



Food fortification:
A “techno-fix” or a sustainable
solution to fight hidden hunger?





The Future of Global Relations



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A “techno-fix” or a sustainable solution
to fight hidden hunger?**

About the report

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This study marks the beginning of the new international series of reports On the future of global relations, which Welthungerhilfe and terre des hommes will publish in German and English. In this series, we will examine various topics related to our programme work and to development policy. Our goal is to highlight political scenarios and developments and possible consequences for our partners, the people we work for, and our own organisations. The series will examine controversies and conflicting views on issues, and make a significant contribution to questions about future developments in global relations.

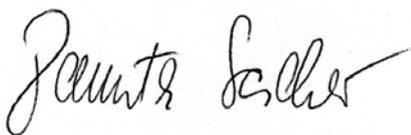
This first report in our series looks at food fortification and related risks and opportunities. Micronutrient malnutrition, known as “hidden hunger”, affects about 2 billion people in the world. It is part of a triple burden of malnutrition (including undernutrition and overweight and obesity) that represents a fundamental development problem and a significant violation of human rights in today’s world. The persistent and widespread deficiency of basic micronutrients (vitamins and minerals) – so-called „hidden hunger“ – is a global food issue. It adversely affects people’s opportunities and the prospect of achieving sustainable development in affected countries.

As a response, various types of fortification with vitamins and minerals are being promoted to fight hidden hunger. In general, however, food fortification remains a highly controversial issue among nutritionists.

With this study, Welthungerhilfe and terre des hommes aim to: shed light on the debate; present various arguments to the public; and clarify potential benefits and risks associated with food fortification. In this context, the two guest statements represent on the one hand a positive and on the other a more critical human rights perspective. Also, we would like to thank Professor Hans Konrad Biesalski, University of Hohenheim, for his cross-reading and commenting.

The study concludes with a number of recommendations aimed at a variety of different stakeholders. Welthungerhilfe and terre des hommes will monitor these carefully.

Bonn/Osnabrück, June 2014



Danuta Sacher
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Food fortification: A “techno-fix” or a sustainable solution to fight hidden hunger?

Is food fortification a “techno-fix” or a sustainable solution to food fortification – or something in between? The report’s title indicates the spectrum of opinions characterising the debate. Indeed, there is evidence that food fortification is a cost effective nutrition intervention that contributes to the treatment and prevention of hidden hunger. It is part of the broader “toolbox” of nutrition specific and nutrition sensitive instruments in various sectors. A number of multi-stakeholder alliances, governments, UN organisations, private sector companies and NGOs at global and country level, promote and support food fortification. The strategy has been endorsed by major nutrition players, such as the Scaling up nutrition (SUN) initiative, the research community (through an influential Lancet series in 2008 and 2013), and the Copenhagen Consensus (2008 – an economic panel on best “buys” in development – see *Box 13*).

But this picture is not the full story. The report is also very outspoken about the risks and limitations of food fortification. As a single intervention, it neither cures the symptoms, or the causes of vitamin and mineral deficiencies. Isolated fortification initiatives do not address the complex and mostly chronic nature of food and nutrition insecurity, including hidden hunger, which has its roots in poverty. There is widespread agreement that measures for eliminating hidden hunger should be based on dietary diversification and consumer education about choosing a balanced and micronutrient-rich diet. Such measures should be combined with interventions that address the underlying factors leading to micronutrient deficiencies, such as sustainable production and consumption of diversified diets and jobs or income support that ensure access to available food.

And there are many challenges with food fortification, highlighted in this report. Fortified foods are often economically and geographically out-of-reach of those people most affected by micronutrient deficiencies. They often lack the resources to buy more expensive fortified foods, or live in rural areas where they are not readily available. Other concerns centre on the threat posed to local

environments and food cultures. Different types of fortification, including biofortified crops, challenge dietary patterns based on fresh and minimally processed foods, and undermine food-based approaches characterised by access to and consumption of diverse crop varieties and plant and animals species. There are also a number of technical challenges, as well as the neglect of small(er) scale, local food processing companies which may not have access to fortification technologies. Many developing countries also lack sufficient regulatory frameworks to monitor various aspects of the intervention, such as fortification levels, marketing and promotional activities by companies, and for balancing the conflict of interest between stakeholders.

