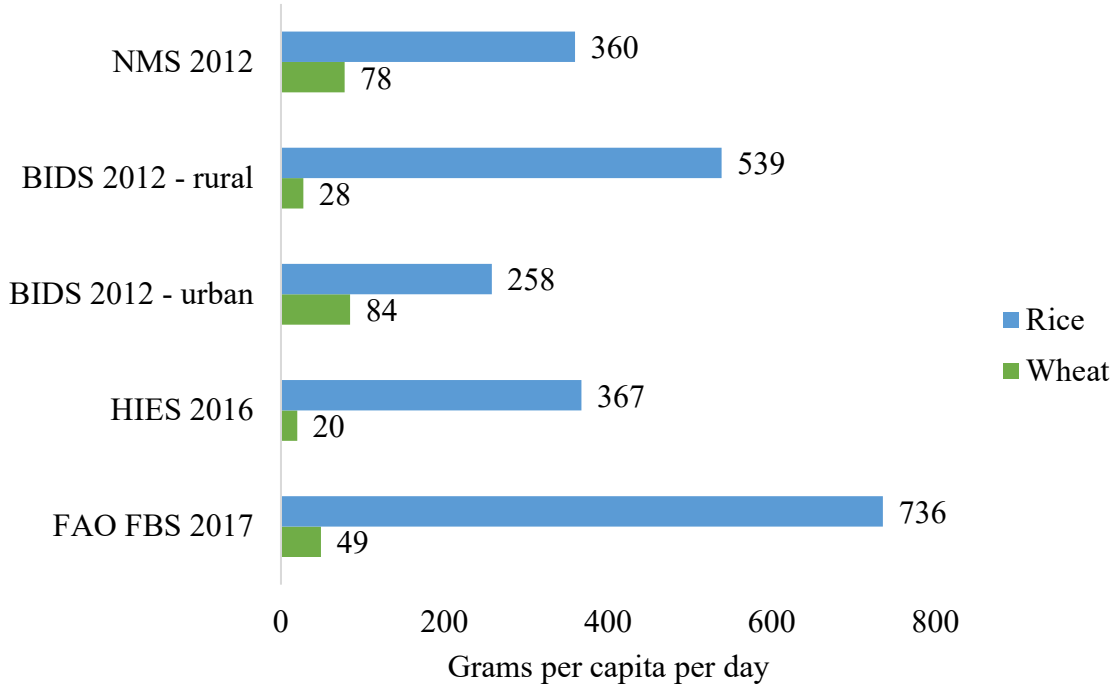
During 2014-2017, availability of rice and wheat were relatively stable, ranging from 728-736 g/c/d for rice and 49-52 g/c/d for wheat (Figure 2). Clearly, rice is consumed in far greater quantities than wheat; however, FAO estimates for rice are nearly double the estimates from other sources; actual consumption of rice may not be so extreme as 700+ g/c/d. The most recent wheat flour g/c/d estimates from various sources is shown in Figure 3 and their interpretation in Table 2.

Figure 2: FAO wheat and rice g/c/d availability trends in Bangladesh, 2014-2017



[6] FAO Food Balance Sheets, 2017. http://www.fao.org/faostat/en/#data/FBS

Figure 3: Wheat and rice g/c/d consumption/availability by source



NMS, National Micronutrient Survey; BIDS, Bangladesh Institute of Development Studies; HIES, Household Income and Expenditure Study; FAO, Food and Agriculture Organization; FBS, Food Balance Sheets

However, FAO data is averaged across the population, which hides potential sub-populations that could have higher consumption of wheat flour. Given that rice is the dominant staple cereal grain in Bangladesh, it is likely that wheat flour foods are not consumed equally across the population. NMS 2011/2012 suggests this is the case – among only women who consume wheat flour or bread, estimated g/c/d may be twice that of the FAO estimate: 77.9-94.1 g/c/d (Table 2)/

A consumption survey by the Bangladesh Institute of Development Studies (BIDS), aimed at addressing the likely under-reporting of cereal grain consumption through HIES methodology[7] also found higher average consumption of wheat flour nationally, provided an urban/rural stratification, and within urban/rural populations, the estimated consumption among poor and non-poor populations[8] (Table 2).

As expected, the urban population (84.3 g/c/d) consumes more wheat flour than rural populations; however, they found that even poor urban populations consume higher than the

[7] Depending on methodology, HIES surveys can underestimate wheat flour consumption that occurs outside of the home, or in processed foods, both of which are important considerations for accurately describing wheat flour consumption.

[8] Hossain, M and Yunus, M. Estimates of Per Capita Consumption of Food Grains in Bangladesh. Bangladesh Development Studies. Vol. XXXIX, March-June 2016, Nos. 1& 2. https://bids.org.bd/uploads/publication/BDS/39/391&2/05_Estimates%20of%20Per%20%20Capita%20Consumption%20of%20Food.pdf

FAO and HIES estimates of wheat flour consumption (69.8 g/c/d). Finally, the report also models the expected rice and wheat flour consumption trends from 2012-2020, which suggests that by 2020, non-poor urban populations would consume 100 g/c/d of wheat flour while the urban poor would consume 75 g/c/d. Wheat flour consumption remains low in rural populations, whether poor (16 g/c/d) or non-poor (22 g/c/d).

Assuming the lower level of the NMS estimate, Table 3 describes the expected nutrient contribution from wheat flour if fortified at the Bangladesh Standards and Testing Institution (BSTI) voluntary standard or the WHO recommended levels for 75-149 g/c/d. The cost for premix using the BSTI voluntary standard is estimated at $3.50-3.72 USD/MT of flour, whereas the cost at the WHO recommended levels $2.94-3.16 USD/MT of flour[9]. This document uses an average $3 USD/MT to estimate the cost of premix under a hypothetical fortification program.

Given that the wheat flour standards are from 2008, nutrient intake and deficiency data from NMS 2011/2012 (and potentially Dhaka Division's micronutrient survey data from 2020) can be used to inform whether the standard should be modified. NMS 2011/2012 found lower-than-expected iron deficiency prevalence (<9%) and iron deficiency-anemia (<5%) in women of reproductive age, attributed to naturally occurring iron in well water2. There was also low vitamin A deficiency prevalence (<5%) in women of reproductive age; the high vitamin A deficiency prevalence in PSAC and SAC populations may be better addressed through supplementation than wheat flour fortification.

[9] Quote from Mühlenchemie in March 2020. Personal Communication.

Table 2: Estimates of wheat flour consumption and coverage, by source

Source	G/c/d	Coverage	Interpretation and Limitations
FAO FBS 2017	49	Not available	• Availability data, not consumption data. • Data is averaged across the population and not everyone is expected to consume wheat flour
HIES 2016/2017	National: 19.8	Not available	• Expenditure data, not consumption data • Does not include processed wheat flour foods, such as bread and biscuits • Data is averaged across the population; the entire population is not expected to consume wheat flour
HIES 2010	National: 26 Urban: 33.6 Rural: 23.3	Not available	• Expenditure data, not consumption data • Does not include processed wheat flour foods • Data is averaged across the population; the entire population is not expected to consume wheat flour
BIDS 2012	National: 41.6 Urban: 84.3 Poor: 69.8 Non-poor: 88.2 Rural: 27.5 Poor: 22.3 Non-poor: 30.2	Not available	• Consumption data • Includes wheat flour contribution from wheat flour foods consumed outside the home
NMS 2011/2012*	NPNL: 77.9-94.1 SAC: 76.2 P-SAC: 62.3	NPNL: 41.9%-52.4% SAC: 66.5%-94.5% P-SAC: 76.2%-100%	• Consumption data • Consumption only among individuals who consume wheat flour and bread • Consumption of bread and wheat flour only; total wheat flour consumption is underestimated since it does not include other wheat flour-based foods

Abbreviations: Bangladesh Institute of Development Studies; FAO, Food and Agriculture Organization; FBS, Food Balance Sheets; G/c/d, grams per capita per day; HIES, Household Income and Expenditure Survey; NMS, National Micronutrient Survey; NPNL, non-pregnant, non-lactating women; P-SAC, pre-school age children; SAC, school-age children

*The NMS food consumption module was a Food Frequency Questionnaire. The consumption of wheat flour and bread are reported as two separate food items and, in their analysis, have not been combined. Thus the consumption of bread and wheat flour are reported in this table as a range, with the lower limit as the higher consumption or coverage level and the upper limit as the two foods combined.

Table 3: Expected nutrient contribution from wheat flour fortification, at 77.9 g/c/d

Nutrient	EAR* (mg/d)	BSTI standards		WHO recommendations	
		2008 standards (mg/kg)	Fortification contribution, mg/d (% EAR)	Addition, 75-149 g/c/d[10] (mg/kg)	Fortification contribution, mg/d (% EAR)
B12	0.0041	0.01	0.0008 (32.5%)	0.02	0.0016 (64.9%)
Calcium	800	53	4.13 (0.5%)	NR	--
Folic acid	0.400	2	0.16 (39.0%)	2.6	0.2 (50.6%)
Iron	18	55 (compound not specified)	4.28 (52.9%)	40 as NaFeEDTA 60 as FF/FS	4.67 (as FS/FF) (57.7%)
Niacin	14	15	1.17 (10.6%)	NR	--
Pyridoxine	1.3	5	0.39 (30.0%)	NR	--
Riboflavin	1.1	4	0.31 (34.6%)	NR	--
Thiamin	1.1	6	0.47 (51.9%)	NR	--
Vitamin A	0.7	3	0.23 (46.7%)	3	0.23 (46.7%)
Zinc	8	27	2.10 (30.9%)	55	4.28 (53.6%)

*For non-pregnant, non-lactating women; no EAR exists for folic acid, so the RDA is used; **Low extraction flour
Green highlighted columns indicate that fortification at the specified levels provide 20% or more of the EAR
Abbreviations: BSTI, Bangladesh Standards and Testing Institute; FF, ferrous fumarate; FS, ferrous sulphate; Mg/kg, milligrams per kilogram; Mg/d, milligrams per day; NR, no recommendation; EAR, estimated average requirement; WHO, World Health Organization

Table 4 proposes the following changes to the existing Bangladesh standard: 1. Removing vitamin A and iron; 2. Increasing niacin and calcium addition to restoration levels in wheat flour (940 mg/kg of calcium as calcium carbonate[11]), and 3. Increasing folic acid, vitamin B12, and zinc levels to meet WHO recommendations. By removing

Table 4: Proposed wheat flour fortification levels, expected nutrient contribution, at 77.9 g/c/d

Nutrient	EAR* (mg/d)	FFI Proposed**	
		(mg/kg)	Fortification contribution, mg/d (% EAR)
B12	0.0024	0.02	64.9%
Calcium	800	940	9.2
Folic acid	0.4	2.6	50.6%
Niacin	11	25.2	17.8%
Pyridoxin	1.3	7.6	45.5%
Riboflavin	0.9	4	34.6%
Thiamin	0.9	6	51.9%
Zinc	6.8	55	53.6%

*For non-pregnant, non-lactating women; no EAR exists for folic acid, so the RDA is used; **Low extraction flour
Green highlighted columns indicate that fortification at the specified levels provide 20% or more of the EAR
Abbreviations: FFI, Food Fortification Initiative; Mg/kg, milligrams per kilogram; Mg/d, milligrams per day; EAR, estimated average requirement.

[10] WHO, FAO, UNICEF, GAIN, MI, & FFI. Recommendations on wheat and maize flour fortification. Meeting Report: Interim Consensus Statement. Geneva, World Health Organization, 2009 (http://www.who.int/nutrition/publications/micro- nutrients/wheat_maize_fort.pdf, accessed February 25, 2020).
[11] WHO/FAO. Guidelines on food fortification with micronutrients. Eds. Allen L., et al. 2006.

