

Business Case for Fortification

STUDY CONDUCTED BY SAHEL CAPITAL AND
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EXECUTIVE SUMMARY



The World Bank reports that high levels of vitamin and mineral deficiencies (MND) continue to depress the Nigerian GDP by more than US\$1.5 billion annually via higher mortality and morbidity rates along with decreased productivity. Furthermore, the 2018 Nigeria Demographic and Health Survey presented the following findings*:



37% of Nigerian children age 6-59 months are stunted (short for their age), 7% are wasted (thin for their height), 22% are underweight (thin for their age)



68% of children age 6-59 months and 58% of women age 15-49 are anemic



12% of women age 15-49 are thin (a body mass index [BMI] below 18.5)

- Fortification of basic foods like salt, margarine, and wheat flours virtually eliminated most MND in North America and Europe. More recently, fortification programs have reduced the prevalence of MND by 34%-74% in countries as diverse as Indonesia, South Africa, Guatemala, and Nicaragua.
- Food fortification to control MND has been implemented in Nigeria for nearly three decades. Salt iodization was made mandatory in 1992 and by 2005, coverage of iodized salt reached 98% and rates of Iodine Deficiency Disorders (IDD) decreased dramatically. Recent surveys continue to show coverage greater than 90% and IDD and iodine nutrition status remains adequate.
- Fortification of cooking oil and sugar with Vitamin A, and flours with multiple micronutrients has been mandated since 2002. While implementation was successfully initiated, compliance with Vitamin A standards currently ranged from 24% for vegetable oil, 29% for sugar and 25% for cereal flour. The success of iodine fortification, visible gaps in compliance and realizing the potential human, social and economic benefits of food fortification for Nigeria will require renewed commitment and investment in food fortification by government agencies, private food companies, and international partners.
- Analysis shows that food fortification costs in Nigeria are already optimized and generally in line with average global benchmarks. Fortification is affordable to both large and small companies representing ~1% of the retail prices, though the cost is marginally lower for larger companies capitalizing on their efficiencies of scale. The national cost of full compliance with fortification standards for salt, oil, sugar and grain flours is estimated at ~\$55 million annually, >1% relative to the range of key industry and consumer benchmarks. Based on average 11.68% annual food inflation, the added one-time price rise of 0.01%-1% can be easily absorbed in the marketplace.**

*2018 Nigeria Demographic and Health Survey (2018 NDHS) <https://dhsprogram.com/pubs/pdf/FR359/FR359.pdf>

** <https://tradingeconomics.com/nigeria/food-inflation>



EXECUTIVE SUMMARY

Analysis has also revealed that food fortification does not influence the competitiveness of product pricing, which is instead largely driven by overall quality, brand recognition, and marketing strategies, further supporting the argument of inconsequential costs.

Due to the high economic burden of MND and relative low cost of adding vitamins and minerals, economists have concluded that fortification is among the most cost effective investments in national economic development. Presuming fortification can lower the \$1.5 billion in annual losses from MND in Nigeria by 25-50%, this suggests \$375-750 million annually in economic returns. To achieve 100% compliance, the annual industry wide program is projected to cost \$55 million. For every \$1 invested, Nigeria can expect a return of \$7-\$14 in the annual value of decreased mortality and morbidity, lower health care costs, and higher productivity.

From a long-term macro perspective, decreasing the economic burden of MND means higher disposable income across the population, leading to increased sales and revenue for domestic industries. In Nigeria, higher disposable income goes primarily to increased purchase of food products which will likely result in wider profit margins for both large and small food enterprises.

In the long term, companies will benefit from complying with mandated fortification, as long as the government applies transparent regulation fairly to all companies. In the short term, fortification offers a positive opportunity to expand market share and increase profit margins by offering healthier, higher quality products. For those companies who choose not to comply, the legal requirement provides a negative incentive and non-compliance can lead to sanctions, fines, plant lockdown, negative media and ultimately reduction of consumer confidence.

KEY TAKEAWAYS

\$55M

Projected cost to achieve
100% fortification compliance

\$7-\$14

Expected return to Nigeria for
every \$1 invested in fortification



EXECUTIVE SUMMARY

OPPORTUNITIES TO ADVOCATE FOR FORTIFICATION

While achieving full and sustained compliance to secure the full economic benefits of fortification may require a long-term effort, in the short term food companies, along with their industry associations, in partnership with government agencies, can take a lead role by:



FORTIFICATION STAMP OF APPROVAL

Promoting and marketing fortification as a mark of product quality to command a winning product proposition and higher market price.

For instance, the NIS Award should be linked to compliance with food fortification.



INDUSTRY BEST PRACTICES

Regulatory agencies should support industry to institutionalize standard practices related to premix selection, usage, and storage, which can be ensured by the adoption of thorough record keeping. This would subsequently facilitate a more transparent system for food inspectors and industry associations as a means of self-regulation.



GOVERNMENT SUPPORT

Encouraging the government to reduce tariffs on premix, create awareness to swing consumption behaviours towards fortified foods and implement rigorous enforcement of national standards.

International development partners like GAIN and TechnoServe stand ready to provide technical assistance, monitoring, and feedback to these and other proactive initiatives.



STRATEGIC BUSINESS CASE

CONTEXT AND NEED FOR INTERVENTION

Nigeria has one of the highest rates of malnutrition in the world. Recent data shows that 44% of children under five have chronic, longstanding malnutrition and are too short for their age; while 11% have acute malnutrition and are too thin.*

Yet, the prevalence of vitamin and mineral (micronutrients) deficiencies is higher than the prevalence of these visible forms of malnutrition. Micronutrient deficiencies are referred to as hidden hunger because there are usually no observable signs to indicate those who are affected by them. In Nigeria, 42% of children 6-59 months have Vitamin A deficiency**, and 21% of the population are at risk of zinc deficiency***. Anaemia, primarily caused by iron deficiency, occurs in 71% of children 6-59 months old, 47% of non-pregnant women 15-49 years old, and 58% pregnant women 15-49 years old****.

Globally, Nigeria ranks 4th among countries that have a high number of women affected by anaemia, and the public health burden of micronutrient deficiencies is considered to be severe*****. Hence, there is a strong case for strategic interventions to address these micronutrient deficiencies (MNDs).

Nutrition and economic development have a two-way relationship. A higher level of economic development contributes to improved nutrition, and more importantly, improved nutrition acts as a catalyst for economic growth. Figure A, adopted from the World Bank report clearly demonstrates this vicious cycle of poverty and malnutrition.

KEY TAKEAWAYS

44%

Percentage of Nigerian children under five with chronic malnutrition

4th

Nigeria's ranking amount countries that have a high number of women affected by anemia

*NBS & UNICEF (2017). Multiple Indicator Cluster Survey 2016-17, Survey Findings Report. Abuja, Nigeria: National Bureau of Statistics (NBS) and United Nations Children's Fund (UNICEF).

** International Food Policy Research Institute (2015). Global Nutrition Report 2015: Actions and Accountability to Advance Nutrition and Sustainable Development. Washington, DC.

***Wessells KR, Brown KH (2012). Estimating the global prevalence of zinc deficiency: results based on zinc availability in national food supplies and the prevalence of stunting. PloS One 29;7(11):e50568.