The most contentious aspect of the debate is the role of the private sector and the combination of resources in PPPs (public private partnerships). On the one hand, food fortification requires collaboration and cooperation between industry and government agencies. On the other, there are doubts as to whether markets can deliver both short-term financial returns for companies and long-term social, economic and health benefits to tackle micronutrient deficiencies. Using public sector resources for the funding of food fortification diverts resources from interventions that promote the longer-term goal of ensuring food security and sufficient sources of nutrients from culturally appropriate and nutritious foods.

The challenge is to balance the conflicts of interest and power between both sectors, public and private, involved in fortification strategies and the people suffering from, or vulnerable to, micronutrient deficiencies and violations of their right to adequate food. Given existing realities, the question today is, however, less about whether to engage with the private sector but rather, how to do it best. Then food fortification can effectively contribute to the elimination of hidden hunger in a sustainable way.

Applying a rights-based approach to food and nutrition security, including the fight against mi-

cro-nutrient deficiencies, asks for a people-centered approach and food systems that are designed and function in the interest of people affected by malnutrition (including hidden hunger). The findings of this report clearly show that food fortification can make an important contribution to collective efforts at all levels to achieve food and nutrition security. There is, however, no quick “techno-fix” to persisting and widespread micro-nutrient deficiencies. The essential action for adequate food fortification initiatives is their integration into comprehensive and effective national food and nutrition security policies, strategies and programmes that also address the possible risks of food fortification and the complex causes of hidden hunger.



Introduction

1.1 The multiple burden of malnutrition

Despite significant advances over the past two decades, undernutrition and malnutrition is still a major public health and development challenge. The Food and Agriculture Organisation (FAO) estimates that since 1990-1992 the number of undernourished people (caused by inadequate energy consumption) in developing countries has declined from 980 million to 842 million people, although that still represents one in eight people in the world.^{[1][7]} There is also an increasing recognition that malnutrition is a broader problem than just insufficient intake of dietary energy and protein (so-called “undernourishment” or hunger – see *Box 1*). Malnutrition also encompasses two other dimensions – micronutrient deficiencies, and overweight and obesity – collectively referred to as the ‘triple burden’ of malnutrition.^[2] And it is now estimated that much greater numbers of people suffer from one or both of the latter two forms of malnutrition than the 842 million who are undernourished, although there is considerable overlap between the different categories. Micronutrient malnutrition, for example, can co-exist with excessive consumption of energy dense macronutrients (i.e. overweight and obesity).^[3] All three forms impose enormous economic and social burdens on countries at all income levels.

In developing countries, child and maternal malnutrition is associated with more than one third of deaths in children under five years of age.^[5] It is also the largest nutrition-related health burden at the global level, almost twice the social costs of adult overweight and obesity (despite this form of malnutrition almost doubling in the last two decades).^[6] Undernutrition and micronutrient deficiencies should therefore continue to be the highest nutrition priority on the development agenda, with the challenge for policymakers being how to address these forms of malnutrition while avoiding or halting the increase of overweight and obesity.^[6] Overnutrition is becoming an increasing burden in low and middle developing countries due to a transition in the dietary intake of populations

and food systems, along with a change in their physical activity patterns.