Cereal grain coverage

Two potential data sources describe the coverage (proportion of population consuming) of wheat flour in Bangladesh (i.e., the proportion of the population that consumes wheat flour): 1.) the Household Income and Expenditure Survey (HIES; most recent survey cycle was 2016/2017), which provides an estimated proxy of household coverage through household purchases of wheat flour/wheat flour containing foods and 2.) the National Micronutrient Survey (NMS) 2011-2012, which contained a 7-day food frequency questionnaire.

Wheat flour data have not been released from the 2016/2017 HIES. The 2010 HIES survey has not been analyzed to describe wheat flour coverage; nor is it openly available for re-analysis. However, on average, there is higher per gram consumption of wheat flour in urban populations compared to rural populations, suggesting that wheat flour is likely to have greater coverage in urban areas[12].

According to the NMS, 41.9% of non-pregnant, non-lactating women in Bangladesh consume wheat flour, and 10.5% consume bread. However, as these groups may or may not overlap, the coverage of wheat flour and bread could be 41.9%-52.4%. Note that this coverage estimate does not account for biscuit or noodle consumption, which could raise coverage of wheat flour based foods, as biscuits appear to be a highly consumed snack food in Bangladesh. However, the NMS survey is the only data that describes wheat flour consumption only amongst those who consume wheat flour.

A 2003 BRAC household expenditure survey[13] in the Dhaka area found high coverage of wheat flour (71%-96%) and biscuits in the studied population (coverage estimate not described, simply describes biscuits as a major processed food item).

[12] Household Income and Expenditure Survey, 2010. Bangladesh Bureau of Statistics.

[13] Halder S., et al. Patterns and Trends in Food Consumption in Poor Urban and Rural Households in Bangladesh: The Field Survey Results. BRAC. 2013.

Feasibility of implementing wheat flour fortification

Wheat flour supply chain
An overview of the supply chain is in Figure 4, with each section in the flow chart described in detail below.

Atta and *maida* are the main two forms of wheat flour used in Bangladesh. *Atta* refers to higher-extraction flour used for *rotis*. However, whereas *atta* in India refers to stone-ground whole wheat flour, in Bangladesh *atta* may not be stone-ground or whole-wheat flour. *Atta* in Bangladesh is still considered low-extraction (70%-75%) relative to 92%-97% extraction whole-wheat flour, and importantly, may be produced from roller flour mills. Flour brands that market whole-wheat flour refer to it as "brown *atta*". *Maida* is low extraction refined flour (~65%), used in baked goods, biscuits, noodles, and *porota*.

High-extraction flours require a higher-bioavailable iron compound (NaFeEDTA) to counter the high phytate content in the flour. However, considering that both *atta* and *maida* may be considered low-extraction flours, there is no need to specify differing iron compounds for the fortification of *atta* compared to *maida*. As a result, the supply chain details below do not distinguish between *atta* or *maida* production by mills.

Market-share of whole-wheat brown *atta* in the retail market is minimal – millers report that the value of wheat bran per kg for animal feed is greater than retail price for whole-wheat flour, so there is little advantage to marketing brown *atta* rather than selling the bran for feed.

Wheat supply
Wheat flour in Bangladesh is milled locally from imported wheat grain; wheat *flour* is not typically imported. Approximately 87% of the wheat grain available in Bangladesh is imported. All of the imported wheat is utilized by large wheat flour millers; however, between FAO and USDA, there is some conflicting information whether any wheat is used for feed grain in Bangladesh. According to FAO 2017, 1.337 MMT of wheat was used for feed – considering this exceeds the amount grown domestically in Bangladesh, this would mean that imported wheat is also used for feed. However, the USDA 2019 Grain and Feed Annual[14] does not report any use of wheat for Bangladesh's growing animal feed requirements – instead, corn is reported as the primary grain used for feed grain. The wheat supply estimates in

[14] USDA 2019 Grain and Feed Annual. Available at: https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Grain%20and%20Feed%20Annual_Dhaka_Bangladesh_4-2-2019.pdf

Table 5 assumes that USDA's interpretation is correct and wheat is only used for human consumption purposes[15].

An estimated 7.2 MMT of wheat grain is available in Bangladesh from both domestic and imported sources, which can be translated into 4.8 MMT of wheat flour.

Table 5: Wheat supply estimates

FAO 2017 Food Balance Sheets	**Metric tonnes**
Domestic wheat grain	
Production	1,311,000
Seed	-49,000
Losses	-303,000
Total wheat grain supply	959,000
Wheat flour (80% extraction)*	767,200
Imported wheat grain	
Imports	6,254,000
Wheat flour (65% extraction)	4,065,100
Total wheat grain supply (domestic + imported)	**7,213,000**
Total wheat flour supply (domestic + imported)	**4,832,300**

*An average extraction of 80% is applied; most domestic production is expected to be self-consumption by farmers taking their harvest to local stone-grinding mills. These mills will produce 100% extraction wheat flour. However, some local production will be sold to mills that will produce lower extraction wheat flour.

Wheat flour milling

As shown in Table 5, total estimated wheat flour produced in Bangladesh is 4.8 MMT. Wheat flour mills in Bangladesh are categorized by their installed wheat grain milling capacity: ≥500 MT/day, 100-500 MT/day, and <100 MT/day.

Many of the large mills are part of large conglomerates, wheat flour milling being a subsidiary activity. These mills produce flour for retail, bulk use by food processing companies, and their own internal food processing subsidiaries, such as for biscuit and/or noodle manufacturing.

According to milling stakeholder interviews, imported wheat is the primary source of grain for commercial wheat flour mills. Locally grown grain is primarily used by stone-grinding mills, with a limited amount entering commercial milling streams.

≥500 MT/day mills

Of the six mills in the ≥500 MT/day category (Table 6), Bashundara is the largest mill, operating two milling lines with a combined 3,150 MT/day milling capacity, with plans for a third in 2020 with 2,000 MT/day capacity; after planned installations, Bashundara's total milling capacity will be 5,150 MT/day. However, the current second largest milling company, CityGroup, has planned investments that, when completed, will make it the largest milling company at 5,350 MT/day. When finished, planned installations across the entire milling industry will almost double the milling capacity in Bangladesh in 1-2 years. As of FFI's mission trip, the current installed

[15] Another interpretation could be that the 1.337 MMT for feed use refers to wheat *bran*, which is a byproduct of wheat flour milling and indeed likely used for feed. If that is the case, then applying the extractions to wheat flour milling already take into account the bran losses that ultimately directed towards feed use.

milling capacity in Bangladesh is 2.6 MMT/year; with the mills running at 90% utilization and producing flour typically at 65% extraction, six of the largest mills in the country produce 1.5 MMT, or 32% of the milled flour in the country.

After installation of the planned milling units and assuming these future milling lines will also run at 90% utilization, the largest mills will produce 2.87 MMT, or 60% of the milled flour in the country, with capacity to mill a maximum of 66% of the country's total flour (100% utilization).

Of these large mills, CityGroup has five PesaMills™ by Bühler Group installed, for a total whole-wheat *atta* production capacity of 214,500 MT/year (running 24 hrs/day for 330 days). However, CityGroup may only be operating these mills at 25% capacity (~54,000 MT). Like standard roller flour mills, PesaMills™ can produce standard bakery flours and *atta* flours of various extraction rate. However, unlike other roller flour mills, PesaMills™ are also able to produce whole-wheat flour with similar specifications as stone-ground flour (a key difference being differing starch damage) Without a PesaMill™, large-scale production of stone-ground *atta* flour is only possible through banked stone-grinding mill lines.

*Table 6: ≥500 metric tonnes per day installed milling capacity**

Milling company	**MT/d**	**Pending installation**	**Total (including pending)**
Bashundara	3,150	2,000	5,150
CityGroup	1,350	4,000	5,350
Akij	1,200	0	1,200
Meghna	1,310	0	1,310
TK	900	0	900
Baishaki	0	1,000	1,000
Total installed capacity (MT/d)	7,910	7,000	14,910
Total installed capacity (MT/yr)	2,610,300	2,310,000	4,920,300
90% utilization (MT/yr)	2,349,270	2,079,000	4,428,270
Total wheat flour, 65% extraction (MT/yr)	1,527,026	1,351,350	**2,878,376**

Utilization assumptions: at this size, mills are engineered to run 24 hours/day; 90% utilization was reported by milling companies, indicating that mills may operate slightly less than 24 hours/day. To account for repairs, maintenance, and other non-operational time, a year's operation is considered 330 days.

100-500 MT/day mills

A second tier of nine large mills fall into 100-500 MT/day installed milling capacity (Table 6). None of these mills report any planned pending installations – signaling that the wheat flour milling industry's growth is primarily within reach of conglomerate companies with the resources to invest in state-of-the-art milling infrastructure. Most mills are operating at 90% utilization and producing flour with an average 65% extraction - these mills produce about 659,340 MT of flour a year, or 9% of the total wheat flour supply in Bangladesh.