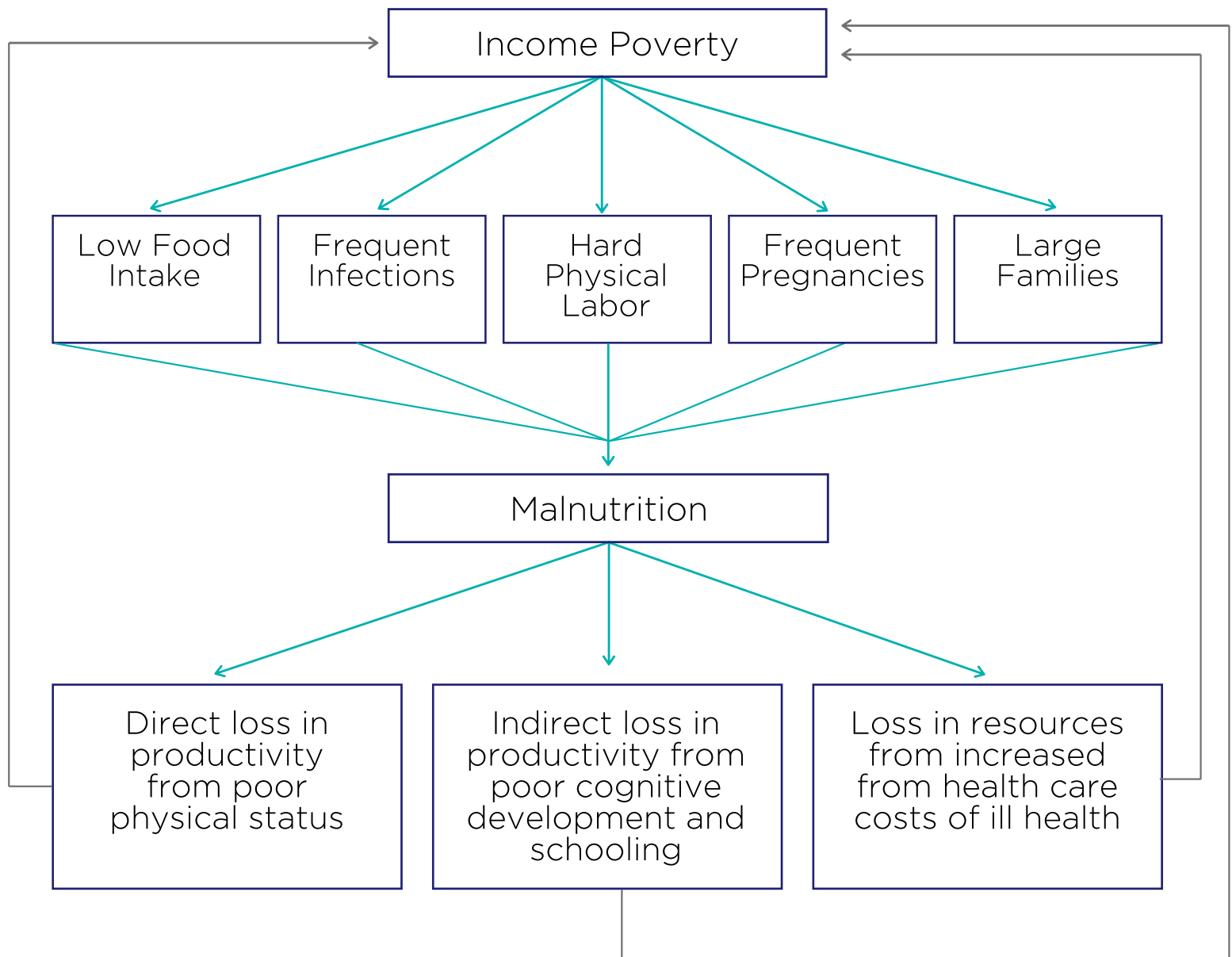
****World Health Organization (2015). The global prevalence of anaemia in 2011. Available at http://apps.who.int/iris/bitstream/10665/177094/1/9789241564960_eng.pdf.

***** Development Initiatives (2017). Global Nutrition Report 2017: Nourishing the SDGs. Bristol, UK: Development Initiatives.



STRATEGIC BUSINESS CASE

FIGURE A: THE CYCLE OF POVERTY AND MALNUTRITION



STRATEGIC BUSINESS CASE

For the private sector, it is extremely important to realize the far-reaching consequences of the vicious cycle of poverty and malnutrition. Studies have shown that iron deficiencies reduce productivity in adults, consequently reducing work efficiency and duration*. This contributes to roughly 0.5%-2% loss in GDP per annum**.

Iodine deficiency causes brain damage and mental retardation, and folate deficiency causes neural tube defects, contributing between 0.5%-2% GDP loss per annum***. It has been estimated that Nigeria loses more than US\$1.5 billion of GDP annually as a result of vitamin and mineral deficiencies****. Thus, nutritional deficiencies directly impact the private sector in the following manner:



Since malnutrition leads to increasing poverty, it would mean continuously shrinking margins for the food companies as people become poorer and are unable to afford, purchase, and consume. As a corollary, better economic growth would mean a shift in consumer behaviour, increased consumption and a willingness to pay more for quality, directly impacting their profit margins.



Also noteworthy is the direct loss in productivity due to malnutrition – both in physical labour and less intensive works. For instance, studies in Indonesia have shown that iron supplementation of male rubber plantation workers and female textile workers showed a 17% and 5% increase in productivity respectively. Thus, companies have a direct incentive to ensure the right nutrients reach the populace to ensure a productive workforce and a sustaining business model.



Lastly, as observed through a broader macroeconomic perspective, the world is moving towards sustainable development with SDGs strongly in place. Companies like Procter and Gamble and Unilever have taken strongly to these initiatives and are ensuring quality, compliance and proactiveness for the consumer as a direct precursor of winning in the market and sustaining in the long term. The food companies in Nigeria should aim to be the agents of change, given the strong correlation each of the MDGs and Copenhagen consensus findings have to good nutrition, right to basic food and addressing the developmental challenges.

*Horton, S., & Ross, J. (2003). The economics of iron deficiency. Food policy, 28(1), 51-75.

**Susan Horton (2004). The Economic Impact of Micronutrient Deficiencies

***Black, R. E., Victora, C. G., Walker, S. P., Bhutta, Z. A., Christian, P., De Onis, M., ... & Uauy, R. (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. The Lancet, 382(9890), 427-451.

****World Bank (2011). Nutrition at a glance: Nigeria. Available at

<http://documents.worldbank.org/curated/en/664181468290730623/pdf/771880BRI0Box0000Nigeria0April02011.pdf>



STRATEGIC BUSINESS CASE

While ethical, human, and nutritional objectives are strong reasons as to why the government should intervene towards this cause, it can be also be strongly justified via the direct economic benefit of savings in healthcare costs. Given the high prevalence of nutritional defects and diseases cited above, it is imperative for the government and policy makers to act against hidden hunger.

For example, poor pre-school nutrition adds to the effect of low birth weight, contributing to roughly 56% of child deaths in developing countries like Nigeria*. From a strategic perspective, it is imperative that government also take significant ownership of the challenge and lead on developing proposed solutions through a more effective monitoring system and an enabling ecosystem. This can drive observable behaviour change aimed at establishing best business practices amongst industry players.

It is widely recognized that regulatory enforcement would provide compliant companies the opportunity to position their products as healthier and thus provide them with the opportunity to gain larger market share. Furthermore, companies that do not comply may face a higher frequency of disciplinary action from enforcement bodies, in the form of hefty fines and factory shutdowns.

FOOD FORTIFICATION – THE MOST COST-EFFECTIVE SOLUTION FOR ADDRESSING MNDS

Empirical evidence has specified several interventions that can address MNDS**. Addressing MNDS generally involves reducing diseases and increasing the intake of foods that are rich in micronutrients and/or taking micronutrient supplements. While many foods are naturally rich in micronutrients, for instance whole grains, fruits, vegetables, and animal source foods, these foods are expensive and inaccessible to the poor. Food fortification, the deliberate addition of vitamins and minerals to foods during processing, is an alternative way to increase dietary micronutrient intakes and is considered one of the most cost-effective micronutrient interventions.

Its cost-effectiveness stems from the fact that fortification relies on existing food distribution systems and does not require behaviour change in dietary patterns, since micronutrients are added to food people already eat. With a high prevalence of poverty, a food system that is inadequately able to deliver affordable food, and 65% of dietary energy derived from cereals and tubers (indicating low consumption of micronutrient-rich foods), Nigeria has a huge potential to benefit from fortification.

*Harold Alderman, Jere R. Behrman, and John Hoddinott (2007). Economic and Nutritional Analyses Offer Substantial Synergies for Understanding Human Nutrition

**Bhutta, Z. A., Das, J. K., Rizvi, A., Gaffey, M. F., Walker, N., Horton, S., Webb, P., Lartey, A., Black, R. E. (2013). Maternal and Child Nutrition 2 – Evidence-based interventions for improvement of maternal and child nutrition: What can be done and at what cost? The Lancet 382(9890): 452-477.