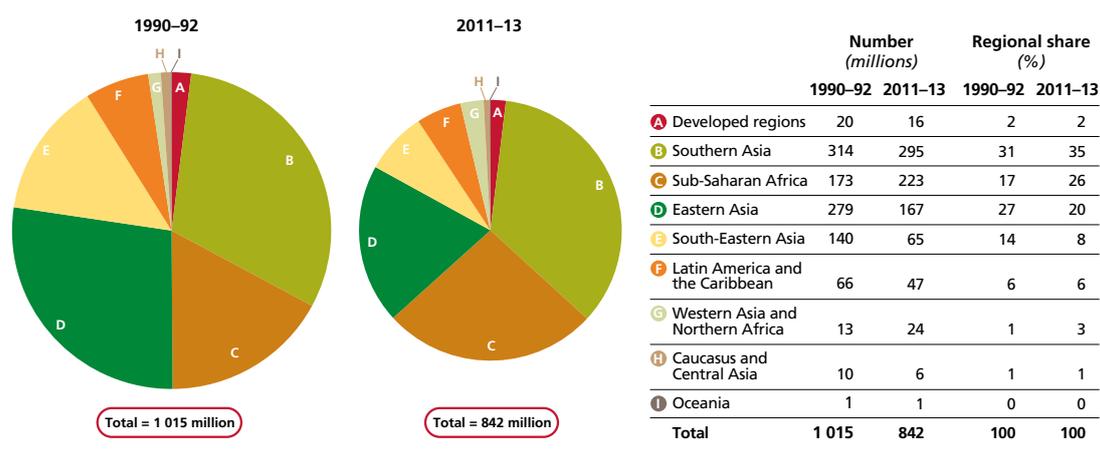
While tackling hunger in its most basic sense has been recognised as a humanitarian issue, the long-term impact on individuals and societies has not. But nutrition is now firmly on the international agenda. On 8 June 2013, a high-level summit – *Nutrition for Growth* – took place in London, and 24 national governments and 28 “Big Business” and scientific organisations signed a *Global Nutrition for Growth Compact* to make nutrition a political priority. This was backed by financial commitments of more than \$4bn (£2.6bn) for undernutrition programmes until 2020. At the same time, a mass civil society rally attended by 45,000 people in London’s Hyde Park called on the G8 to “act on global hunger”. The first international congress on hidden hunger, with a focus on assessment and solutions, took place in Stuttgart, Germany, in 2013, with another planned for 2015.

Box 1

Hunger and malnutrition

The majority of those suffering from hunger and malnutrition are smallholders or landless people, mostly women and their children living in rural areas without access to productive resources.^[4] Although many people might imagine that deaths from hunger generally occur in times of famine and conflict, the fact is that only about 10% of these deaths are the result of armed conflicts, natural catastrophes or exceptional climatic conditions. The other 90% are victims of long-term, chronic lack of access to adequate food.^[4] Many “high burden” countries are in Sub Saharan Africa and South Asia where extreme poverty, chronic undernutrition and, in particular, the prevalence of multiple micronutrient deficiencies remain unacceptably high.

Figure 1

Number and share of undernourished people by region, 1990–92 and 2011–13 ^[7]

Note: The areas of the pie charts are proportional to the total number of undernourished in each period. All figures are rounded.
Source: FAO.



Box 2

Definitions of different forms of malnutrition^{[1][7][9]}

Malnutrition is an abnormal physiological condition caused by inadequate, unbalanced or even excessive consumption of macronutrients that provide dietary energy (carbohydrates, protein and fats) but not all the essential micronutrients (vitamins and minerals), some of which are important for physical and cognitive development.

Undernourishment refers to food intake that is insufficient to meet dietary energy requirements for an active and healthy life (FAO defines this as an average food intake below 1,800 kilocalories a day)^[7]. *Undernutrition* is the outcome of insufficient food intake. *Hunger* is usually defined as the discomfort associated with a lack of food.

Micronutrient deficiencies (or *micronutrient malnutrition*) occurs when the body does not have sufficient amounts of vitamins or minerals due to inadequate food intake, and/or insufficient absorption, and/or suboptimal utilization, or an age- or disease-related increased need of micronutrients within the body.

Also known as “*hidden hunger*”, deficiencies of different vitamins and minerals result in impairment of the immune system and have a negative impact on organ function. This kind of hunger is called “hidden” due to a lack of specific symptoms related to the micronutrient. However, prolonged inadequacy of a micronutrient will finally result in specific disorders, depending on their essential function in the body.