Figure 4: Flow chart of flour supply, milling, and use in Bangladesh

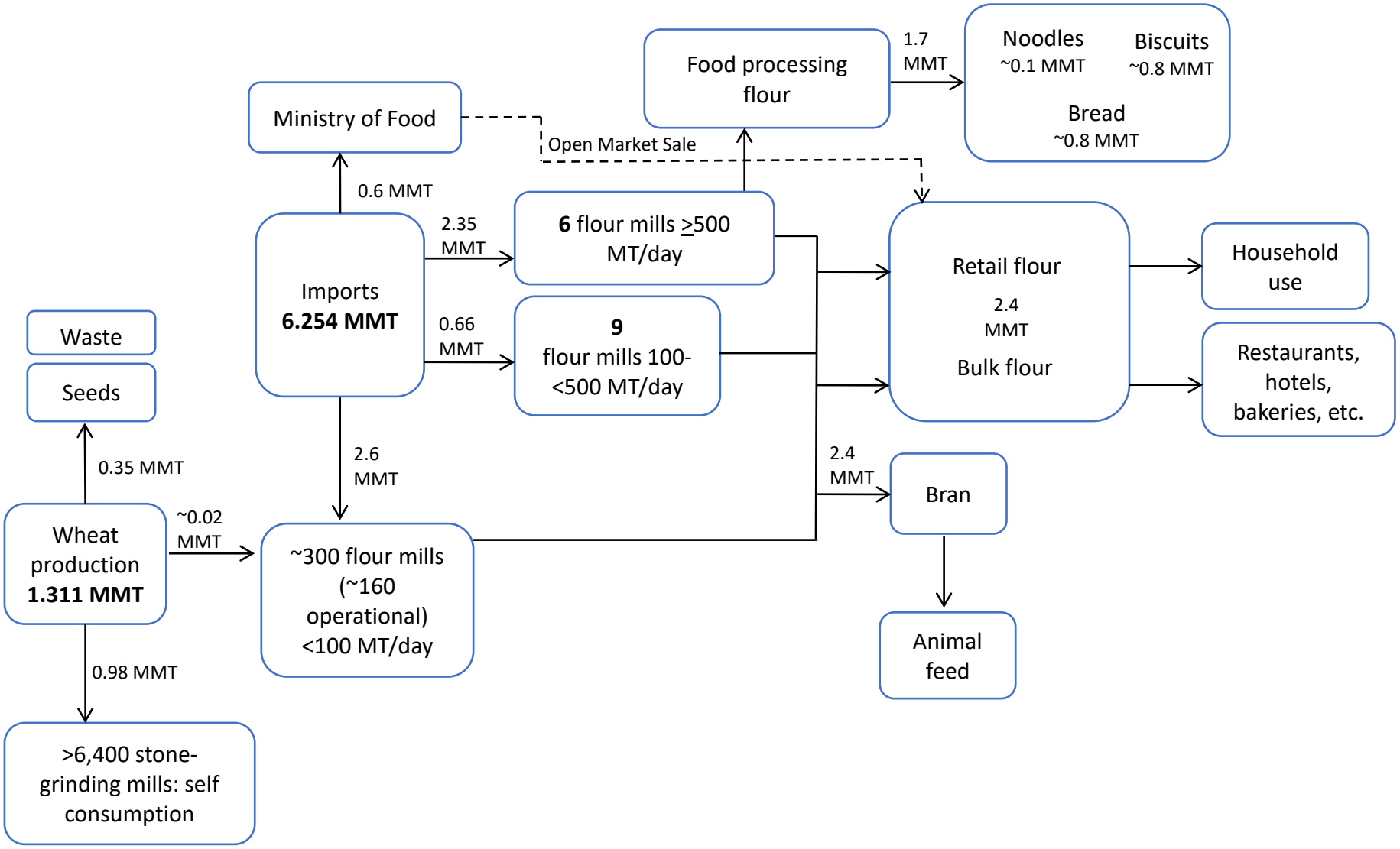


Table 7: 100-<500 metric tonnes per day installed milling capacity

Milling company	MT/d	Pending installation
FM flour mills	320	0
Joy flour mills	200	0
VIP flour mills	180	0
Bestgarden	220	0
Sena Kalyan	300	0
ACI	300	0
Nurjahan (currently leased by ACI)	250	0
IFAD	150	0
Shajib	300	0
Total installed capacity (MT/d)	2,220	N/A
Total installed capacity (MT/yr)		**732,600**
90% utilization (MT/yr)		659,340
Total wheat flour, 65% extraction (MT/yr)		**428,571**

<100 MT/day mills

Approximately 300 remaining mills are classified as <100 MT/day, although reportedly only 160 of these mills are still operating. While larger mills have a clear understanding of their competitors (capacity, utilization, etc.), based on FFI's mission trip to two mills in Rajshahi and Mymensingh, smaller regional mills in this category have limited knowledge outside their market regions. Outside of surveying all 300 mills, it was not possible to obtain concrete numbers for this category's average milling capacity or utilization; however, if these mills process the remainder of the imported wheat grain available in Bangladesh that is not milled by large mills, then these mills produce 2.1 MMT of flour, or 44% of the flour available in Bangladesh. This may reduce to ~8% if the pending industrial milling capacity absorbs the activities of these smaller industrial mills.

A premix dosifier of the capacity required for these mills may cost approximately 3,000 USD. Dosifiers are available domestically as well as imported from India.

100 kg/hour village stone-grinding mills

The domestically produced flour is milled by village stone-grinding mills, for farmers who grow wheat for their own consumption. A typical stone-grinding mill can process 100 kg of wheat grain per hour. If a stone-grinding mill of this size runs for 4 hours a day, 300 days a year (approximately 150 days), then one mill may produce 120 MT of flour in one year (100% extraction). If 100% of the flour domestically produced is milled by village stone-grinding mills, then there may be at least 6,400 village stone-grinding mills, accounting for 16% of the flour produced in Bangladesh. If assuming 2-3 mills per village in the wheat-producing divisions of Rajshahi (14,079 villages) and Rangpur (9,050 villages), then the number of stone-grinding mills may be as much as 46,000.

Quality control and assurance practices

Almost all of the largest wheat flour mills (>500 MT/day) have in-house laboratories, with capacity to test the full suite of typical wheat grain and flour parameters (e.g. moisture, ash, gluten content) used to differentiate various wheat flours. Most mills in the 100-500 MT/day

category are able to assess gluten content, which serves as their basis for distinguishing between *atta* and *maida* flours, and can conduct analyses for their flour's wheat origins. Other parameters are sent to third parties for analysis.

Mills of <100 MT/day capacity typically do not have in-house testing capacity for wheat and flour parameters. These mills rely on analyses from third parties for quality control of their products.

Total industrially milled flour

Combining all mills with capacity over 100 MT/day, there are 15 milling companies with total milling capacity of 3.3 MMT; after planned installations, this will rise to 5.4 MMT, or at maximum, 78% of the wheat supply in Bangladesh. The roughly 2 MMT increase in milling capacity in the country (consolidated in the ≥500 MT/day category mills) will likely reduce even further the number of <100 MT/day mills operating. Given that all flour milled by stone-grinding mills is unlikely to shift to industrial milling, and depending on the number and operations of the remaining <100 MT size mills, potentially a remaining ~16%-24% of the wheat flour supply will likely remain out of reach for large-scale mandatory fortification. While technically feasible to fortify, past experiences with stone-grinding-mill fortification in India have been logistically challenging to maintain over the long-term[16],[17].

Wheat flour use

Of the 4.8 MMT of flour produced in Bangladesh, approximately 1.7 MMT (35%) is used in the food processing industry to manufacture wheat flour foods, such as biscuits/crackers (~0.8 MMT), breads (~0.8 MMT), and noodles (~0.1 MMT).

There are an estimated 5,000 bakeries and wheat flour food manufacturers, of these only 100 are considered "automated manufacturers"[18].

Commercial bread production

The majority (85%) of flour used for breadmaking (including buns and cakes) is used by small and medium enterprises; only approximately 15% (~100,000) is used by a small number of large-scale commercial producers. Of these, Pran is the market leader in bread production, with 80% of the market share of large-scale commercial producers.

Commercial biscuit production

The top biscuit manufacturers and their market share are listed in Table 7, while multiple sources list Olympic as the market leader, sources differ according to the size of its market-share and those of its competitors. 54% of biscuit factories are located in the Dhaka division, followed by 15% in Chittagong[21], suggesting that the biscuit market primarily serves urban consumers.

[16] Institute of Health Management Research, Jaipur. Rapid Assessment of Promotion of Fortification of Wheat Flour through Small Millers in Sarada and Salumber Blocks of Udaipur District. March 2014.
[17] World Food Programme. Report Of The Village Level Wheat Flour Fortification Project
[18] EBL Securities Ltd. Equity Note on Olympic Industries Limited. July 2017. http://www.eblsecurities.com/AM_Resources/AM_ResearchReports/EquityReport/Equity%20Note%20on%20Olympic%20Industries%20Limited.pdf

Table 8: Bangladesh biscuit manufacturers[18,19,20,21]

Company	Market share
Olympic	16%-30%
Al-Amin	5%-10%
Pran	6%-8%
Nabisco	5%-8%
Globe	<5%
Danish	<5%
Haque	<5%
Romania	<5%
New Olympia	<5%

Commercial noodle production

At this time, a relatively minor share of the domestically milled wheat flour is used for (instant) noodle production (100,000 MT). Of the 24 noodle manufacturing companies in Bangladesh[22], Nestle (Maggi brand) and Pran (Mr. Noodles brand) are the market leaders in instant noodle manufacturing, with 28% and 22% respectively; the remainder of the market is composed of small producers (22%), Cocola (20%), Chopstick (4%) and Kolson (4%)[23]. Nepalese brand Wai Wai also plans to launch a noodle processing plant in Bangladesh[24].

[19] Noyon, AU. The Business Standard. Munching on the cookies. September 3, 2019. https://tbsnews.net/economy/munching-cookies

[20] Lightcastle Analytics Wing. Biscuits and Confectioneries Industry of Bangladesh. April 10, 2019. https://www.lightcastlebd.com/insights/2019/04/10/biscuits-and-confectioneries-industry-of-bangladesh

[21] Assessment And Sector Mapping On The Biscuit Manufacturing Industry In Bangladesh. https://www.inclusivebusiness.net/ib-voices/assessment-and-sector-mapping-biscuit-manufacturing-industry-bangladesh

[22] Jitpleecheep, P. Bangkok Post. Making Mama instant everywhere. January 4, 2018. https://www.bangkokpost.com/business/1390034/making-mama-instant-everywhere

[23] Habib, A. The Daily Star. Nation of noodle lovers. January 15, 2020. https://www.thedailystar.net/business/news/nation-noodle-lovers-1854271

[24] CG Foods (BD) Ltd. https://www.multimodebd.com/company/cg-foods-bd-ltd

Regulatory monitoring

Regulatory monitoring of fortified food ensures that food fortification is safe, nutritionally effective, and fair for the food industry complying with fortification requirements. Clear identification of government actors, responsibilities, and processes are necessary for implementation of regulatory monitoring activities. However, for *sustainable* regulatory monitoring, activities related to food fortification should be integrated into an existing food control system, which should already be in place to focus on food safety activities.

This section aims to assess the current regulatory monitoring system against four key categories and the degree to which wheat flour fortification monitoring could be implemented within this existing system:

1. Policy and Legislation
2. Food Control Framework
3. Resources and Support Services
4. Stakeholder Liaison and Information Services.

Policy and Legislation

There are currently three ministries (Ministry of Industry (MOI), Ministry of Health and Family Welfare (MOHFW), and Ministry of Food (MOF)) that have relevant responsibilities for the monitoring of foods, either through inspection mandates and/or laboratory testing of samples. The three main agencies responsible for food control under these ministries are in Figure 5. Agency and institution mandates at production, import, and market levels is described in Table 8. The various institutions and agencies involved in food control within each of these ministries has been established through a number of laws and ordinances.

Figure 5: Government authorities involved in regulatory monitoring of food fortification and relevant available resources.

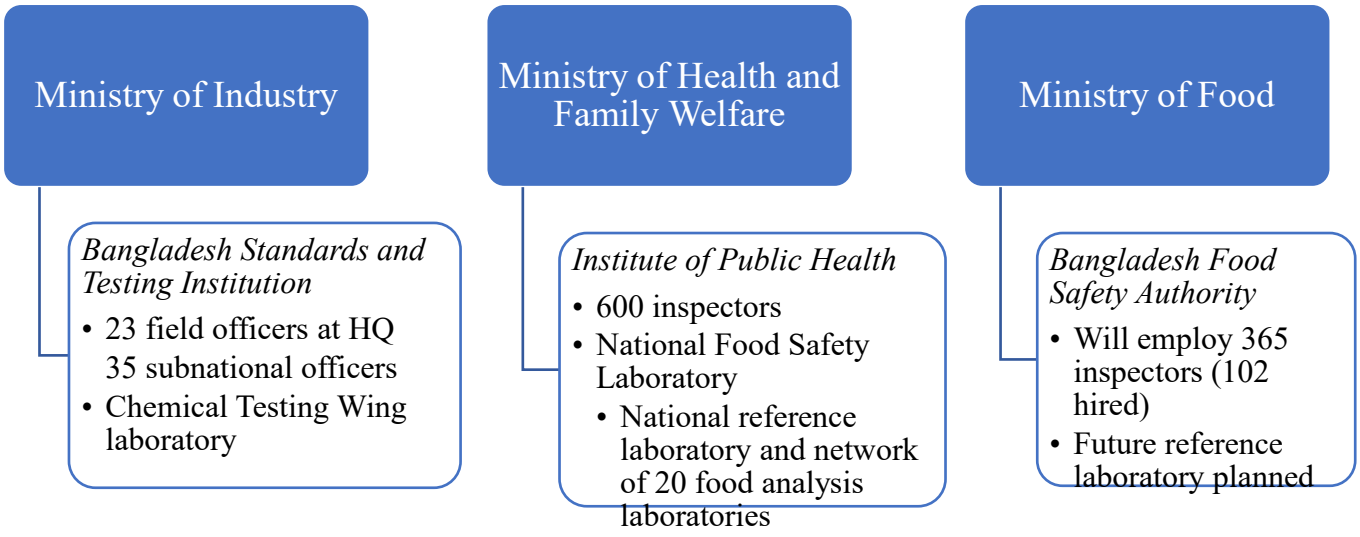


Table 9: Agencies and institutions involved in food control, by point of regulatory action.