***Spohrer, R. (2015). Food security and nutrition viewpoint paper. Copenhagen Consensus Centre. Available at



STRATEGIC BUSINESS CASE

In recognition of this potential to benefit, the fortification of salt with iodine was made mandatory in 1992, while vitamin A fortification of vegetable oil and sugar was made mandatory in 2002. Also made mandatory in 2002 was the fortification of wheat flour and maize flour with vitamin A, iron, zinc, and B-vitamins.

Despite the meaningful progress to institute fortification, the rate of industry compliance with standards and the coverage of fortified foods are low. A national study in 2012 showed that compliance with vitamin A fortification standards was 24%, 26%, and 10% in vegetable oil, sugar, and cereal flours respectively. For iron fortification, 37.8% of cereal flours were compliant with standards*.

Another study in 2013 indicated that less than 20% of households consumed vitamin A fortified foods**. More recent, smaller studies indicate that the trend has not changed in the past five years***. It is therefore necessary to intervene to strengthen food fortification and increase the compliance and/or coverage of mandatory food fortification in Nigeria.

IMPACT AND OUTCOME

The impact of strengthening food fortification in Nigeria is improved nutritional status of the populace, including women and children under five years of age.

Specifically, strengthening food fortification will result in reductions in:

- Prevalence of anaemia
- Vitamin A deficiency
- Risk of neural tube defects

As well as improved resistance to infection and illness, and improved cognitive and physical development among children.

Allen, L. H., De Benoist, B., Dary, O., Hurrell, R. (2006). Guidelines on food fortification with micronutrients. Geneva & Rome: World Health Organization and Food and Agriculture Organization of the United Nations

*Ogunmoyela, O. A., Adekoyeni, O., Aminu, F., Umunna, L. O. (2013) A critical evaluation of survey results of vitamin A and Fe levels in the mandatory fortified food vehicles and some selected processed foods in Nigeria. Nigerian Food Journal 31(2):52-62.

**Busari, A. Two Decades of Food Fortification in Nigeria: Situational Analysis. MPH Thesis, Rollins School of Public Health of Emory University; 2013.

***Aaron, G. J., Friesen, V. M., Jungjohann, S., Garrett, G. S., Neufeld, L. M., & Myatt, M. (2017). Coverage of Large-Scale Food Fortification of Edible Oil, Wheat Flour, and Maize Flour Varies Greatly by Vehicle and Country but Is Consistently Lower among the Most Vulnerable: Results from Coverage Surveys in 8 Countries. The Journal of Nutrition, 147(5), 984S-994S.



STRATEGIC BUSINESS CASE

Studies have shown that such large-scale food fortification programs have led to a significant improvement in micronutrient status in low- and middle-income countries*. For instance, a 34% reduction in anaemia, a 74% reduction in odds of goiter and a 41% reduction in the odds of neural tube defects was observed for similar developing countries like Indonesia, South Africa, Guatemala and Nicaragua, thereby validating the impact it would have in Nigeria that has one of the highest rates of hidden hunger.

The expected outcome is to increase the population dietary intake of iron, vitamin A, zinc, and other micronutrients.

Here, it is important to understand the decision-making process followed by the general population. They allocate the resources available based on benefits of that investment. Since the effects of malnutrition are not immediately visible, they might choose to allocate these resources differently.

Hence, it is extremely crucial for the program to not only increase the distribution and coverage of fortified foods, but also increase the public awareness and sensitization towards this issue. Thus, an effective program should rely on existing consumption behaviours to increase the reach of micronutrients, while also leveraging the public private partnership to shift behaviours and dietary habits towards healthier and fortified foods.

KEY TAKEAWAYS

2002

The year in which Vitamin A fortification of vegetable oil and sugar was made mandatory

20%

Percentage of Nigerian households who consumed Vitamin A fortified foods in 2013

*Emily C Keats, Lynnette M Neufeld, Greg S Garrett, Mduduzi NN Mbuya, and Zulfiqar A Bhutta (2019). Improved micronutrient status and health outcomes in low- and middle-income countries following large-scale fortification: evidence from a systematic review and meta-analysis



STRATEGIC OPTIONS FOR LARGE-SCALE FOOD FORTIFICATION INTERVENTION

There are at least three options for strengthening food fortification in Nigeria.

Compliance Option

Strengthening mandatory industry compliance with existing government standards can ensure the success of mandatory food fortification program. This option will address supply-side constraints and involve compliance support for food processors and regulatory/enabling environment support for relevant government agencies. An approach to improve compliance will therefore not only focus on supply and regulatory interventions but should also consider self-regulation by industry with appropriate pressure from consumers, academia and the media, shining a light on poor or non-compliance.

Increased Access Option

The access to fortified foods can be expanded by changing consumer dietary habits or inclusion of more staple food vehicles in the mandatory food fortification program depending on the consumer consumption behaviours. The Increased Access Option hence focuses on addressing demand-side challenges to fortification, including poor nutrition knowledge and awareness among the population, absence of mechanisms to inform consumers about the fortification status of food vehicles, rigid dietary habits leading to nutrients not reaching the target populace and limited distribution of fortified foods among the poor and vulnerable*. It is recommended to invest the time and effort to determine the coverage of current food vehicles and the need to expand the number of vehicles under the mandatory fortification program.

Dual Approach Option

In an effort to combine the two aforementioned strategies, the Dual Approach would achieve universal compliance with mandatory food fortification standards and also introduce new food vehicles fortified with adequate levels of the targeted micronutrients, thus increasing the likelihood of attaining the RNI for the populace. This is the most ideal option which would achieve the target of eliminating the MNDs completely.

This study focuses on the compliance option and presents insights on why it makes business sense for both the companies and the government agencies to invest in adequate food fortification to ensure 100% compliance to the current standards. It presents a robust financial analysis of fortification costs for all the food vehicles. The costs are then analysed from the perspective of optimization, industry size, pricing and marketing variables and overall healthcare spending, thereby addressing all the business concerns of the industry and the government.

*Robinson, E., Akinyele, I. O., Humphrey, J., & Henson, S. (2014). Policy Options to Enhance Markets for Nutrient-Dense Foods in Nigeria (IDS Evidence Report; 66). Brighton, UK: Institute of Development Studies. Retrieved from <https://opendocs.ids.ac.uk/opendocs/handle/123456789/3680>.



FINANCIAL CASE FOR FOOD FORTIFICATION

The financial case seeks to build a strong business argument around fortification. In this regard, breaking down the unit costs of mandatory fortification, looking at the profit margins and the retail price impact of mandatory fortification can present compelling insights.

This is especially true since the industry for each of the food vehicle (except vegetable oil) is dominated by a handful of companies, making the logistics of increasing compliance a lot cheaper than it would otherwise be and making the industry wide collaboration much more feasible. For example: for the wheat flour industry, only 4 companies account for 91% of the market size by capacity*.

The costs** of implementing the Compliance Option – achieve compliance with national mandatory food fortification standards – is thus presented below. The costs presented are the costs of compliance to industry, and do not include the costs of supporting industry to comply or improving the fortification enabling environment.

The unit costs (per kg/l) of fortifying maize, wheat and semolina flour, edible salt, edible oil, and sugar were determined using information provided by food manufacturers, industry experts, key industry dynamics and current economic realities. The cost variables included premix costs, fortification equipment costs, and quality assurance costs. The specific factors costed for each of these variables is highlighted in Table 1, while Table 2 highlights the import tariffs for the fortificants of each food vehicle.

TABLE 1: COST ANALYSIS VARIABLES FOR FOOD FORTIFICATION

PREMIX COSTS	FORTIFICATION EQUIPMENT COSTS	QUALITY ASSURANCE COSTS
Premix purchase price	Equipment purchase cost	Cost of external tests
Local import tariff	Depreciation	Cost of internal/spot tests
Cost of storage and cooling system for premix storage	Importation and clearing costs	Cost of internal test equipment
Annual maintenance cost of cooling system	Installation and maintenance	Salary of quality assurance staff

*KPMG (2016). Wheat-based consumer foods in Nigeria. Nigeria: KPMG
**Sahel Capital Partners & Advisory Limited (2018). Food fortification costing analysis. Abuja, Nigeria: Global Alliance for Improved Nutrition (GAIN).