Acute malnutrition (wasting) is normally the result of acute (short-term) insufficient food intake and frequent illness. Wasting is assessed by anthropometric measurements (weight for height) mainly in children below the age of five years, but also in adults (body mass index). *Moderate Acute Malnutrition (MAM)* refers to the percentage of wasted children below the cut-off point of -2 Standard Deviations (S.D.) compared to the reference population, while *Severe Acute Malnutrition (SAM)* refers to the percentage of wasted children below the cut-off point of -3 Standard Deviations (S.D.).

Chronic malnutrition (stunting) is normally an indicator of chronic (long-term) insufficient energy or micronutrient intake, which results in irreversible growth retardation and cognitive and mental impairment in the children in the first years of life (see *Box 6 – The first 1,000 days*). Stunting is the phenotype of hidden hunger which “invites” additional problems such as chronic or recurring infections. Children below five years of age are classified as stunted if they have a height-for-age z-score of less than - 2 S.D. compared with international growth standards.

Underweight is an indicator assessing adequacy of weight for age, the causes of which can be short or long-term and are difficult to define.

Low birth weight, i.e. weight that is less than 2.5kg at birth, is the result of premature birth (before 37 weeks gestation) or intra-uterine growth retardation (babies born at full-term who are underweight).

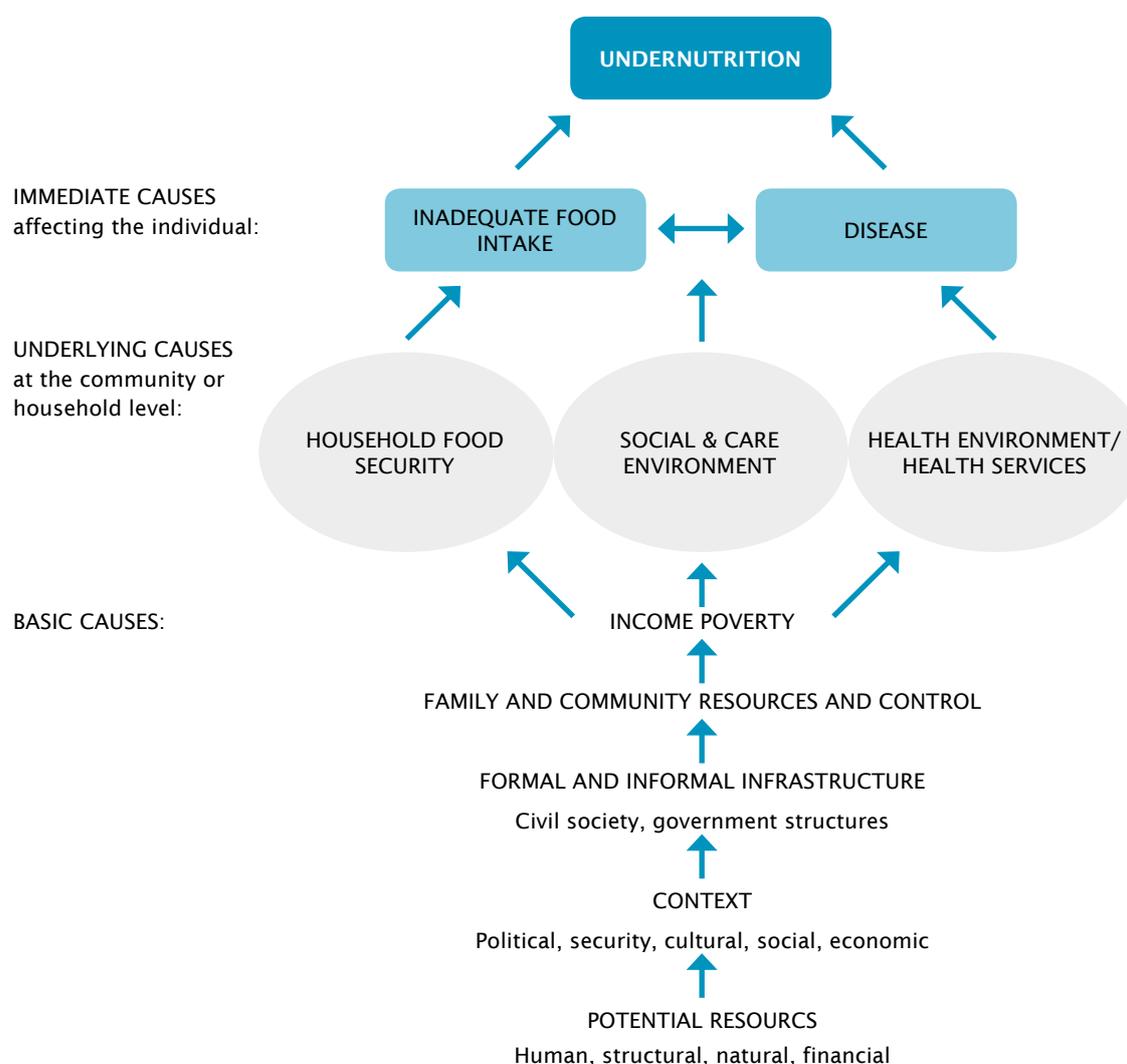
1.2 The causes of malnutrition

All forms of malnutrition share a common cause: unbalanced diets or diets with a low dietary diversity that provide inadequate, or excessive macro-nutrients and micronutrients. However, there may also be numerous factors acting at different levels, such as those identified in the UNICEF conceptual framework (see *Figure 2*), which was developed in the 1990s and is still widely used today. The immediate causes are inadequate dietary intake and disease, which directly impacts on an individual's nutritional status. These primary causes are influ-

enced by underlying causes, such as food access and availability, healthcare, water and sanitation, and the way a child is cared for (e.g. whether a child is breastfed, or levels of hygiene such as hand-washing), which operate at the household or community level. The basic causes of malnutrition are wide-ranging, from structural and natural resources to social and economic environments and political and cultural contexts, and operate at regional, national and international levels.