	Production	Import	Market
BSTI	• Development of standards (mandatory / voluntary) • License to use BSTI mark • Ongoing certification (surveillance inspections) • Laboratory - specific to parameters in standards	• Development of standards (specific to import requirements) • License to import with BSTI mark • Clearance prior to customs • Laboratory - specific to parameters in standards	• Development of standards (specific to import requirements) • Ongoing certification (surveillance inspections) • Laboratory - specific to parameters in standards
BFSA	• Shared sentry inspectors – ongoing surveillance • Future reference laboratory	• Shared sentry inspectors – ongoing surveillance • Future reference laboratory	• Shared sentry inspectors – ongoing surveillance • Future reference laboratory
IPH	• Shared sentry inspectors – ongoing surveillance • Laboratory – many food safety and quality parameters	N/A	• Shared sentry inspectors – ongoing surveillance • Laboratory – many food safety and quality parameters
IFST	• Laboratory – many food safety and quality parameters; current country reference laboratory	• Laboratory – many food safety and quality parameters; current country reference laboratory	• Laboratory – many food safety and quality parameters; current country reference laboratory
NBR	N/A	• Sets import tariff / tax rates	N/A
Bangladesh Bank	N/A	Collects import tariffs and taxes	N/A
DG NCRP			• Collects consumer complaints and conducts investigations

BFSA, Bangladesh Food Safety Authority; BSTI, Bangladesh Standards and Testing Institute; DG NCRP, Directorate General of National Consumer Rights Protection; IFST, Institute of Food Science and Technology; IPH, Institute of Public Health; NBR, National Board of Revenue.

Ministry of Health and Family Welfare

The Bangladesh Pure Food Ordinance No. LXVIII of 1959[25], revised most recently in the Bangladesh Pure Food (Amendment) Act No. XXVII of 2005, provides for the creation of a National Food Safety Advisory Council, chaired by the Ministry of Local Government, Rural Development, and Co-operatives, and including participation by 10 Ministries, among other key stakeholders across academia, the Dhaka Deputy Commissioner, and Chamber of Commerce. Through this Council, the MOHFW has been provided the major responsibility for the enforcement of food control legislation to ensure safe food. This includes monitoring food quality and safety, including collection and testing of food samples and inspection of food manufacturing and selling premises. The Bangladesh Pure Food Rules of 1967 has generic standards for 107 food products, including wheat flour, which are enforceable.

The Institute of Public Health (IPH, under MOHFW) was established to have the authority to take food samples at both production and market level in order to test for food and water safety concerns, including contamination, adulteration, and environmental health hazards.

Ministry of Industry

The Bangladesh Standards and Testing Institute (BSTI, under MOI) was established through the BSTI Ordinance No. XXXVII of 1985, revised in 2018[26]. This ordinance provides BSTI the mandate to control standardization, testing, metrology, quality control, grading, and marking of goods, including foods for import/export and domestic consumption, with the BSTI certification mark.

There are 600+ standards within the BSTI system, 181 of these are considered mandatory (76 for agricultural and food products). Of the 76 mandatory standards, 23 of them (asterisked below in Table 9) are also brought under mandatory certification for imports before clearing customs. 21 food products are also provided a certificate of authentication (CoA) from BSTI for the purposes of export to India (including noodles, instant noodles, and biscuits).

Table 10: BSTI standards for wheat, wheat flours, wheat flour-based foods, and other fortified staple foods

Standard for wheat	**Standards for fortified fats or oils**
BDS 1237:1989 – Grades of Wheat	*BDS 1769:2014 (1st Revision) – Fortified Soybean Oil
	BDS 1770:2014 (1st Revision) – Fortified Edible Palm Oil
Standards for wheat flours	
BDS 381:2007 (3rd Revision) – Wheat Maida	*BDS 1773:2016 (1st Revision) – Fortified Edible Sunflower Oil
BDS 380:2007 (2nd Revision) – Wheat Atta	BDS 1774:2006 + Amendment 1:2014 – Fortified Palm Oil
BDS 1793:2008 – Fortified Wheat Atta	BDS 1886:2014 – Fortified Edible Rice Bran Oil

[25] Government of the People's Republic of Bangladesh. The Pure Food Ordinance, 1959 (East Pakistan Ordinance No. LXVIII of 1959). 14th October, 1959.
[26] Government of the People's Republic of Bangladesh. The Bangladesh Standards and Testing Institution Ordinance, 1985 (Ordinance No. XXXVII of 1985). 25th July, 1985.

BDS 1794:2008 – Fortified Maida	BDS 1772:2006 – Fortified banaspati (ghee)
BDS 1225:2002 – Wheat flour for use by bread industry	BDS 1771:2006 – Fortified Mustard Oil
BDS 1546:1996 – Wheat flour for use by cake industry	
BDS 1168:2002 – Wheat flour for use by biscuit industry	
Standards for wheat products	**Standards for other fortified foods**
*BDS 383:2001 (2nd Revision) – Biscuits	BDS 1236:2001 (1st Revision) + Amendment 1:2007 – Iodized salt
BDS 384:2017 (2nd Revision) – Macaroni, Spaghetti, and Vermicelli	BDS 1897:2015 – Fortified rice
BDS 997:2006 (1st Revision) – Wheat Bran	
BDS 1106:2015 (2nd Revision) – Noodles	
*BDS 1552:2015 (2nd Revision) – Instant Noodles	
*BDS 1556:2017 (1st Revision) – Chips/Crackers	
BDS 1574:2012 (2nd Revision) – Cakes	
*BDS CAC 74:2007 – Processed Cereal Based Food for Infants and Young Children	
BDS 382:2016 (3rd Revision) + Amendment 1:2018 – Bread	

*Indicates a mandatory standard

Ministry of Food

The Bangladesh Food Safety Authority (BFSA, under MOF) was established by the Food Safety Act of 2013[27]. BFSA was created with the mandate to regulate, through coordination, the activities relating to food production, import, processing, stock, supply, marketing, and sales to ensure the rights toward access to safe food. Through this act, an attempt was made to repeal all former laws and acts related to food safety and consolidate food control under one agency.

Food Control Framework

How the responsibilities across the three ministries described above relate to each other (e.g. when one institution may take the primary lead) are not clear. As far as FFI was able to discern, the current activities of each agency appear to overlap each agency's regulatory mandate, rather than complement. This section will describe the institutional framework and modes of operating within each of the Ministries.

Ministry of Industry

Where it relates to fortified foods specifically, BSTI currently plays the largest role in activities related to regulatory monitoring. Many other agencies are involved in inspection and food testing activities, though this role has been primarily relegated to monitoring and enforcement of food

[27] Government of the People's Republic of Bangladesh. Ministry of Food. The Food Safety Act, 2013 (Act No. 43 of 2013). 10th October, 2013

safety parameters, rather than any fortification-related parameters. This may change in the future when the BFSA matures in its role as the lead agency for food safety, which was described as a new Prime Minister directed initiative to consolidate food control activities.

BSTI is organized into several wings. As relevant for food fortification, BSTI develops food standards through its Standards Wing; its Certification & Marks Wing carries out licensing of businesses intending to produce foods bearing the BSTI logo, and its Chemical Testing Wing conducts the sample testing of foods with the BSTI logo.

BSTI's mandate for quality control of foods comes through the use of the BSTI logo, which is intended to confer to the consumer a degree of quality and/or trust in the product. BSTI develops both mandatory and voluntary standards for a number of product categories, including food. Foods (and other products) that fall under a mandatory standard are required to carry the BSTI logo and thus go through the certification and licensing process to legally be able to use said logo. For foods produced under voluntary standards, it is up to the producer whether to apply for BSTI licensing in order to use the logo for marketing purposes. Producers may choose to follow voluntary standards but not apply for a license or use the logo, or also choose not to use the voluntary standards at all. The current wheat flour fortification standards are voluntary and no wheat flour producers have ever applied to use the BSTI logo.

An overview of the broad process to propose a new standard:

1. Make an application to BSTI with justification. After approval by the relevant committee, a draft is prepared and reviewed by various technical/sectional committees, then passed to the BSTI Secretariat for editing and circulation for comments.
2. The standard is posted for a 60-day comment period; after comments are incorporated into the draft, then it is approved and published in the National Gazette.
3. All standards are intended for review at least every 5 years; however in practice they may not be reviewed this frequently.

The process to make an existing voluntary standard mandatory is shown in Figure 6. The responsible committee from the standards wing is considered the "Highest committee" and includes representatives from multiple ministries, Chamber of Commerce, Police, and Media. Justification for why the standard should be mandatory should be included. The process generally takes 6+ months.

After the initial business license is granted through an application and a series of inspections and sample tests of a product (Figure 8), on-going BSTI monitoring activities include a license renewal application every 3 years and a review of product quality every 6 months (Figure 7). The product quality review is conducted at either the factory or market levels and includes product sampling and testing.

Ministry of Health and Family Welfare

Similar to BSTI, the IPH also has an inspectorate with a mandate to analyze food, primarily for food safety and contamination parameters, rather than for food quality parameters such as micronutrient content. IPH inspectors generally take samples and analyze foods from both marketplaces and production facilities and use the generic standards in the Pure Foods Ordinance to evaluate compliance. It is unclear how the National Food Safety Laboratories will operate

after BFSA has taken over its food safety mandate, e.g. whether the laboratories will continue to operate under MoHFW or transfer to MoF.

Ministry of Food

Whereas currently food regulatory activities are conducted by IPH (MoHFW) as well as BSTI (MoI), the Prime Minister's directive to the three Ministries was that all food-related regulatory activities (standards development, monitoring, certification, and laboratory testing) should be consolidated with BFSA under the MoF by 2030. Although it was established five years ago, BFSA is still very much in the beginning stages of its development – on FFI's mission trip, the Authority had very few staff and no procedural documentation (e.g. protocols) that could be used in monitoring. As a result, while BFSA currently holds the mandate for food regulatory activities (which should also include the enforcement of food fortification regulations), in practice it will be several more years before BFSA is equipped to carry out their mandate. BFSA acknowledged that there is a shift underway, allowing IPH and BSTI to continue their existing activities while any new activities are brought under BFSA. Neither IPH nor BSTI indicated that they were planning to transition any activities (current or new) to BFSA.

Resources and Support Services

Sufficient human, financial, infrastructure, and analytical/laboratory resources are necessary to monitor food fortification standards and relevant food control legislation. This section will describe such resources available within each of the three aforementioned Ministries.

Ministry of Industry

The BSTI Certification & Marks Wing employs 23 field officers at their HQ in Dhaka and 35 sub-national field officers spread across the country's additional 11 BSTI offices. These officers are responsible for the full licensing and inspection processes for all products falling under BSTI's 600+ standards.

In FY 2018-2019, BSTI granted 233 new licenses and renewed 3,089 licenses. 520 were rejected. 2,047 investigations were made on non-compliance (346 w/ Mobile Courts, the rest with the BSTI surveillance team). Of these, 1,201 were brought forth as cases (395 w/ Mobile Courts) and 505 of these were deposed (395 w/ Mobile Courts). 42.9M Tk (505,500 USD) was collected in fines/punishments.