FINANCIAL CASE FOR FOOD FORTIFICATION

TABLE 2: IMPORT DUTIES AND TARIFFS ON FORTIFICANTS

	Wheat/Semolina Flour	Sugar	Salt	Vegetable Oil
Fortificants	Premix	Vitamin A Premix	Potassium Iodate	Vitamin A
Import Duties	5	5	5	5
Levy	5	5	0	5
VAT	0	0	0	0

DATA SOURCES AND ASSUMPTIONS

- Annual production for each food vehicle: The per capita consumption numbers for Nigeria were used to estimate the annual production for each food vehicle. Company specific production figures were obtained from the key informants in these companies. These were subsequently used to estimate the market shares for the top companies, which also provided a sanity check on the production numbers obtained from company representatives. Industry-wide unit costs were estimated using the annual demand of each food vehicle based on consumption data.
- Premix formulation: The quantities of premix required was based on national standards as well as fortification dosing rates and overages published by the Standards Organization of Nigeria (SON) as presented in Table 3. Overages are the recommended overdosing done at the industry level to account for subsequent losses across the supply chain like handling, storage and exposure to light.
- Import tariffs: The tariffs, as presented in Table 2 were obtained from the Nigerian Customs Services by one of our partners, Sahel Capital.



FINANCIAL CASE FOR FOOD FORTIFICATION

DATA SOURCES AND ASSUMPTIONS

- Quality assurance and quality control (QA/QC): The capacity for QA/QC varied across companies based on company size and specific food industry. Large companies for some vehicles had up to 2 staff dedicated to ensuring adherence to food fortification standards. The estimated overhead was ₦200,000 monthly for the QA analyst and ₦100,000 monthly for support staff 100% dedicated to fortification. It was assumed that SMEs typically utilized between 20% - 50% of the time of these 2 staff members for fortification, the cost of the quality assurance equipment, such as the iCheck and iCheck reagents and external laboratory tests used in the analysis was based on observed inventory records of processors obtained during the stakeholder engagement.
- Fortification equipment: The cost of microfeeders for flour fortification costs was obtained from stakeholders in the flour processing sector, while the cost of the dosifier for sugar was based on a brand called the FAR 500kg premix plant. Installation costs were estimated at 20% of the total cost of the equipment. Depreciation expenses for fortification equipment were based on feedback from food processors and desk research on the annual depreciation period for the respective equipment. Thus, iCheck machine depreciation was estimated at 20% (5 years), while depreciation of microfeeder, dosifier, and cooling system was estimated at 10% (10 years). Equipment maintenance was based on the universal benchmark measure of operating asset performance success, with maintenance cost estimated at 3% percent of Replacement Asset Value (RAV).
- Clearance charges: Clearance charges were estimated at 0.5% based on recent (November 2017) purchases by processors.
- Annual days of production: Factories were found to typically operate for 24 hours on production days. The number of production days in a year was estimated at 25 to 26 days each month, allowing a few days for maintenance and other servicing. As a result, total production days in a year were averaged at 306 days. This number was used to estimate the cost of reagents and QA tests.
- Retail prices: Prices consumers paid for fortified products and any identified unfortified substitutes were obtained from supermarkets as well as open air markets. Prices of food products at other points (distributor and wholesaler) between factory and consumer were also collected. Unless there was a huge difference, the average retail prices of each of the food vehicles were assumed for subsequent calculations.



FINANCIAL CASE FOR FOOD FORTIFICATION

**TABLE 3: MANDATORY FORTIFICATION STANDARDS FOR
ALL FOOD VEHICLES**

Food Vehicle	Fortification Standards*		
	Micronutrient (Chemical Form)	Level	Overage %
Wheat Flour Semolina Maize Flour (600mg/kg)	Vitamin A (dry vitamin A palmitate 250 CWS)	2.0 mg/kg	0%
	Vitamin B9 (folic acid food grade)	2.6 mg/kg	
	Vitamin B12 (vitamin B12 0.1% CWS)	0.02 mg/kg	
	Iron (NaFeEDTA)	40.0 mg/kg	
	Vitamin B2 (riboflavin fine powder)	5.0 mg/kg	
	Zinc (zinc oxide)	50.0 mg/kg	
	Vitamin B1 (thiamine mononitrate)	6.0 mg/kg	
	Vitamin B3 (niacinamide)	45.0 mg/kg	
	Vitamin B6 (pyridoxine hydrochloride)	6.0 mg/kg	
Vegetable Oil	Vitamin A (palmitate)	≥20,000 I.U./kg	15%
	Vitamin A (palmitate 1.7 million IU)	13.53g/1000L	
	Vitamin A (palmitate 1.0 million IU)	23.00g/1000L	
White Sugar	Vitamin A	≥25,000 I.U./kg	15%
Salt	Iodine (potassium iodate)	50.0 mg/kg	50%

*The fortification standards were obtained from publications of the Standards Organization for Nigeria (SON) for each food vehicle



FINANCIAL CASE FOR FOOD FORTIFICATION

UNIT COSTS OF MANDATORY FOOD FORTIFICATION

This section presents a summary of the unit costs of mandatory food fortification. We have calculated the costs for both the large companies (LCs) and small-medium enterprises (SMEs). The LCs are the ones with a significant market share (ranging from 5% to 35% depending on the food vehicle) while SMEs have <5% market share.

The costs of fortification per metric ton/ 1000 litres ranged from US\$ 2.5 for LCs of oil processors to US\$ 7.7 for SMEs of flour processors as shown in Table 4. A closer look at individual food vehicles suggests a small difference in the unit costs for the food vehicles between SMEs and LCs. The key difference in the unit costs arises from several factors like cheaper premix costs for the LCs due to economies of scale and the fact that the fixed costs of equipment, operation and quality tests (which are assumed to be constant) are distributed over a smaller volume for the latter vs. the former. Table 5 presents the building blocks of the total fortification costs as the three major components – cost of premix, QA/QC costs and cost of equipment.

For all food vehicles except oil, regardless of the company size, the cost of premix accounts for 84% - 97% of the mandatory fortification costs. The second major cost component for SMEs is QA/ QC tests is majorly contributed by the cost of reagents that ranges from 9% for wheat flour to 32% for vegetable oil. This is because as noted previously, irrespective of the scale, basic quality tests need to be performed for all the companies.

Since there is no correlation between the size of the company and the retail price, we have assumed an average retail price for each food vehicle for the purpose of drawing business conclusions. Table 4 further shows that the fortification cost is between 0.1% for LCs of oil to 1.2% for SMEs of flour of the retail price.

Thus, it is evident that irrespective of the scale of the companies or higher fixed costs, fortification is a very small percentage of the average retail price.

Thus, it is evident that irrespective of the scale of the companies or higher fixed costs, fortification is a very small percentage of the average retail price. Thus, despite the higher percentage contribution of QA/QC costs to the fortification costs for SMEs as stated above, it is still negligible in comparison to the retail prices for food.



FINANCIAL CASE FOR FOOD FORTIFICATION

The industries of wheat flour, sugar and salt are highly concentrated with the LCs contributing to >90% of the market demand. For oil, there are significant imports and multiple smaller players and distributors. However, as there is no significant difference in the total fortification costs between SMEs and LCs for individual food vehicles, the following conclusions hold true for all the processors in each of the industry, irrespective of the size.