Figure 2

The UNICEF conceptual framework for undernutrition^[8]





1.3 What works in reducing malnutrition?

It is a combination of nutrition's multi-sectoral nature and chronic underfunding that has made tackling the problem of undernutrition so challenging. For a long time nutrition was described as “every-one’s problem and no-one’s responsibility”, and a lack of co-ordination at the highest levels (both national and international) has led to poorly targeted funding and a focus on short-term food aid and nutrition-specific interventions. However, a growing evidence base for what works in saving lives and improving maternal, infant and child health such as *The Lancet series on Maternal and child undernutrition*^{[9][10]}, has built support for investment in nutrition among bilateral and multilateral institutions, civil society organisations, research consortia and the private sector.

The estimated total annual cost of scaling up the most recent “*Lancet package*” of 10 direct nutrition-specific interventions (see *Box 3*) in the

34 focus countries (with 90% of the world’s children with stunted growth) is Int\$ 9.6 billion per year.^[11] It has been estimated that nutrition-specific interventions like fortification that only tackle the immediate causes of undernutrition (see *Figure 2*), such as poor breastfeeding practices or vitamin and mineral deficiencies, can only reduce global levels of chronic undernutrition by one-third and child mortality by one-quarter.^[8] Without efforts to address the underlying causes of malnutrition through nutrition-sensitive approaches – such as women’s empowerment, agriculture, food systems, education, employment, social protection and safety nets – the global problem will not be resolved.^[12]

Box 3

The Lancet package of 10 interventions^[11]

Optimum maternal nutrition during pregnancy

- Maternal multiple micronutrient supplements
- Calcium supplementation to mothers at risk of low intake
- Maternal balanced energy protein supplements as needed
- Universal salt iodisation

Infant and young child feeding

- Promotion of early and exclusive breastfeeding for 6 months and continued breastfeeding for up to 24 months
- Appropriate complementary feeding education in food secure populations and additional complementary food supplements in food insecure populations