727.53M Tk (8,573,228) was collected in revenue throughout the licensing process. Fees are collected during licensing for the following activities:

- 1,000 Tk for a new application or 500 Tk for application renewal.
- For each year that the license is active, a 200 Tk License fee/year
- 0.1% of factory price for items (1,875 to 1.5M Tk)
- Testing fees

Beyond the certification/licensing process, samples are also sent to BSTI from government/industry and police department/mobile courts in connect with arbitration on disputes of quality.

The BSTI Chemical Testing Wing is responsible for testing fortified food samples collected during inspections. Although the Wing has the equipment necessary to test vitamin and mineral content (AAS, HPLC), the reagents and training would be necessary to capacitate the lab fully for food testing related to various vitamins and minerals in fortified wheat flour. The Wing is already familiar with iCheck Chroma for vitamin A testing in fortified edible oil. In terms of human resources, there are 25 lab analysts, primarily situated in Dhaka. It is not clear whether any additional human resources would be required to add the testing of fortified wheat flour to the responsibilities of the existing analysts, or how this activity may overlap with the responsibilities of the National Food Safety Laboratories under the Institute of Public Health (IPH).

Ministry of Health and Family Welfare

The IPH currently employs 600 food inspectors. IPH also operates a National Food Safety Laboratory, considered the National Reference Laboratory. This laboratory includes a network of 20 food analysis labs all over the country. Although this laboratory has not conducted any testing on fortified foods for micronutrient content, they claim to have the necessary equipment to do so.

In addition to its regulatory monitoring responsibilities, IPH also supports a "diploma in sentry inspectorship" through seven universities in Bangladesh, as well as an undergraduate degree in food safety.

Ministry of Food

Within the BFSA, a total of 365 food safety officers have been approved for hire; of these, 105 have been hired already at the district level. Activities thus far include managing the #333 hotline for consumer reporting of food safety violations as well as the initiation of food safety inspections at the retail level (e.g. restaurants, hotels).

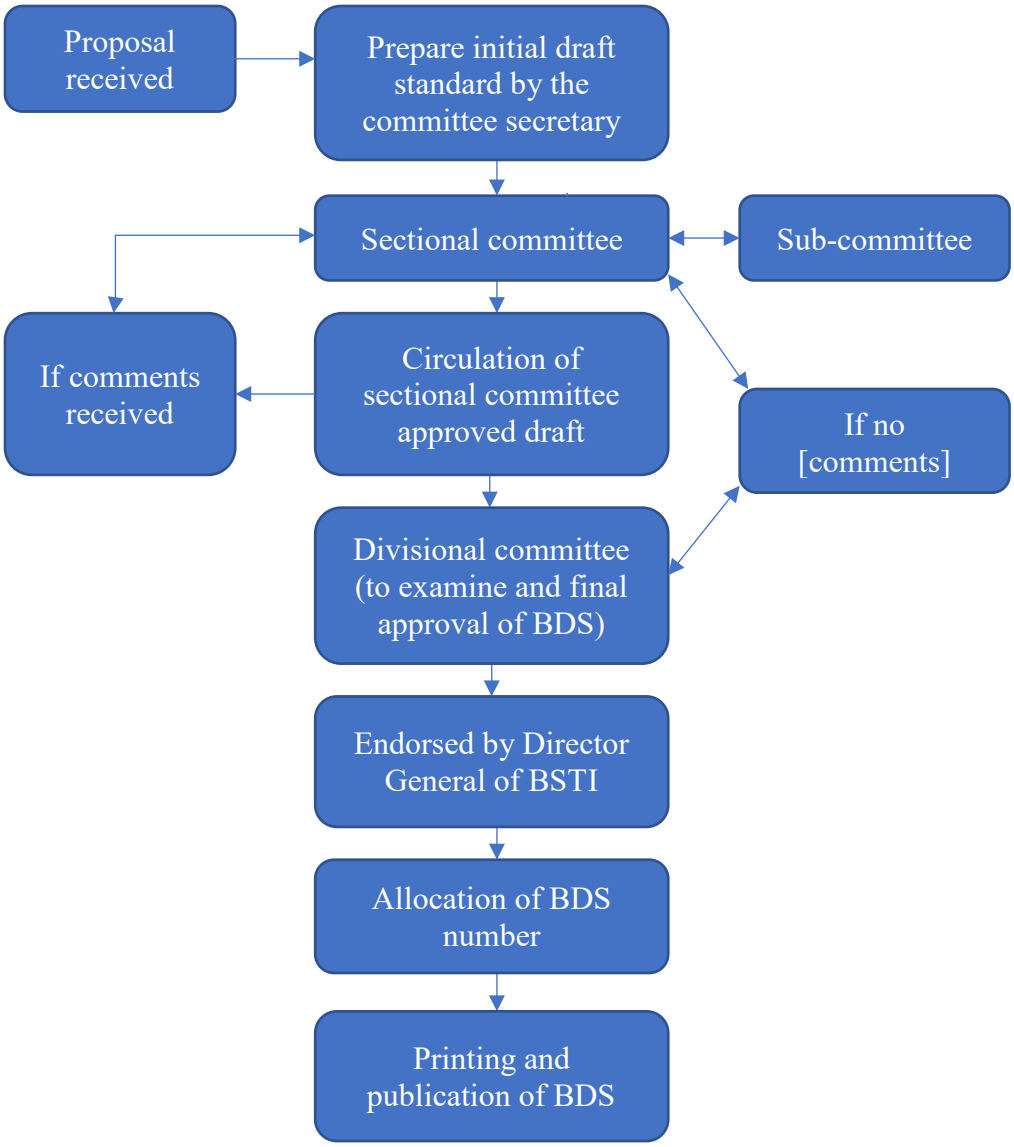
A construction site for a future joint reference lab with the Institute of Food Science and Technology (under the Bangladesh Council of Scientific and Industrial Research) has been secured. Currently, mobile labs are shared with FAO for metal and microbiological testing.

Other Ministries

The Institute of Food Science and Technology (Bangladesh Council of Scientific Industrial Research) operates 3 regional laboratories and is the government agency responsible for providing laboratory technical support and services to food industry and government. They have provided technical training to the food industry, tested raw materials for high-energy biscuits distributed by the World Food Programme, work with BSTI on the preparation of food standards, and develop testing methodologies and validation studies. For wheat in particular they are able to test for contaminants such as aflatoxin, heavy metals, and quality parameters such as protein levels.

IFST has had limited experience testing vitamin and mineral content in foods, but have tested iron and vitamin A content in WFP high-energy biscuits in the past. They operate on a fee for service model and estimate that the cost for vitamin A analysis is 6,500 Tk (76 USD) and 2,000 Tk (23 USD) for iron. In terms of throughput, the lab can test approximately 100-300 samples per month on around 29 parameters.

Figure 6: Flow chart for the development of Bangladesh Standards (BDS)



Reproduced from BSTI Annual Report 2019-2020

*Figure 7: Flow chart of certification marks (CM) license activities for the **products** brought under mandatory certification*

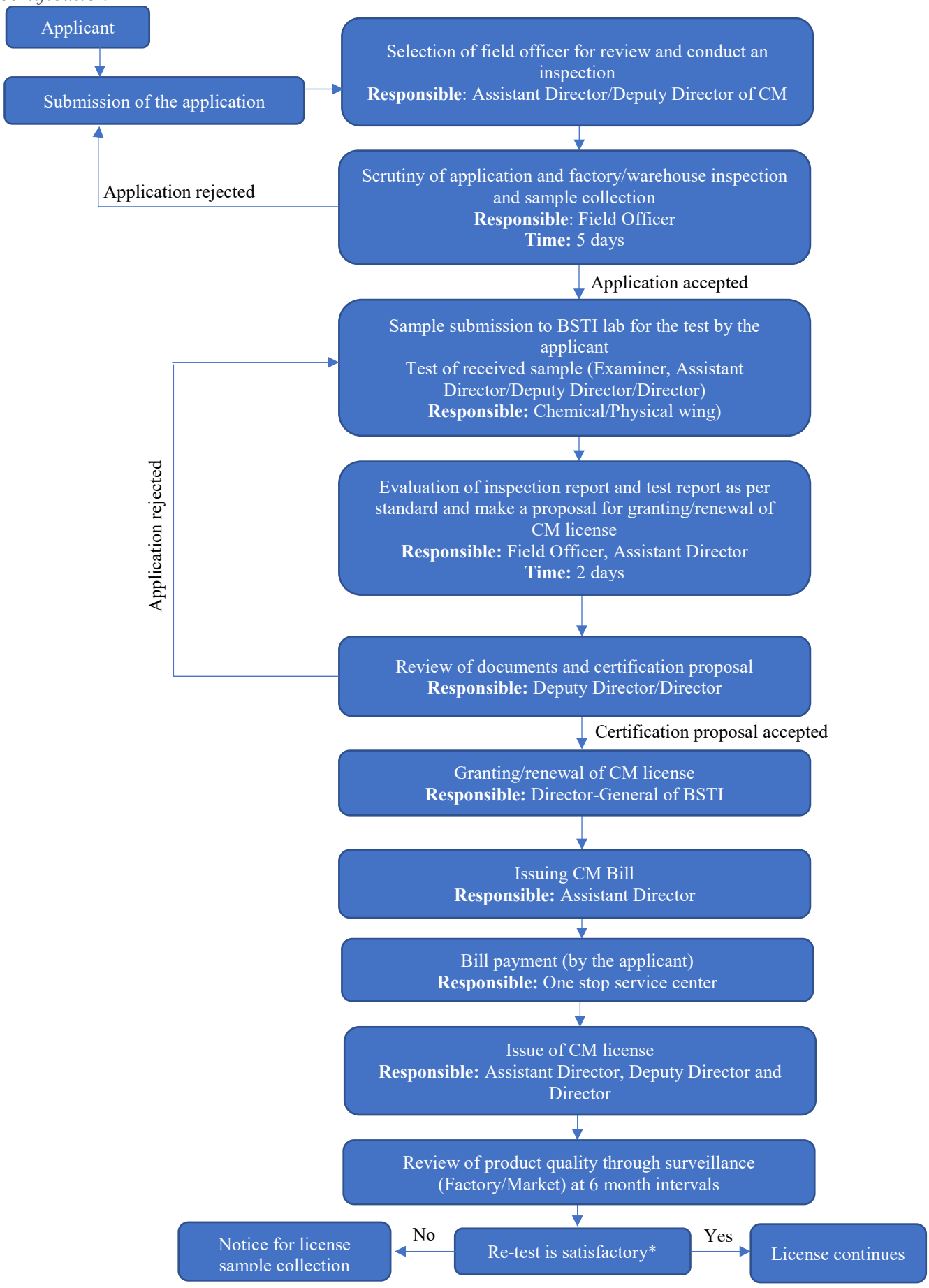
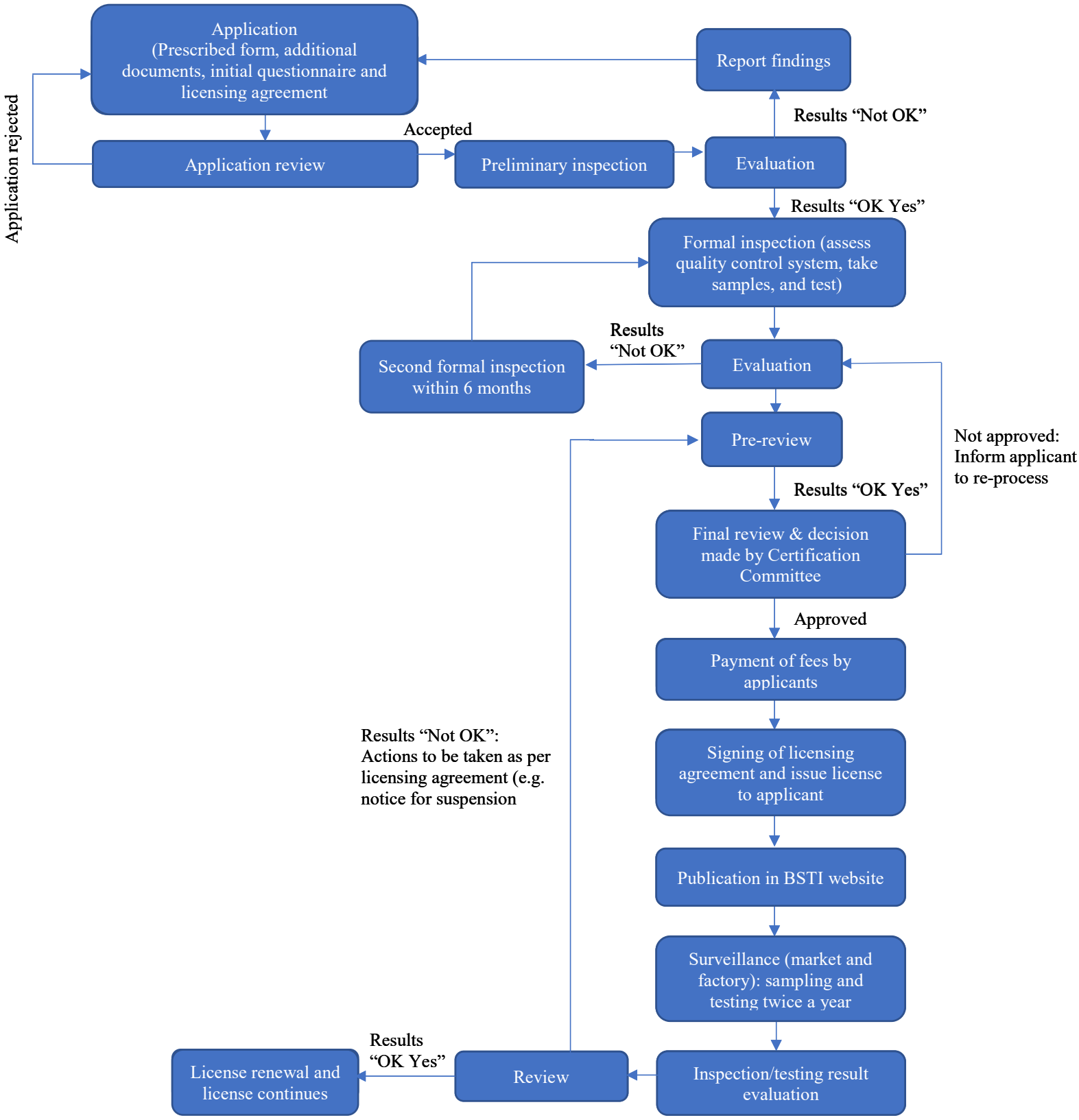