TABLE 4: TOTAL COSTS OF FORTIFICATION PER METRIC TON OR 1000 L

Food Vehicle	Total fortification costs per MT/1000L (₹)		Total fortification costs per MT/1000L (US\$)		Average retail price (₹)		Fortification as % avg. retail price	
	SMEs	LCs	SMEs	LCs	SMEs	LCs	SMEs	LCs
Vegetable Oil	1456	853	4.2	2.5	893	893	0.2%	0.1%
Salt	2231	1760	6.4	5.1	183	183	1.2%	1.0%
Sugar	2503	2058	7.2	5.9	545	545	0.5%	0.4%
Wheat flour/ Semolina	2677	2232	7.7	6.5	226	226	1.2%	1.0%

TABLE 5: BUILDING BLOCKS OF TOTAL FORTIFICATION COSTS

Food Vehicle	Total fortification costs split SMEs			Total fortification costs split LCs		
	Premix	Equipment	QA/QC	Premix	Equipment	QA/QC
Vegetable Oil	67%	1%	32%	91%	0%	9%
Salt	84%	1%	15%	97%	0%	3%
Sugar	88%	0%	11%	97%	0%	3%
Wheat flour/ Semolina	90%	1%	9%	98%	0%	2%
Average	82%	0%	17%	96%	0%	4%



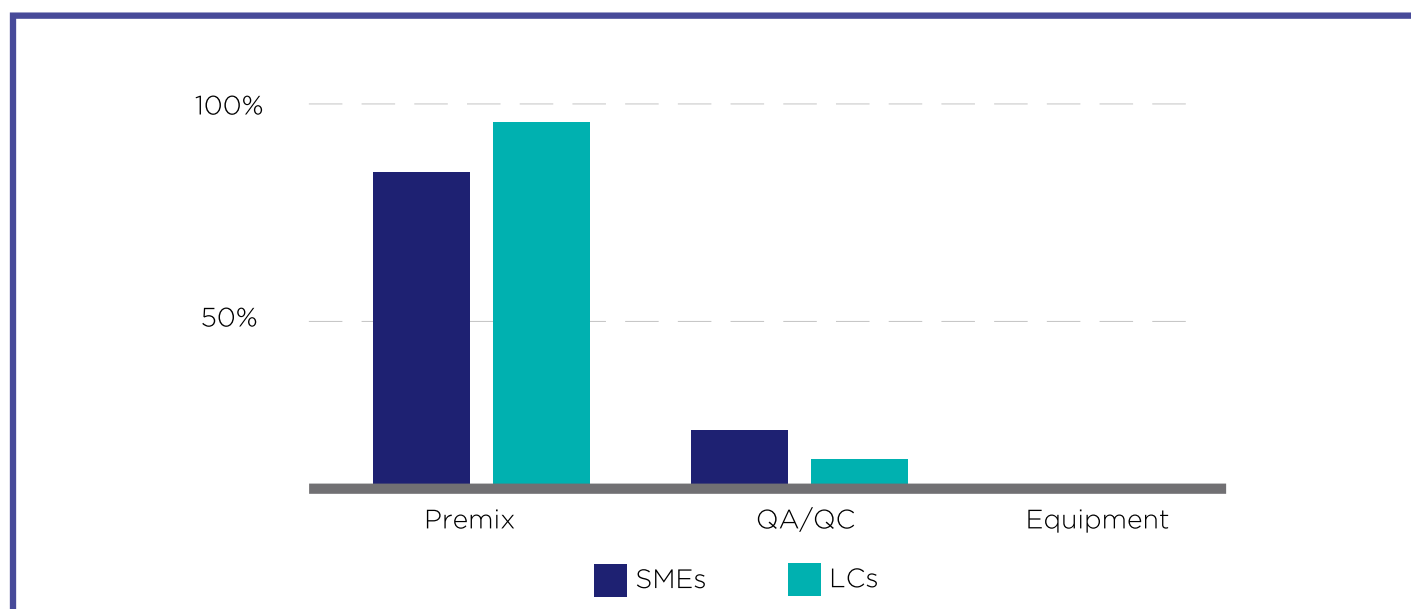
KEY CONCLUSIONS

Conclusion 1: The cost of fortification incurred by the food companies is already competitive, consistent across the industry and on par with global benchmarks

The first major conclusion for the industry from the cost analysis is the fact that the economics of food fortification is already optimized. Figure B shows that 82% - 96% of the costs of mandatory food fortification is contributed by the price of premix across all the food vehicles and company sizes. Since majority of the premixes are sourced from global producers at globally competitive prices, it leaves little room for optimization in the total fortification cost for the companies. Therefore, from a business perspective, the Nigerian food fortification market is already operating at an optimal cost.

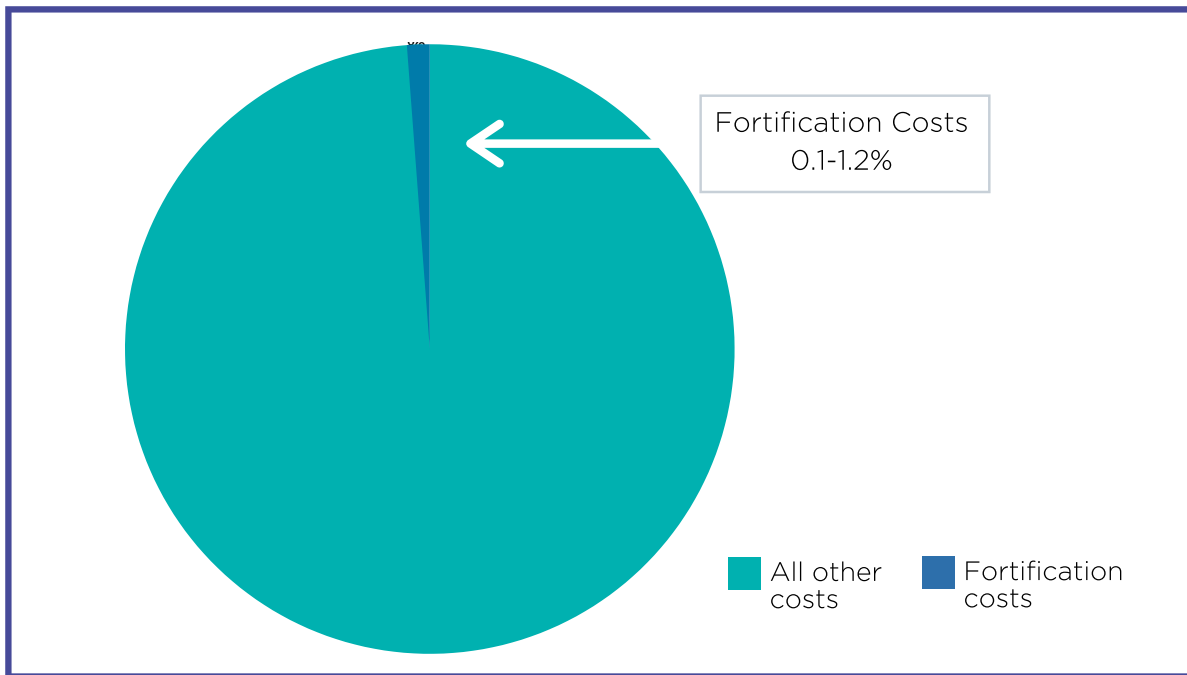
Secondly, Figure C further shows that food fortification is a mere 0.1% to 1.2% of the retail price across all food vehicles. This fraction is even smaller than the average currency fluctuation between Nigerian Naira and US Dollar. Additionally, the other cost centres in manufacturing like core production, sales and marketing and distribution contribute much more to the retail price and hence it makes much more business sense to focus on optimizing these costs rather than the mandatory food fortification costs. Even a 1% reduction in any of these cost centres is bound to translate to larger business benefit than a 10% reduction in food fortification costs.