Micronutrient supplementation in children at risk

- Vitamin A supplementation between 6 and 59 months of age
- Preventative zinc supplements between 12 and 59 months of age

Management of acute malnutrition

- Management of moderate acute malnutrition
- Management of severe acute malnutrition

1.4 The social (and political) determinants of nutrition

Critics claim that what is missing from the discussion of “what works” is a focus on the social determinants of nutrition (including its political determinants) – the basic causes – and that these are being ignored due to the increasing influence of private corporations and donors over public policy. The structural roots of hunger lie in the inequitable distribution of power, money and resources, and a lack of access to education, health services and sanitation, yet such issues are rarely, if ever, mentioned by the private sector.^[13] The activities of public private partnerships (PPPs – see 4.2) are criticised by rights-based organisations as reinforcing increasingly globalized food chains and undermining local food systems and household food security.^[14] Nutrition interventions, such as food fortification aimed at alleviating micronutrient deficiencies, have been described as technical solutions for what are fundamentally social problems.^[15]

According to FAO, the world produces enough food to feed its entire population. The root cause of hunger and malnutrition is therefore not a lack of food but a lack of economic access to adequate food. For example, poverty, social exclusion and discrimination often undermine people’s access to food not only in low income countries but in some of the most economically developed countries with an abundance of food.^[4] Malnutrition (in all forms) is one of the main pathways through which poverty is transmitted from one generation to the next. For this reason, the recognition of food as a human right (see *Box 4*) may be vital to achieving sustainable, long-term food security^[15] (see also *Box 4*).

It is against the backdrop of that debate that this report investigates the role of food fortification, including biofortification, in addressing one type of malnutrition, namely micronutrient deficiencies. Having established the complex nature of malnutrition, the report further examines the issues concerning hidden hunger, its prevalence, effects and causal factors, as well as links with changes in food systems. The next two chapters establish food fortification’s position as one of a number of approaches to tackle micronutrient malnutrition, describing both its origins and current forms, and the key players and programmes involved in fortification today. Opportunities and risks posed by this approach, with a focus on four specific types of fortification, are discussed in chapter five.

The following chapters highlight new developments and strategies in a global context and food fortification’s social and political ramifications. Having summarized the arguments for and against the strategy, the report concludes with action-oriented recommendations for different stakeholders.



Box 4

Some key definitions**The right to food**

Combatting hunger and malnutrition is more than a moral duty or a policy choice; in many countries, this human rights obligation is a legally binding part of national law.^[4] The *right to food* is recognized in the 1948 *Universal Declaration of Human Rights* as part of the right to an adequate standard of living, and is enshrined in the 1966 *International Covenant on Economic, Social and Cultural Rights*. Regional treaties and national constitutions also protect it. All human beings, regardless of their race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth or other status have the right to adequate food and the right to be free from hunger. The *right to food* is specifically defined as “the right to all nutritional elements that each individual needs to live a healthy and active life, and the means to access them”, and its attainment is through assurance of a guaranteed right to feed oneself by ensuring *availability, accessibility* and *adequacy* of food. A rights-based approach therefore views target groups as “rights holders” rather than “beneficiaries of aid”, with a focus on building capacity to address the root causes of their food and nutrition security problems. The FAO/UN endorsed guidelines on the Right to Food in 2004 (see *Appendix I*).

Food security is present when “all people at all times have physical, social and economic access to sufficient, nutritious and safe food that meets their dietary needs and food preferences for an active and health life”.^[16]

Nutrition security (especially for infants and young children) exists when food security is combined with adequate health services, sufficient care and feeding practices, and sanitary household conditions to ensure proper utilisation of food within the body (see *Figure 2*).

