World Food Programme

SAVING LIVES CHANGING LIVES

Summary of Evidence on the Economic Benefits of Large-Scale Food Fortification

Micronutrient deficiencies have debilitating consequences on human health and local economies. Food fortification is one of the most accepted and scientifically proven ways to tackle micronutrient deficiencies on a large scale.

Across the world, large-scale food fortification (LSFF) has also proven to be an inexpensive intervention that helps reduce the cost and non-affordability of a nutritious diet, yields high returns on investment, and is highly cost-effective. These economic benefits have helped position fortification as an essential strategy for saving lives and changing lives.

PART 1: The consequences of micronutrient deficiencies on human health and national economies

Deficiencies of micronutrients (vitamins and minerals) affect over 2 billion of the world's population, including one in two pre-school-age children and two in three women of reproductive age [(1)].

Micronutrient deficiencies occur when individuals fail to meet nutrient requirements due to the unavailability or unaffordability of a diverse and nutrient-rich diet. Micronutrient deficiencies are particularly common in poor households where less nutritious staples, such as bread, rice and maize are the dominant foods. Though these households may meet their daily energy needs, their vitamin and mineral needs remain unmet [(2)].

Deficiencies of the essential vitamins and minerals needed by the body to maintain optimal health and immunity can cause severe and even life-threatening conditions, contributing to increased maternal and child mortality, impaired immune function, and reduced cognitive and physical development and performance [3].

The economic consequences of these health outcomes are significant, with micronutrient deficiencies costing low- and middle-income countries (LMIC) an annual gross domestic product (GDP) loss of 2% to 5% in lost lives, disability and lost productivity [4-6]. Estimates for annual GDP losses in LMICs have even reached as high as 8% for physical and cognitive productivity losses due to iron deficiency [7].

With micronutrient deficiencies representing such a significant barrier to economic growth, addressing this public health concern on a large scale is critical to sustainably improve health, human capital, local economies, and the future development and resilience of countries.

PART 2: The economic benefits of large-scale food fortification as a strategy to address micronutrient deficiencies

LSFF involves enhancing the vitamin and mineral content of widely consumed foods during post-harvest processing [3].

LSFF has proven to be one of the most effective strategies to reduce micronutrient deficiencies on a large scale, when sufficiently diversified diets are inaccessible [8].

The economics of food fortification has played an important role in its implementation in public policy across the world since the practice began in the 1920s [9].

1 | Food fortification can help reduce the cost and non-affordability of a nutritious diet

WFP's Fill the Nutrient Gap (FNG) is an analytical framework that combines an analysis of barriers to nutrient intake and the contributions across sectors needed to overcome these barriers, with a multi-stakeholder engagement process to support decision-making for improved nutrition policy and practice. To date, FNGs have been conducted in over 40 countries [10].

For more information and to read WFP's FNG topic and country reports, please visit the FNG publications page.

The FNG process relies on the calculation of the cost and affordability of nutritious diets for specific countries and regions, using locally collected price and expenditure data and accounting for the needs of individual household members. The FNG conceptual principles and methodology are summarized in Bose et al [11].

The FNG can model the impacts of specific interventions, including fortification, on the cost and affordability of nutritious diets.

According to WFP's FNG analyses, fortified foods have the potential to reduce the cost and non-affordability of nutritious diets for all household members. This holds true across:

- regions of analysis (Asia and the Pacific, West Africa, Southern Africa, East Africa, and Latin America and the Caribbean);
- food vehicles (rice, wheat flour, and maize flour);
- different price increases modelled for the fortified vehicle; and
- fortification standards.

The cost of nutritious diets is reduced by a higher proportion for more nutritionally vulnerable household members (i.e., children, adolescent girls, and pregnant and breastfeeding women), as their high nutritional needs are often difficult to meet with locally available foods.

INDONESIA

If the rice included in a nutritious diet was fortified (post-harvest) and priced 3 percent above the market price of unfortified rice, the daily cost of a nutritious diet for the modelled household would be reduced between 12 and 21 percent, depending on the region. If post-harvest fortification were available to all consumers in Indonesia, it could decrease the cost of a nutritious diet for the population as a whole. For example, in the region of Nusa Tenggara Timur, an additional 26 percent of people in urban areas and 11 percent in rural areas would be able to afford the lowest-cost nutritious diet if all rice were fortified.