Figure 8: Process flow chart of granting a Certificate Marks certification



Reproduced from BSTI Annual Report 2019-2020

Stakeholder Liaison and Information Services

Overall, based on the FFI assessment of the regulatory monitoring system currently in place encompassing the three Ministries, all seem to have a strained relationship with the private sector as it relates to food control generally. There is a common perception worldwide that regulators are mandated to monitor and enforce, normally with emphasis on the latter action. There are restrictions (either legally or a personal interpretation of the law) on supporting and assisting industry to comply, and even where there are no such restrictions, regulators often do not feel as though they are trained and competent to advise industry in food control areas. This is especially true for fortification, which is relatively newer as an industrial practice.

In the case of Bangladesh, personal communication with regulators and industry suggest that the regulators are viewed as pedantic and looking for faults while the industry is viewed as trying to cut corners and put the public at risk. These perceptions result from industry and regulators not actually understanding each other's actions and the reasoning behind them. Thus, a key recommendation, not just for establishing wheat flour fortification, but generally, is to ensure inspectors spend significant time in a few industry facilities working more hands-on with the fortification process. This will help to build trusting relationships between regulators and industry while furthering each other's understanding and empathy with the knowledge, practices, and limitations of the other.

Additionally, until BFSA moves more confidently into its mandate to coordinate and implement all aspects of food control, greater coordination and communication is critical between the various ministries and government stakeholders working in regulatory monitoring of foods (all foods, not just fortified foods). This will serve to reduce overlap and more efficiently utilize the limited resources available.

Overall Assessment of Regulatory Monitoring System

Overall, the assessment of Bangladesh's regulatory monitoring system revealed that there are current processes in place and in use, primarily within BSTI, for fortification of edible oil. For these same processes to be used for fortified wheat flour, the BSTI standards for fortified wheat flour need to become mandatory, which triggers the described processes and action. It is important to note that these processes form what the authors would consider a "certification" process (indeed, falling under BSTI's Certification and Marks Wing), rather than what would be recommended from a *monitoring* standpoint. However, the end result appears to achieve the same objective: in the case of edible oil, ensuring that all manufacturers are certified (benchmarked against a set of food safety, food quality, and hygiene standards) to produce and a large proportion (61%[28]) of edible oil production that is packaged and labeled with the BSTI quality mark is actually fortified.

That said, there is a general lack of capacity within institutional inspectorates (BSTI, BFSA, and others) as well as within laboratories. The large number of products (both food and non-food) that require inspections means that inspectors must move quickly through their checklists and

[28] Global Alliance for Improved Nutrition (GAIN) and International Centre for Diarrheal Diseases and Research, Bangladesh (icddr,b). Assessment of presence of edible oil brands in Bangladesh and their content of fortification, 2017. Switzerland. 2017.

may not be able to afford the time for critical thinking and problem-solving alongside industry when discrepancies or non-compliance are found. Considering the current overlaps between BSTI, BFSA, and IPH mandates, it may be a worthwhile for an inter-Ministry collaborative agreement to streamline inspections, reducing inefficiencies and collaborating/sharing inspectors where possible.

There is a strong emphasis on food testing as the ultimate decision tool for non-compliance; however, this approach is ill-advised for fortification regulatory purposes, even with a highly capacitated laboratory infrastructure. This is primarily due to: 1) small amounts of nutrients added to fortified foods, which are difficult for laboratory tests to detect accurately; 2) heterogeneity of mixing that occurs with most fortified foods, equating to a large range of variability; and 3) critical, but often inappropriately conducted, product sampling, which is strongly tied to the reliability and confidence of laboratory test results, even if 1 and 2 can be mitigated. In the context of Bangladesh, where there exist police-deputized mobile courts for enforcement action, reliance on non-compliance fines and testing service fees to meet institutional budgetary requirements, and a strong culture against food adulteration, this overreliance on food testing provides a disabling and fear-based environment for industry to operate in, rather than one that enables success.

Building trust within the food system, between regulators, industry, and consumers, is of paramount importance to shift this culture, which will enable a more process-based approach to monitoring to take place. Trust and mutual understanding between food system stakeholders can then open the door to allow Bangladesh to start strengthening processes in alignment with the recommendations in the Regulatory Monitoring Policy Guidance[29] (i.e. utilizing a systems-based approach to monitoring which focuses on the process of fortification, rather than the end product (1 and 3); aligning goals of food safety, food quality, and fortification together in a single auditing package (2); and ensure steps are being taken to minimize inaccurate reporting from laboratory tests based on improvements to sampling protocols (4, 5)).

It is positive to note that BSTI has taken steps to integrate the use of a management information system tool (FortifyMIS, developed by GAIN and Project Healthy Children/FFI) for tracking, analyzing, reporting, and acting on data related to quality and compliance of fortified edible oil. Based on the experiences to date and with the ongoing roll-out of this tool, it will be possible and advisable to expand the use of this tool to other fortified foods (including wheat flour) and even other food and non-food products BSTI inspects as part of its mandate. This will help to further simplify activities, freeing time of BSTI inspectors for greater engagement with industry and reducing false-positives when it comes to identification of non-compliance.

[29] Global Alliance for Improved Nutrition (GAIN) & Project Healthy Children (PHC). 2018. Regulatory monitoring of national food fortification programs: A policy guidance document. *Global Fortification Technical Advisory Group (GF-TAG).* [https://www.fortificationdata.org/resources].

Evaluating opportunities for wheat flour fortification

Mandatory fortification

Operational feasibility

With a milling industry rapidly consolidating and established systems within BSTI for licensing and testing products that must follow mandatory standards, mandatory fortification of wheat flour produced by large industrial mills should be relatively simple to implement:

- In 1-2 years, ~68-74% of the national wheat flour supply will be processed by wheat flour mills with capacity of ≥100 MT/day.
- The number of mills that will require regulatory monitoring by BSTI (or BFSA in the future) ranges from 15-160. After pending milling capacity is installed by the largest 500+ MT/day mills and its impact on <100 MT/day size mills is realized, the number of operating mills in the market will be clearer.
    - Once it is clear how many mills will require monitoring, an assessment of whether additional inspections, audits, and sample testing are within the abilities of the current BSTI staff is necessary.
- The largest millers report already using the same kind of equipment (dosifiers) required in fortification, but to add flour improvers.
- There are clear processes in place for BSTI to grant business licenses and certification to products that must meet mandatory standards. Importantly, these processes indicate that mandatory wheat flour fortification would be integrated into the existing food control system, rather than monitored in a stand-alone system that may have more long-term sustainability challenges.

Potential coverage

The best data there is on wheat flour consumption and potential coverage of fortified wheat flour is from NMS 2011/2012[30]:

- As NMS wheat flour consumption data excludes non-consuming individuals, the average g/c/d intake of 77.9 is higher in NMS 2011/2012, compared to nationally averaged food availability data from FAO (49 g/c/d).
- Nationally, wheat flour and bread may reach up to 52.4% of non-pregnant and non-lactating women and a higher proportion of school-age children (up to 94.5%). However, this number may be overestimated if it includes non-industrially milled flour, and underestimated since it does not include other wheat-flour based foods (which likely use industrially milled flour).
- School-age children in slums and urban areas consume higher amounts of wheat flour than school-age children in rural areas, indicating that urban and slum school-age children may be greater beneficiaries of wheat flour fortification than rural children.
- Wheat flour consumption was the lowest in Dhaka and Khulna and highest in Chittagong and Rajshahi; this may reflect that bread and processed food consumption are higher in

[30] Leyvraz et al, 2015. An Assessment of the Potential Impact of Fortification of Staples and Condiments on Micronutrient Intake Young Children and Women of Reproductive Age in Bangladesh. Nutrients 2015, 7, 9960–9971

Dhaka and Khulna, whereas wheat flour used at home to prepare *rotis* is more common in the Chittagong and Rajshahi areas.

The concentration of wheat flour mills and food processing facilities within Dhaka Division, Chittagong, and a small number of other locations supports the assumption that major beneficiaries of fortified wheat flour are likely urban consumers. 36.6% of the population (59 million individuals) in Bangladesh is urban-dwelling[31].

Wheat-growing regions are also less likely to benefit from wheat flour fortification, as these populations may consume locally grown wheat and/or grow their own wheat for self-consumption. Wheat is grown in the northern and western regions of Bangladesh (e.g. Dinajpur, Rajshahi, and Rangpur); wheat production was reported by 128 *mouzas* (administrative districts) the HIES 2010 survey[12].