FIGURE B: BUILDING BLOCKS OF COST OF MANDATORY FOOD FORTIFICATION



KEY CONCLUSIONS

FIGURE C: FORTIFICATION COSTS AS A PERCENTAGE OF RETAIL PRICE



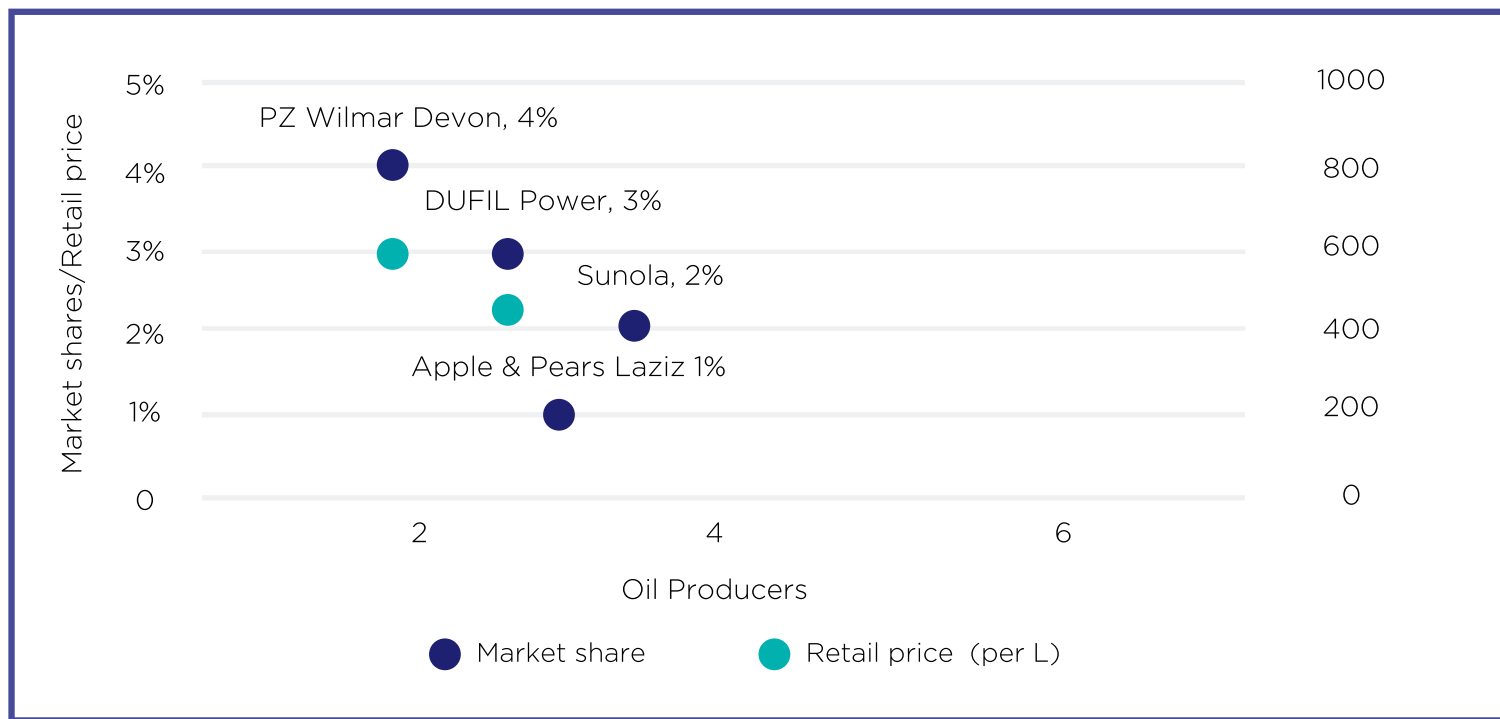
Conclusion 2: Food fortification does not influence the competitiveness of product pricing, which is instead largely driven by overall quality, brand recognition, and marketing strategies

Contrary to popular belief, as also shown in Figure C above, fortification is a negligible percentage of retail price and doesn't contribute in determining the retail price. The retail price is, in fact, determined by several more important factors like brand positioning, product quality, key product attributes, distribution and sales strategy, raw material sourcing and marketing and promotional strategies. The couple of analysis below strongly support this conclusion.

During the field study in Lagos, Nigeria in November 2019, the team collected the retail prices of four oil companies (PZ Wilmar, DUFIL, Sunola and Apple and Pears). These four producers are all complying to fortification standards while sourcing from different suppliers at different prices. Figure D plots these retail prices against the market shares of the respective brands. It shows that there is, in fact, no correlation between the two. Thus, the fortification cost doesn't trickle down into the retail prices and contrary to popular belief, the cheapest brand doesn't have the largest market share. This shows that product pricing is based on the long-term company strategy and not impacted by small costs like that of food fortification.

KEY CONCLUSIONS

FIGURE D: CORRELATION BETWEEN RETAIL PRICE & MARKET SHARE



Having established that retail prices don't necessarily correlate with the market shares, an analysis was done for theoretical increase in retail prices if the companies wanted to maintain the same profit margins. It was assumed that the average profit margins for different food vehicles are between 5-10%. This analysis, summarized in Table 6, shows that the retail price would just need to be increased between 2₹ - 3₹ across the food vehicles, which is even smaller than the lowest currency denomination of 5₹. Additionally, Figure E plots the retail price variation over time and different companies across different distribution channels. The range of price variation is a huge 24₹ to 278₹, and the effect of passing on the fortification costs falls well within the range.

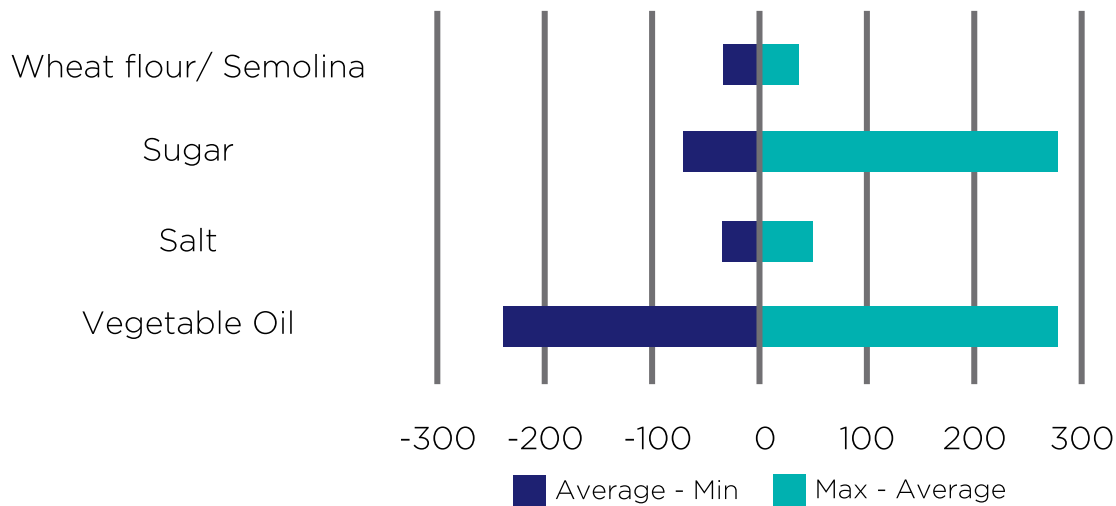
Given the near to zero impact of fortification on company profit margins and pricing decisions, it makes long-term strategic sense for the companies to comply to fortification. It can act as a catalyst for creating a competitive edge, enabling them to build a stronger brand based on better quality and thereby command a higher price and market share. Fortification is also mandated by law, and any non-compliance could lead to a widespread negative media coverage, plant lockdown by regulators or hefty fines. Given these huge strategic impacts, it's in the business interests to ensure the supply of the best quality product fortified to the right standards.

KEY CONCLUSIONS

TABLE 6: IMPACT ON RETAIL PRICE DUE TO FORTIFICATION

Food Vehicle	Current Average R.P.	New R.P. to maintain same profit margins	% increase in R.P.
Vegetable Oil	893	895	0.2%
Salt	183	185	1.3%
Sugar	545	548	0.5%
Wheat flour/ Semolina	226	229	1.3%

FIGURE E: RETAIL PRICE VARIATION ACROSS BRANDS AND TIME



KEY CONCLUSIONS

Conclusion 3: The industry wide costs of fortification are negligible compared to the long-term benefits of increased nutrient intake.

Table 7 highlights the estimated industry wide costs of mandatory food fortification based on per capita consumption patterns. The average unit fortification costs for each food vehicle, as calculated in above sections, were used in these calculations. The average retail prices were used in estimating the overall industry revenues. The total annual cost of achieving compliance with standards across all food vehicles is US\$ 55 million or nearly 19 billion ₦ (million ₦ 19,020). Wheat flour has the highest total costs of fortification (US\$ 30 million), followed by sugar (US\$ 12 million). However, given the huge total revenues of US\$ 12.5 billion or 4330 billion ₦, fortification accounts for just 0.4% of the total industrial revenues. The total costs of mandatory fortification are also well within the annual US\$ 188 million that the World Bank estimates⁹ is necessary to address vitamin and mineral deficiencies in Nigeria.

The long-term benefits of improved nutrient intake are reflected in the form of averted diseases, improved earnings and enhanced work productivity. As highlighted in the introduction, GDP and productivity improvement are demonstrated benefits of food fortification. As per studies, every \$1 investment in fortification leads to \$27 in economic returns*. For the private sector, the higher earnings of the population and the savings in personal healthcare costs translate into higher disposable income and paying capacity, thus translating into higher profit margins.