AFGHANISTAN

Replacing standard wheat flour with fortified wheat flour using national standards with no change in price could reduce the daily cost of a nutritious diet for the modelled household by 10 to 22 percent, depending on the region. Fortification would also improve access to nutritious diets in all areas modelled. The greatest improvement was found in urban Herat, where the number of households unable to afford a nutritious diet could decrease by 20 percentage points (from 56 percent to 36 percent).

It is important to note that the lower cost does not necessarily mean that households will reduce income spent on food with the consumption of fortified foods. Rather, these results illustrate that the risk of micronutrient deficiencies would be lower, as it would be cheaper for households to meet their essential nutrient needs.

2 | Food fortification has a high return on investment

According to analyses carried out by a panel of global economic experts for the Copenhagen Consensus Center

FOOD FORTIFICATION IS RANKED AMONG THE TOP NUTRITION INTERVENTIONS IN TERMS OF ECONOMIC RETURN ON INVESTMENT FROM AVERTED DISEASE, IMPROVED EARNINGS AND ENHANCED WORK PRODUCTIVITY.

Food fortification was described as having “tremendously high benefits compared to costs” and ranked top three in international development priorities [12].

Analyses from the Global Alliance for Improved Nutrition (GAIN) and Bill and Melinda Gates Foundation (BMGF) estimate that, on a weighted average, every US $1 invested in food fortification generates US $27 in economic return from averted disease, improved earnings, and enhanced work productivity. As a comparison, the benefit-cost ratio of child vaccination is approximately 16:1 [13].

BENEFIT-COST RATIOS FOR FORTIFICATION

Iodine

According to estimates from the 2008 Copenhagen Consensus, the benefit-cost ratio for salt iodization is 30:1 [14]. In other words, every 1 monetary unit invested in salt iodization generates 30 monetary units in economic return. More recent calculations from work in Ethiopia suggest that the benefit-cost ratio could be as high as 81:1 [15].

Iron

According to simulations in ten low- and middle-income countries, the median benefit-cost ratio for long-term iron fortification programs is 6:1 for the effects on physical productivity and nearly 9:1 when cognitive benefits are included [7].

Folic acid

According to a systematic review, the median benefit-cost ratio of mandatory folic acid fortification of flours is 17.5:1 from neural tube defect prevention [16]. To put this into perspective, considering averted costs of minimal medical intervention during the first 3 years of life from the prevention of spina bifida, folic acid fortification in South Africa resulted in net cost savings of R40.6 million per year (approximately US $6.05 million/year [i]). These savings represent a benefit-cost ratio of 30:1 [17].

3 | Food fortification is cost-effective

The high cost-effectiveness of food fortification, as measured by cost per death averted or cost per disability-adjusted life year (DALY) [ii] saved, has helped position fortification as a high priority intervention [9].

DISABILITY-ADJUSTED LIFE YEAR (DALY)

DALY is a measure that combines years of life lost due to premature mortality and years of life lost due to disability as a result of a disease or health condition (WHO, DALY). One DALY represents the loss of the equivalent of one year of full health [18] (1). Using DALYs, the burden of diseases that cause premature death but little disability (e.g., drowning or the measles) can be compared to that of diseases that do not cause death but do cause disability (e.g., cataract causing blindness) [18]. When a cost-effectiveness analysis uses a generic measure of health status, such as the DALY, standardized cost-effectiveness thresholds are often used to determine whether an intervention is cost-effective or not [19]. The threshold is an explicit cost per unit of outcome below which an intervention is considered cost-effective (e.g., USD 20,000 per DALY saved) [19]. Since different countries may use different thresholds, the examples presented here may or may not be considered cost-effective in specific contexts.

The World Bank proposes that a public health intervention is ‘very cost-effective' if its cost per DALY saved is below US $150 [ii] [18,20,21]. If we employ this threshold, fortification, according to the below examples, is a very cost-effective option to address micronutrient deficiencies.

COST-EFFECTIVENESS OF FORTIFICATION

Multi-micronutrients

According to estimates from Bangladesh (iii) and Cameroon (iv), each DALY saved due to multi-micronutrient fortified wheat flour costs between US $14.75 and US $34.50 [21,22].

Vitamin A

According to estimates from Bangladesh and Uganda, the cost per DALY saved from the use of vitamin A-fortified vegetable oil ranges from US $3.12 to US $18 [22,23].

Folic acid

According to estimates from Zambia, each DALY saved due to mandatory folic acid fortification of maize flour costs US $14.90 [25]. In Chile, each DALY saved due to folic acid fortification of wheat flour costs I $89 [v] [26], representing 0.8% of Chile's GDP per capita [27].