Potential nutrient intake through fortification

Voluntary fortification standards for *atta* and *maida* flours exist. Were these to be made mandatory and assuming 77.9 g/c/d among NPNL women, Table 3 provides the expected nutrient contribution from the standard and compares it to the expected nutrient contribution from following the WHO recommendations. Consumption of 77.9 g/c/d is an adequate consumption level to contribute additional iron, folic acid, vitamin B12, and zinc through fortification.

Voluntary fortification

Potential coverage

Voluntary fortification of wheat flour is already allowed in Bangladesh; standards for voluntary fortification of both *atta* and *maida* flours were established in 2008. Although there are voluntary standards for the quality of flour used in bread, cakes, biscuits, and various wheat grades, these standards do not include any specifications for fortification.

There is currently no fortified flour available for retail purchase. ACI Pure was the only milling company that reported producing a fortified wheat flour product in the past. Their fortified flour was launched in 2003 and sold at a 15% premium over non-fortified flour. They reported withdrawing the product after they felt a subsidized fortified *atta* product jointly launched by WFP and the government competed with their product. Given the timing, it's likely that ACI is referring to the MOST/WFP VGD fortification pilot. However, it's unclear how the MOST/WFP project (which provided fortified stone-ground *atta* to recipients previously receiving wheat grain) would have taken market-share away from ACI's product (which likely reached urban consumers purchasing a retail branded product). Additionally, the MOST/WFP project ended in 2003. Regarding potentially re-launching another fortified product, ACI Pure suggested that the Bangladesh market may be more accepting of fortified flour now than in 2003. However, the representative also indicated that if there is a government subsidized fortified product available in the marketplace, they would not be interested in competing with the government's lower-priced product.

[31] World Bank 2018. https://data.worldbank.org/indicator/SP.URB.TOTL?locations=BD

Olympic has been producing a fortified noodle product for the last year and reports minimal consumer uptake.

Given that voluntary fortification has been allowed for 12 years but no fortified flour is available in the marketplace and no producers have applied for a license under the BSTI standard, it is apparent that voluntary fortification is unlikely to lead to widespread coverage or adequate enough intake to improve public health nutrition.

Fortification of foods provided through social safety nets

Potential coverage

Wheat is distributed by the government through 13 mechanisms (unclear if all are considered social safety net programs). The distributed quantities and proportion of total government distributed wheat in recent years are in Table 10; the programs with distribution comprising more than 10% of the total wheat distributed are highlighted.

Table 11: Distribution pattern of government stocks of wheat[32],[33]

Program	July 2018-March 2019, MT (%)	July 2016-June 2017, MT (%)	July 2015-June 2016, MT (%)
4th Class Staff	0 (0)	27 (0)	0 (0)
Essential Priority	89,808 (28.3)	124,736 (19.7)	119,275 (21.6)
Freedom fighter	484 (0.2)	692 (0.1)	763 (0.1)
Gratuitous relief	0 (0)	23,635 (3.7)	10,546 (1.9)
Kabikha (Food 4 work)	3,781 (1.2)	7,163 (1.1)	42,409 (7.7)
Large Employee	9,814 (3.1)	9,281 (1.5)	8,426 (1.5)
OMS	182,193 (57.5)	301,456 (47.7)	265,069 (48.1)
Other priorities	2,673 (0.8)	3,876 (0.6)	3,635 (0.7)
Others	26,878 (8.5)	35,425 (5.6)	37,723 (6.8)
School Feeding	1,225 (0.4)	1,7271 (2.7)	14,196 (2.6)
Test Relief	0 (0)	0 (0)	0 (0)
VGD	0 (0)	158 (0)	0 (0)
VGF	0 (0)	107,950 (17.1)	1,714 (0.3)
Total*, MT	316,856 (205,956 as WF)	631,670 (410,586 as WF)	551,586 (358,531 as WF)
% of total government grain distribution	20.2%	28.2%	26.7%

MT, metric tons; OMS, Open Market Sales; VGD, vulnerable group development; WF, wheat flour.
*assuming 65% extraction
10% or more of the wheat distributed

[32] USDA, Bangladesh Grain and Annual Feed, April 2019. https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Grain%20and%20Feed%20Annual_Dhaka_Bangladesh_4-2-2019.pdf
[33] USDA, Bangladesh Grain and Annual Feed, April 2018. https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Grain%20and%20Feed%20Annual_Dhaka_Bangladesh_4-3-2018.pdf

According to a 2016 World Bank assessment of social safety net programs in Bangladesh, out of the nine largest social safety net programs, four provide food (primarily rice) as in-kind support or at a subsidized price to beneficiaries (Table 11) (although not one of the nine largest programs, the Food Friendly Program also provides rice and is listed in the table). Two of these either provide wheat (as an option under Vulnerable Group Development, VGD) or subsidize the cost of wheat flour to beneficiaries (Open Market Sales)[34]. The World Bank's report directly conflicts with the USDA data that indicates that Vulnerable Group Feeding (VGF) is the program that offers wheat flour/wheat grain as an option.

Table 12: Social safety nets in Bangladesh providing cereal grains[34,35,36]

Program, Responsible Ministry	**Benefits**	**Duration**	**Number of beneficiaries (FY 2019-20)**	**Eligibility**	**Budget allocation (FY 2019-20)**
Food for Works MoDMR	8 kg rice/day or BDT equivalent for every 7 hours/day	Unspecified	1.71 million	Monthly income <4,000 BDT and "categorically poor"*	12 billion BDT (142 million USD)
Food Friendly Program	30 kg rice/mo at 10 BDT/kg	March-April and September-November	5 million	Extreme poor families	26 billion BDT (310 million USD)
Open Market Sales MoF	5 kg rice/day (30 BDT/kg) 1 kg *atta* for 17 BDT/kg	Always available	8.94 million	Not targeted**	9.5 billion BDT (112 million USD)
Vulnerable Group Feeding MoDMR	10-20 kg rice/mo	Lean season, religious festivals, 6 months following any disaster	14.25 million	Disaster affected households	17 billion BDT (201 million USD)
Vulnerable Group Development MoWCA	30 kg wheat or rice/mo or 25 kg fortified *atta*	2 years	8.34 million	Ultra-poor (extreme poor) women	19.6 billion BDT (231 million USD)

* The categorical poor include those who lack land ownership and family income and those from certain family background, subject to differ by program.
** Although anyone can officially purchase OMS flour from the OMS market/truck locations, these trucks are strategically located in lower-income areas.
1 USD = 84.91 BDT

The OMS program comprises about half of the government's distribution of wheat. If the second half of 2018/2019 year is equivalent to the first half, then a total of 364,386 MT of wheat

[34] World Bank: Bangladesh Social Protection and Labor Review: Towards Smart Social Protection and Jobs for the Poor. Bangladesh Development Series Paper No. 33. March 2016. Available at: https://openknowledge.worldbank.org/bitstream/handle/10986/25265/Bangladesh0soc0nd0jobs0for0the0poor.pdf?sequence=1&isAllowed=y
[35] Bangladesh launches open market sale of rice. September 3, 2020. http://www.fao.org/giews/food-prices/food-policies/detail/en/c/1106344/
[36] Social Security Policy Support (SSPS) Program. http://socialprotection.gov.bd/en/programmes/

(236,851 wheat flour) may have been distributed. Since OMS supplies may be purchased by anyone, the actual number of beneficiaries purchasing wheat flour are unknown. However, a crude estimate using the average NMS 2011/2012 consumption of 77.9 g/c/d among NPNL women would indicate that 7.0 million individuals (4.3% of the population) could be consuming OMS flour.

Operational feasibility

Again, assuming that the second half of the 2018/2019 distribution is similar, if all wheat distributed by the government were to be fortified (633,712; 411,913 as wheat flour), at a premix cost of $3/MT of flour[37], fortification could cost the government 1.24 million USD. If fortification is limited to the two main recipients of government distributed wheat, OMS and VGF, then these relative additional costs are 710,553 USD (for OMS in 2018/2019) and 314,135 USD (for VGF in 2016/2017). The estimated costs, potential coverage, and feasibility in the current milling industry are summarized in Table 12.

OMS feasibility

As OMS is currently selling flour, not grain, there would likely be minimal procurement changes in order to fortify the flour in OMS; any of the large mills (and likely the smaller regional mills, as long as they are not stone-grinding village mills) would be able to fulfill a fortified flour tender from the Ministry of Food. The larger barrier to implementation may be ensuring that the Ministry of Food conducts adequate regulatory monitoring of the mills contracted to produce fortified flour for OMS. Fortifying 236,851 MT of flour (364,386 MT equivalent grain) could reach a potential 8.1 million individuals (4.9% of the population), an additional premix cost of 710,553 USD (0.6% of the 2019/2020 OMS budget).

VGF feasibility

It appears from USDA data (sourced from the Ministry of Food) that wheat was provided as recently as 2016/2017 in the VGF program, although it was not provided in 2018/2019. Wheat grain is provided to beneficiaries, not flour[38]. As beneficiaries are taking the grain to local village stone-grinding mills, to convert 107,950 MT of wheat grain into flour on their behalf, the Ministry of Food would be required to set-up a tendering system among 3,000 village stone-grinding mills (each mill with average 100 kg/day capacity). However, the MOST/WFP pilot project in 2003 concluded this system was inefficient and unsustainable in the long-term[39].

A more efficient option would be tendering the grinding to a mill that with PesaMills™. CityGroup is the only milling company in Bangladesh with this capacity. The available capacity of the installed PesaMills™ today in Bangladesh (214,500 MT/year) would be able to mill all of the VGF grain (at the 2016/2017 distributed grain amount, 107,950 MT), with excess utilization to spare. The additional premix cost would be 314,135 USD (0.2% of the 2019/2020 VGF budget).

[37] Premix following WHO recommendations for ferrous fumarate or ferrous sulfate and includes vitamin A. Premix quote from Mühlenchemie, March 2020. Premix following the 2008 Bangladesh BSTI standard is $3.71/MT.
[38] Ministry of Finance. Strengthening Public Financial Management for Social Protection Project. Study On Vulnerable Group Feeding Scheme of Ministry of Disaster Management and Relief. http://spfmsp.org/wp-content/uploads/2018/06/Diagnostic-Study-on-Vulnerable-Group-Feeding-VGF.pdf
[39] USAID Micronutrient Program (MOST). Wheat Flour Fortification Program in Bangladesh. Final Report. October 2003

If only VGF flour is fortified (i.e., there is no mandatory flour fortification for commercially available flour), the standards for fortified VGF flour should follow those recommended by WHO at the 75-149 g/c/d consumption level (Table 3). If there is mandatory fortification of flour, VGF flour standards should follow the same standards as commercially available flour.

VGD feasibility

Although wheat and wheat flour are officially listed as options under the VGD, personal communication from a VGD official during FFI's mission trip stated that only rice has been provided in the last 10 years of their tenure provided, never wheat/wheat flour.

During FFI's mission trip, no stakeholders reported any intention or appetite to convert current rice distribution to wheat or wheat flour. Below, the *theoretical* (and unlikely) situation of distributing fortified wheat flour in the VGD program.