Furthermore, as earning improves, consumption and demand of better-quality food increases, thereby leading to a growth in the size of all the industries. Lastly, as pointed out before, fortification ties well with the long-term business strategy to ensure a winning product proposition in the market. Given the huge benefits and the revenues companies are making off the Nigerian population, it makes perfect economic and ethical sense to invest in this national strategy.

As per an estimate by World Poverty Clock, the estimated population living under extreme poverty and earning less than US\$ 1.8/ day is expected to increase to 46% from current levels of 44%**. Given the cyclic effect of poverty on economic growth, food consumption and ultimate revenues of food companies highlighted earlier, coupled with the fractional overall industry costs, it builds a more compelling case for the industry to come together and ensure the food being supplied is completely fortified.

*<https://www.gatesfoundation.org/TheOptimist/Articles/food%20fortification%20to%20fortify%20the%20future>

**World Poverty Blog: [https://worldpoverty.io/blog/index.php?](https://worldpoverty.io/blog/index.php?r=12#targetText=Nevertheless%2C%20the%20overall%20effect%20will,living%20under%20%241.90%20per%20day.)

[r=12#targetText=Nevertheless%2C%20the%20overall%20effect%20will,living%20under%20%241.90%20per%20day.](https://worldpoverty.io/blog/index.php?r=12#targetText=Nevertheless%2C%20the%20overall%20effect%20will,living%20under%20%241.90%20per%20day.)



KEY CONCLUSIONS

TABLE 7: INDUSTRY WIDE COSTS OF MANDATORY FOOD FORTIFICATION

Food Vehicle	Per capita consumption (kg/year)	Total fortification costs (p/year)		Total food industry costs for fortification		Total industry revenue		Per capita consumption (kg/year)
		₦	US\$	₦ M	US\$M	₦ M	US\$M	
Vegetable Oil	11.5	15	0.04	2933	8	2053900	5936	0.1%
Salt	4	7	0.02	1431	4	146400	423	1.0%
Sugar	10	21	0.06	4205	12	1090000	3150	0.4%
Wheat flour/ Semolina	23	52	0.15	10452	30	1039600	3005	1.0%
Overall Total		95	0.27	19020	55	4329900	12514	0.4%

Conclusion 4: Spending by government on regulating/ enabling Food Fortification is significantly lower than the public health expenditures due to MNDs.

Government investment in adequate and sustainable enforcement to food fortification could yield approximately US \$178 million or ₦62 billion in savings.

Literature has shown that the Nigerian government spends roughly 1% of its GDP on health and private health expenditure is another 3% of GDP, out of which 0.5% is assumed to be contributed by donor organizations like the Gates Foundation*. Given that 2% and 5% of this public and private expenditure** is used in addressing issues due to MNDs (even as a very conservative estimate as per the WHO report), the total health expenditure due to micronutrient deficiency comes out to be ₦309 / person/ year (Table 8).

Just for perspective, when we use Table 5 above to calculate the per capita industry wide costs of food fortification, the total incremental costs for the industry is US\$ 0.27/ person/ year or ₦95 / person/ year. Thus, the health expenditure due to MNDs is almost thrice the total industry wide costs of mandatory fortification for the entire Nigerian market. The actual number would in fact be even higher since we haven't considered the private expenditure done by individuals on MNDs, which would also translate into direct disposable income and uplift people from poverty.

*Indexmundi. <https://www.indexmundi.com/facts/nigeria/health-expenditure#targetText=The%20value%20for%20Health%20expenditure,was%2025.15%20as%20of%202014.>

**World Health Organization (2018). Public Spending on Health: A Closer Look at Global Trends



KEY CONCLUSIONS

This is in line with the findings for other developing economies. For example, a 2008 WHO report by top economists details the costs benefit analysis of public health interventions. Fortification is validated to be the most cost-effective solution, with costs ranging from \$0.05 to \$0.25 per person per year. In Tanzania, iron, vitamin A and folic acid deficiencies cost \$518 million (2.65% of GDP) according to a World Bank estimate. Thus, each dollar spent guarantees an \$8.22 in return*.

Given the direct (in healthcare spending) and indirect (increased productivity and GDP growth) economic benefits of adequate fortification, it presents a very strong case for government to make all the necessary investments to drive adequate fortification compliance. The current investments by the regulators in this direction are much lesser than these accumulated benefits.

From a business perspective for the government, this investment towards increasing compliance ensures that Nigeria is on the path of GDP growth and economic development.

TABLE 8: TOTAL AND PER CAPITA HEALTH EXPENDITURE ON MNDS

Nigeria GDP (million ₦)	Government (Public) health expenditure on MNDS			Donor health expenditure on MNDS			Total health exp on MNDS (million ₦)	Per capita exp (₦/ person/ year)
	Public exp. (%GDP)	% public exp on MNDS	Total public exp (million ₦)	Donor exp (% GDP)	% public exp on MNDS	Total public exp (million ₦)		
137455420	1%	2%	27491	50%	5%	34364	61855	309

*<https://www.who.int/vietnam/news/feature-stories/detail/food-fortification-q-a>



KEY CONCLUSIONS

The cost analysis of fortification hence leads us to the following conclusions:



Majority of the food fortification costs are attributed to the cost of premix. The fortification process, contrary to popular belief, is extremely cost effective and hence nullifies the entire argument around the process inefficiencies and optimization. Thus, the fortification costs are optimized and in-line with global averages.



The fortification process is a minor cost as compared to other costs like overall production, marketing and distribution. Retail prices increases under ~1% can offset the costs of fortification, which is much lesser than the natural variation in costs across brands. Thus, companies should look at optimizing other cost buckets and use fortification as a competitive advantage for long term sustainable growth.



The industry wide cost analysis also implies that fortification is just 0.3-1.5% of the industrial revenue but has long term benefits in terms of higher workforce efficiency, economic growth and thereby increased consumption and paying capacity, and reverse the projections of increased poverty in Nigeria by 2030. This presents a strong case for the industry to come together and work towards increased awareness and adequate supply of fortified foods to increase the compliance of fortified food consumption.



For government organizations like NAFDAC and SON, fortification has a strong incentive, not only from a public health and wellness standpoint, but also financially. The current spending on health easily offsets the per person cost of fortification, thereby implying a strong business case for going all and taking proactive interventions in to ensure compliance to mandatory fortification.



KEY RECOMMENDATIONS

SELF-REGULATION AND COMMITMENT TO ADEQUATE FORTIFICATION BY THE INDUSTRY

Having established that fortification cost is already optimized and in-line with global benchmarks, the food processors should focus on strong self-regulation to ensure compliance to mandatory fortification standards.

This includes ensuring adequate measures at different points in the supply chain. Some of these measures are highlighted below:

PROCUREMENT

The food processors should ensure that they procure the premixes only from registered suppliers that have been validated by the NAFDAC. Additionally, they should engage in active engagements with the premix industry to create a consistent and sustainable supply of premixes. They should invest in re-validating the premix samples received from the suppliers to ascertain compliance, provide feedback and take adequate actions as necessary.

PRODUCTION

Companies should ensure the right process controls to ensure adequate dosing of the premixes to the food vehicles. They should also invest in training their personnel for the right manufacturing practices to fortify and test the products to ensure sustained compliance. They could leverage partners like Technoserve for getting the right technical assistance and process guidance.

QUALITY

Like production, companies need to ensure they have the right equipment, well calibrated and approved, for testing the presence of Fortificants. The operators should be trained, and the labs being used for the tests should be adequately accredited. GAIN and Technoserve could also provide the technical and process assistance in this regard.

STORAGE & DISTRIBUTION

Lastly, the storage and distribution for the processed food should be as per standards and one that minimized degradation of vitamins and minerals in the food vehicles. Companies should avoid open truck transfers, transparent storage and bulk transfers that don't comply with the standards.



KEY RECOMMENDATIONS

LEVERAGE FORTIFICATION AS A COMPETITIVE ADVANTAGE TO COMMAND A WINNING PRODUCT PROPOSITION AND HIGHER MARKET PRICE IN THE LONG-TERM

Since fortification cost is negligible compared to other costs and is a very small fraction of the retail price, the companies should focus on optimizing other costs while strongly using self-regulation to comply to fortification standards.