4 | Food fortification is inexpensive

Well-implemented food fortification programmes significantly impact the health and productivity of target groups for a comparatively low cost [3].

It is important to note that the cost of fortification is determined by various context-specific variables, including the structure and capacity of the industry, the complexity of the supply chain, the policy and regulatory environment, including whether taxes are applied to imported equipment and premix, the food vehicle used, and the micronutrients added [28].

COST OF FORTIFICATION PER CONSUMER

Multi-micronutrients

According to estimates from Cameroon [vi], over 10 years, mandatory wheat flour fortification was predicted to cost US $0.12 per woman or child reached [23]. More generally, according to analyses conducted by GAIN and BMGF, wheat and maize flour fortified with iron and folic acid costs US $0.12 per person reached per year, with lifetime costs of less than US $15 per person for these two fortified foods [13].

Iodine

According to estimates from the 2008 Copenhagen Consensus, salt iodization costs approximately US $0.05 per person per year [14].

Iron

Depending on the iron compound and level and the food vehicle used, the cost of iron fortification can range from US $0.10 to US $0.12 per person per year [14].

The cost of fortification can also be expressed in terms of retail price increase. According to the below examples, the increase in retail price as a result of fortification is low (1% or below after having reached economies of scale) and relatively similar across food vehicles.

COST OF FORTIFICATION IN THE MARKET

Rice

For fortified rice, according to information available from global experience, the retail price increase ranges from an additional 1% to 10%. Importantly, as rice fortification expands, production and distribution achieve economies of scale and costs are expected to decrease [29]. For example, in Costa Rice, at program onset, retail prices for fortified rice increased by 5% to 6% but dropped to only 1% after efficiency was improved and costs across the supply chain were minimized [30]. In Costa Rica, this incremental cost is passed on to consumers in the market. Prior to the global food crisis, we could expect to see fortified rice costing approximately US $8-28 more than unfortified rice per metric ton (US $0.008 - 0.028 per kg), assuming it was fortified at scale and with effective quality controls in place [vii]. For example, in India, fortified rice costs US $0.009 per kg more than unfortified rice, representing a 1.7% increase compared to unfortified rice [31]. This incremental cost of fortified rice is currently borne by the Government of India, as part of their national social protection programmes.

Wheat flour

In Pakistan, the cost of fortifying wheat flour produced by large mills (50% of the national demand) according to the recommended national standard is US $0.0017 per kg, which is 0.4% of the current retail price of US $0.40 per kg [32].

Maize flour

According to estimates from Zambia, Kenya and Uganda, the annual incremental cost of maize flour fortification ranges from US $3.19 to US $4.41 per metric ton. Assuming all incremental costs are passed on to the consumer in these three countries, fortification would result in, at most, a 0.09% increase in the price of maize flour. For example, in Uganda, if unfortified maize flour costs US $0.69 per kg in the market, fortified maize flour is estimated to cost US $0.74 per kg, representing a 0.07% increase [33].

CONCLUSION

Food fortification is a low-cost, highly cost-effective intervention that yields high returns on investment for an important public health problem, making it a key strategy for countries seeking to improve population health and develop their economies.

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Notes

i. Conversion calculated using average exchange rates for 2006.

ii. This threshold was proposed in 1993. If the value is adjusted for the change in purchasing power of the dollar, the alternative threshold, calculated in 2014, is USD 268 per DALY saved [(18)].

iii. The model estimated the cost-effectiveness of wheat flour fortification with calcium, iron, thiamine, riboflavin, niacin, pyridoxine, vitamin B12, zinc, vitamin A and folic acid using the fortification levels established in the official Bangladesh fortification regulations.

iv. The model estimated the cost-effectiveness of mandatory wheat flour fortification with iron, folic acid, zinc and vitamin B12 using the World Health Organization standards.

v. International dollars (I$) are calculated by dividing local currency units by an estimate of their purchasing power parity (PPP) compared to a US dollar. PPPs are the rates of currency conversion that equalize the purchasing power of different currencies by eliminating the differences in price levels between countries. In other words, an international dollar has the same purchasing power as the US dollar has in the United States [(26)].

vi. The model estimated the cost of mandatory wheat flour fortification with iron, folic acid, zinc and vitamin B12 using the World Health Organization standards.

vii. Other important factors that influence price include, but are not limited to: fortification levels of different micronutrients, blending ratio, current price of rice that is used to create the FRKs when using extrusion technology, potential import duties/taxes, etc.

NUTRITION

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