Table 13: Potential coverage, cost, and feasibility of fortifying wheat flour in social safety nets in Bangladesh

Program	Potential beneficiaries (% of population[31])	Premix cost (USD/yr)	%, 2019/2020 budget[36]	Wheat grain, MT (wheat flour, MT)	Milling industry feasibility
OMS	8.1 million* (4.9%)	710,553	0.6%	364,386** (65% extraction: 236,851)	Roller flour mill capacity currently exists
*VGD – hypothetical****	8.34 million (5.1%)	8.1 million	4%	2.7 MMT (flour)	Requires installation of PesaMill™ if milling needs surpass 214,500 MT of grain
VGF	14.25 million (8.7%)	314,135	0.2%	107,950 (97% extraction: 104,712)	PesaMill™ capacity currently exists
All wheat distributed in 2018-2019 SSN combined	14.1-21.1 million (8.6-12.8%)*	1.24 million	NC	633,712 (65% extraction: 411,913)	Roller flour mill capacity currently exists

MT, metric tonnes; NC, not calculated; OMS, Open Market Sales; VGD, Vulnerable Group Development; VGF, Vulnerable Group Feeding; SSN, Social Safety Net
VGD does not currently provide wheat grain or flour to beneficiaries, although it has been distributed in the past through a MOST/WFP pilot project.
Premix cost: $3 USD/MT of flour. This cost estimate follows WHO recommendations for all nutrients and addition levels at 75-149 g/c/d of wheat flour.
*Since anyone may purchase OMS flour, and SSN benefits may overlap populations, the estimate of potential beneficiaries was crudely estimated here by dividing the flour by estimated average consumption according to NMS 2011/2012 (~80 g/c/d).
**Assuming 2018-2019 six month distribution is doubled for OMS annual total
***VGD does not currently provide wheat grain or flour to beneficiaries, although it has been distributed in the past through a MOST/WFP pilot project.

Evaluating past wheat flour fortification activities

An effectiveness/acceptability study of fortified wheat flour pilot project was undertaken by the USAID/MOST and WFP between Nov 1999 and October 2003[39]. The project provided subsidized, fortified stone-ground wheat flour to 10,000 VGD households. The project assessed the organoleptic qualities of the fortified flour and foods made with the flour, an effectiveness study on the health impact on beneficiaries consuming the flour, and a utilization and acceptability study to assess how beneficiaries used the flour.

The project found that fortified stone-ground *atta* was acceptable and 90-100% of the flour provided was consumed, but households preferred roller mill *atta* for its consistency, flavor, and color. The premix cost $5/MT due to addition of vitamin A, considered an acceptable increase in the retail price of *maida* flour, had the cost been passed on to the consumer. Households also found it more convenient to be provided flour instead of grain.

The wheat grains used in the MOST project were donated through WFP, but still concluded that the "approach of producing fortified flour in small chakki mills (small stone-mills) operated by NGOs is neither institutionally viable nor economically sustainable under a nationwide program." The project acknowledged that "due to the small size of the chakki mills, their large number and their scattered distribution in remote locations in rural areas, they are difficult to regulate."

The MOST project targeted rural beneficiaries of a government social safety net program that serves ultra-poor female households. Given that mandatory fortification of wheat flour is more likely to benefit urban populations (and potentially higher-income households), a mandatory law for commercialized fortified wheat flour would be unlikely to reach the MOST project's population. Compared to the MOST project, any future social safety net provision of fortified wheat flour has the advantage of the ability to procure stone-ground-quality flour from a modernized private milling sector, or the option of providing roller mill *atta* if beneficiaries found it acceptable. Doing so would address the regulatory monitoring and economical barriers of fortifying wheat flour at small stone-grinding mills.

Recommendations

Based on the wheat flour milling industry, the existing regulatory monitoring system for food safety, and currently operating social safety net programs, FFI concludes the following:

1. **Mandatory fortification is recommended**, recognizing that fortified wheat flour may primarily benefit urban consumers. However, given that the magnitude of micronutrient deficiencies measured in NMS 2011/2012 were the same across both urban and rural populations, there is a demonstrated public health need for food fortification in urban consumers. A BIDS 2012 consumption analysis also found that the urban poor population could consume at least 75 g/c/d of flour by 2020, suggesting that wheat flour fortification will not just benefit well-off urban consumers but also the urban poor.
    a. The urban population is 59 million individuals, or 37% of the population of Bangladesh.
    b. The current voluntary standard should be revised to:
        i. Reconsider nutrient levels for folic acid, zinc, and B12 for alignment with WHO recommendations or to fill nutrient intake gaps identified through NMS 2011/2012. Other B vitamins should be considered for addition at levels to reconstitution levels.
        ii. Reconsider whether iron is a necessary nutrient for inclusion given the NMS 2011/2012's findings of low iron deficiency and iron deficiency anemia.
        iii. Reconsider whether vitamin A is a necessary for inclusion given the NMS 2011/2012's findings of low vitamin A deficiency and its inclusion in fortified oil.
        iv. Results from the Dhaka Division micronutrient survey could further inform the nutrients of public health need in Bangladesh, wheat flour consumption patterns and amounts, and population groups that will likely benefit from fortification. Given that urban populations are the most likely to consume wheat flour, this information could inform nutrients for inclusion and fortification levels.
    c. Fortification should be mandatory for all flour used for human consumption, not just retail flour. There are several standards for wheat flour depending on their intended use; a revision of multiple standards and application for their mandatory status to BSTI may be necessary.
    d. Voluntary fortification is unlikely to reach broad coverage or public health impact. Standards for voluntary fortification already exist but are not utilized by the private sector, for either retail, bulk, or processed food flour. There is no incentive for private sector to increase the cost of their product if their competitors will not do the same.
    e. Considering greater rice coverage and consumption in Bangladesh, the rice milling landscape in Bangladesh should be assessed for feasibility of mandatory fortification. If feasible, complementary wheat flour and rice standards should be developed, considering the consumption levels and coverage of both foods.
2. **It is possible today for the Government of Bangladesh to convert all of the wheat they distribute (2018/2019 estimated volume of 633,712 MT) into fortified wheat flour.** Although it is not clear what proportion is currently distributed as wheat vs. wheat

flour, the current milling industry in Bangladesh is likely to immediately absorb the government's milling needs.

   a. There are two main potential opportunities to fortify wheat flour provided through social safety net programs; the cost of implementation and coverage will depend in any given year on the government's planned distribution volumes:
      i. OMS: currently already sells wheat flour. Fortifying 236,851 MT of flour (364,386 MT equivalent grain) could reach a potential 8.1 million individuals (4.9% of the population), an additional premix cost of 710,553 USD (0.6% of the 2019/2020 OMS budget)
      ii. Vulnerable Group Feeding: in the recent past (2016/2017) has provided 107,950 MT of grain, which would require tendering into fortified, stone-ground *atta* flour before distribution to beneficiaries. Currently, one mill in Bangladesh has the capacity to produce whole-wheat flour with stone-ground *atta* properties in a modern milling facility. The additional premix cost would be 314,135 USD (0.2% of the 2019/2020 VGF budget).

3. **BSTI has an established system that can integrate the monitoring of fortified wheat flour under a mandatory standard**. However, BSTI would likely require training to develop and validate testing protocols for the specific vitamins and minerals of interest as well as improvements in their understanding of the limitations of laboratory testing. Whether additional Certification & Marks inspectors or Chemical Wing analysts are needed to carry out additional regulatory monitoring activities should be assessed as such staff are already overwhelmed with the high number of products to inspect and producers to certify.
4. **There is limited micronutrient content testing ability in Bangladesh.** The BSTI laboratory has had past experience measuring vitamin A in fortified edible oil as well as iodine in salt. IFST, has also had past experience with measuring vitamin A and iron content in fortified high-energy biscuits. Additional training and protocol development and validation are likely needed across all laboratories that may test fortified wheat flour.
5. **The future of food safety and quality monitoring in Bangladesh hinges on BFSA**. The Food Safety Act of 2013 provides BFSA the legal mandate over other existing regulatory agencies regarding food safety activities. However, despite the Act having been passed 7 years prior, FFI found BFSA under-developed, lacking sufficient staff, offices, and protocols. If by 2030 (the deadline under the Prime Minister's directive), BFSA continues to lack the capacity to conduct its regulatory role, there will likely continue to be overlapping roles and mandates of BSTI, BFSA, and IPH. BSTI will likely retain control of certifying fortified wheat flour producers and testing fortified wheat flour for various nutrient parameters. Likewise, IPH and/or BFSA will retain food safety-related monitoring and surveillance, representing significant overlap and confusion for producers.
6. **Greater trust between regulators and industry, then further between these stakeholders and consumers needs to be built.** This means that a greater understanding of the actions undertaken by each stakeholder is necessary. All stakeholders should seek opportunities for joint learning and sharing. Specifically, regulators should identify opportunities to spend time within food production facilities to understand and empathize with the levels of knowledge held and the constraints faced. They should take the time to explain to industry the purpose of their regulatory activities and to ensure they are

reporting back to industry the results of those activities in a timely and helpful manner. Additionally, the consumer protection agencies existing within Bangladesh should be working more closely with regulatory agencies to understand and better communicate to consumers how they are monitoring and controlling the foods present in the marketplace.

Annex 1: Organizations and individuals met with for this report:

Agro Best Corporation (milling equipment manufacturer)
Mr. Ashikur Rahman Khan
Managing Director

ACI Foods (flour mill)
Mr. Anup Kumar Shaha
Deputy Executive Director

Bashundhara Group (flour mill, food conglomerate)
Mr. Abdus Shukur
Director, Supply Chain and Distribution

Buhler-Bangladesh (milling equipment manufacturer)
Moshfeq Ullah Rafiq
Country manager

CityGroup (flour mill, food conglomerate)
Mr. Emdad Uddin
Director, Business Development

Sayed Rafiqur Rahman
Technical Director

Consumers Association of Bangladesh
Ghulam Rahman
President

Ahmad Ekramullah
Program Coordinator

Directorate General of Food
Md. Amzad Hossain
Director, Supply, Distribution, and Marketing

Food and Agriculture Organization of the United Nations
A.K.M Nurul Afsar
National Team Leader, Institutionalization of Food Safety in Bangladesh for Safer Food

FM Flour Mill
Mr. Badal
Managing Director

Khan Flour Mill
Mr. Maznu Khan
Proprietor

Ministry of Food
Bangladesh Food Safety Authority
Professor Dr. Md Abdul Alim
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Institute of Public Health
Dr. Shah Mahfuzur Rahman

Assistant Professor, Academic Wing and
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Ministry of Industry
Dr. Md. Akhteruzzaman
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Bangladesh Standards and Testing Institution
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Deputy Director and Head, Agriculture and Food Division

Pankaj Kumar Kundu
Director, Chemical Wing

Md. Arafat Hossain Sarker
Assistant Director, Certificate Marks Wing

Engr. Md. Nurul Islam
Deputy Director, Certificate Marks Wing

Engr. Golam Baki
Deputy Director, Certificate Marks Wing

Md. Nurul Amin
Deputy Director, Certificate Marks

Md. Nozir Ahmmod Miah
Deputy Director, Management System Certification Wing

Engr. Md. Sajjadul Bari
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Nutrition International
Manoj Kumar Raut
Regional Manager, Research & Evaluation - Asia

Muhammad Mahbubul Islam Bhuiyan
Project Manager, School Nutrition for Adolescent Project

Ashek Mahfuz
National Program Officer, Fortification

Engr. Md. Guljer Ahmmed
Project Coordinator, Rice Fortification

Olympic Biscuit
Mr. Arman Mahmud
Deputy General Manager, Operations

Pran Food
Md. Ilias Uddin Mridha
Managing Director

Sena Kalyan Sangstha Flour Mill
Mr. Indrojit Kumar Mahalanabish
Technical Head of Project Implementation, Sena Flour Mills

Zayed Flour Mill
Mr. Sukur Hazi
Proprietor