This is the right strategic investment towards building a strong brand that aligns well with the SDGs, which is going to be a major factor for companies in the future for winning and sustaining in the market. Building the right capabilities, behaviours and product that meets the quality and fortification standards would help the companies command a winning product positioning and a price premium in the long-term.

However, the journey towards this compliance needs to start now to ensure adequate level of readiness. Given the lack of correlation between price and market share, the minor price increase can ultimately be passed onto the population once the economic condition and purchasing capability of the population is above a threshold level.

We already know that fortification commands a ₦2 - ₦3 increase in retail price to offset the costs. Table 9 presents the analysis and impact of passing on this price increase onto the public. Assuming an average household size of 5 people, the average retail price and the average per capita consumption of staple food items, the household expenditure on these increases from ₦108248 Naira to ₦108849 Naira annually (if fortification cost is added to the retail price). This is just a 0.6% increase in the household expenditure for staple food items.

Assuming one earning family member per household with an average income of ₦41800/month*, this implies that the annual expenditure on fortified foods increases from 21.6% to 21.7% of the total household earnings. Given the relatively price inelastic nature of basic food vehicles like cereals, rice and oil as cited in multiple studies** and shown above in Figure E, it builds a compelling business case of passing on this price increase to the consumers without having any negative impact on consumption behaviours or their household budgets.

**<https://www.who.int/vietnam/news/feature-stories/detail/food-fortification-q-a>

**L. Colen, P.C. Melo, Y. Abdul-Salam, D. Roberts, S. Mary, S. Gomez Y Paloma (2018). Income elasticities for food, calories and nutrients across Africa: A meta-analysis



KEY RECOMMENDATIONS

TABLE 9: ESTIMATED IMPACT ON HOUSEHOLD EXPENDITURE OF THE PRICE INCREASE DUE TO FOOD FORTIFICATION

Food Vehicle	Per capita consumption (kg/year)	Per household consumption (kg/year)	Retail price (₦)	New retail price (₦)	Original household expenditure (₦)	New household expenditure (₦)
Vegetable Oil	11.5	57.5	893	895	51348	51438
Salt	4	20	183	185	3660	3707
Sugar	10	50	545	548	27250	27382
Wheat flour/ Semolina	23	115	226	229	25990	26323
Overall Total					108248	108849

MARKETING BENEFITS OF FOOD FORTIFICATION AND BUILDING PUBLIC AWARENESS TOGETHER AS AN INDUSTRY

The private sector, in partnership with the public sector, should also introduce a widespread marketing campaign in order to change the consumer behaviour in the right direction towards consumption of fortified food items only.

Firstly*, all the private sector companies need to come together to craft communication strategies that create the demand for fortified products. The strategies should also have the right coverage and reach the poor effectively, which can be achieved by the right level of engagement of government agencies. We know that blatantly marketing health benefits is not always welcome as an effective communication campaign. An in-depth understanding of the properties people value in their foods, perception of fortification and perceived advantages and disadvantages of food processing is needed. Some successful examples of marketing campaigns are:

- Vitamin A fortified sugar was marketed as “sweet” in Bolivia because consumers believed it would change the taste of their food or beverage
- “When it rains, it pours”. Advertising the dryness of salt, Morton Salt, USA
- “Strengthens your baby’s health and immune system”, Gerber fortified infant cereals, USA

*Marcia Griffiths – Food and Nutrition Bulletin, vol. 24 (2003). Communicating the benefits of micronutrient fortification



KEY RECOMMENDATIONS

The second important consideration here is tailor-making the communication strategies to each audience according to their perceptions and needs – what might work for affluent well-paying individuals might not work for the poor population. For example, the urban consumers might give importance to packaging and might regard fortified sugar as “cleaner” while the rural consumers might not be interested in packaging but affordability and the “extra sweet” element of sugar.

On similar lines, one of the classic cases of demand creation is the way Procter and Gamble succeeded in the crowded soap industry. They marketed “Ivory” white soap as a symbol of purity and its ability to float. There was never a need for marketing its personal hygiene, an obvious property linked to any soap. They followed it up with subsequently successful campaigns and market leadership with Chipso and Dreft.

The right communication strategies would not only give the companies that comply to fortification a competitive edge but is also the right direction to ensure long term sustainability of the fortification process by shifting the consumer behaviour towards consumption of healthier foods and investing their earnings in food quality.

INCREASE GOVERNMENT INVESTMENT IN NATIONAL FORTIFICATION PROGRAM VIA TARIFF REDUCTION, INCREASING PUBLIC AWARENESS AND CREATING A STRONGER ENABLING/ REGULATORY ENVIRONMENT

Given the huge economic benefits to the government budget, food fortification and MNDs need to be specifically called out in the annual budgets and disproportionately higher investments needs to be made to ensure fortification compliance. The public sector should impose stricter controls and monitoring mechanisms, like that for salt for driving food fortification compliance.

Given the strong commitment by most of the companies to absorb the food fortification costs, the government should undertake enabling measures to thrust the Nigerian market towards adequate compliance.



KEY RECOMMENDATIONS

One such strong gesture would be eliminating import duties and levies on premixes, vitamins and associated consumables like i-check quality vials. Not only would it eliminate the sporadic demand and continuous price fluctuations in premix costs, it would also prevent the constant back and forth between the premix suppliers and the companies. Consequently, Table 10 models the potential impact of complete elimination of these tariffs. As indicated, tariff reduction leads to a saving of roughly US \$4.5 million for the industry, which is roughly 8% of their fortification costs of US \$55 million (Table 7). However, for the government, it is just 2.5% of the direct savings they get from the reduction in healthcare expenditure of US \$178 million (Table 8).

TABLE 10: IMPACT OF TARIFF ELIMINATION ON TOTAL INDUSTRY COSTS

Food Vehicle	Original tariffs - Fortification costs per MT/ 1000L (US\$)	0 tariffs - Fortification costs per MT/ 1000L (US\$)	Original total industry costs (million US\$)	Reduced total industry costs (million US\$)	Savings (million US\$)
Vegetable Oil	4.2	4.0	9.7	9.1	0.6
Salt	5.1	4.8	4.1	3.8	0.2
Sugar	5.9	5.4	11.9	10.8	1.1
Wheat flour/ Semolina	6.5	5.9	29.7	27.0	2.6
Overall Total					4.5

Apart from the elimination of tariffs, the rest 97% of the healthcare savings should go into creating an enabling environment for the success of food fortification program. This could include, but is not limited to, awarding of premix quality certifications, setting up labs at ports of entry and within Nigeria to ensure compliance, including premix as a part of quality standards that are widely recognized by the public and strengthening un-announced food audits to ensure compliance.

KEY RECOMMENDATIONS

They also need to support the industry by creating widespread consumer awareness for consumption of fortified foods via television, radio and health camps, which is a systematic way to change consumer consumption behaviour. They should also actively engage with partners like GAIN and TechnoServe and leverage these as the third independent eye for technical assistance, monitoring and feedback to the companies. Lastly, the actions against the non-compliant players need to be stringent in terms of fines, cancellation of certifications or exposure in the media. These measures act as the required stick for ensuring the right level of compliance in the industry.

For example*, the Philippines awards Sangkap Pinoy seal to manufacturers that meet the fortification standards for vitamin A, iron or iodine. They also marketed this certification program with widespread multimedia coverage in print, radio and television - Fortified foods kainin, dagdag sustansya'y kamtin—Eat fortified foods to meet nutrient needs, look for Sangkap Pinoy seal. Thus, it made public aware of the superior quality thereby encouraging them to consume food items with the seal. The government has setup a technical committee to perform quality assurance and monitoring on a regular basis. Thus, this program has acted as a key enabler for private sector to market fortified foods with government support (while creating a competitive advantage) and created a healthy environment for public-private partnership in the food fortification program.

*Florentino S. Solon, Liza E. Sanchez-Fermin, and Lorena S. Wambangco (2000). Strengths and weaknesses of the food fortification programme for the elimination of vitamin A deficiency in the Philippines