Micronutrient deficiencies

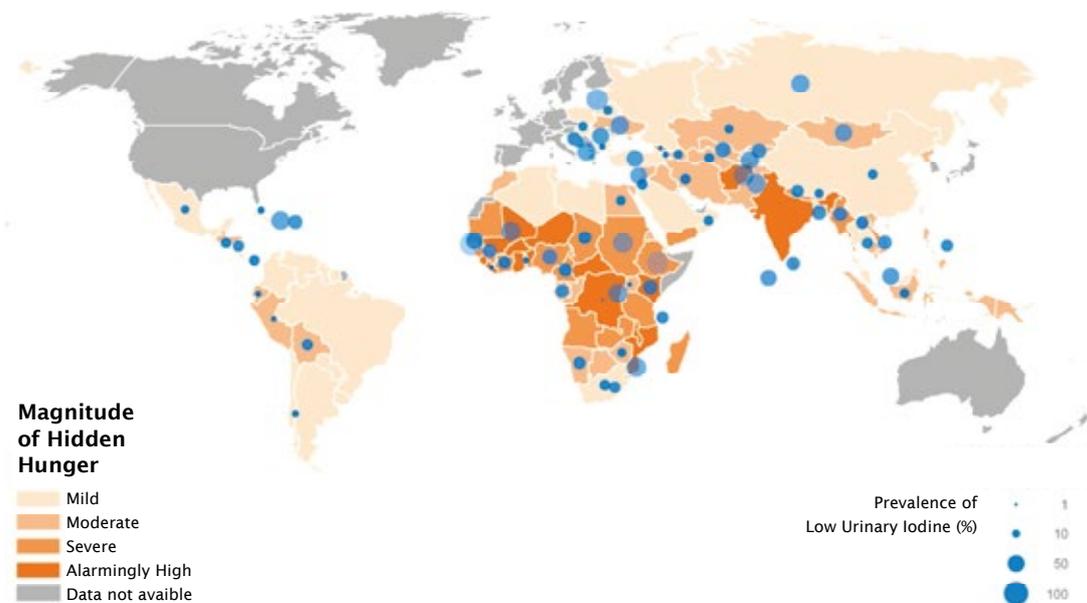
2.1 Prevalence of micronutrient malnutrition

More than 2 billion people are currently thought to suffer from different micronutrient deficiencies (when clinical symptoms occur). As the term “hidden hunger” indicates, the signs of micronutrient malnutrition (MNM) are less overtly visible but the effects on health, productivity, and physical and mental development are far-reaching. Hidden hunger is caused by either micronutrient inadequacy or inadequate supply.^[17] Iron deficiency affects about one third of the world’s population; other widespread deficiencies include vitamin A and iodine (see *Figure 3*). Health consequences are both direct,

through iron deficiency anaemia, xerophthalmia (vitamin A deficiency is the leading cause of blindness in children) and iodine deficiency disorders (such as cretinism); and indirect, by increasing the risk of serious infectious diseases, such as measles and malaria.^[18] Other micronutrients such as zinc, selenium, folate and vitamin B12 are also important for health but comprehensive data does not exist for global estimates of deficiencies in these micronutrients – apart from zinc, which is estimated to be approximately 1 billion.^[6] In developing countries, multiple MN deficiencies often occur together in the same population. In developed countries lack of vitamin D is also a problem, primarily due to low exposure to sunlight.^[17]

Figure 3

Magnitude of hidden hunger (iron, vitamin A and zinc deficiencies), plus prevalence of iodine deficiency^[19]





Box 5

Key facts on micronutrient malnutrition (MNM)

- MNM accounts for 10% of the global health burden^[6]
- Deficiencies of vitamin A and zinc are responsible for nearly 300,000 child deaths in under fives^[18]
- 18 million babies are born mentally impaired due to iodine deficiency each year^[20]
- 190 million preschool children are affected by vitamin A deficiency^[21] and 293 million by anaemia^[22]
- Iron deficiency undermines the health and energy of 40% of women in the developing world. Severe anaemia kills more than 50,000 women a year during childbirth^[23]
- Countries may lose 2-3 % of their Gross Domestic Product (GDP) as a result of iron, iodine, and zinc deficiencies.^[24]

In the 1990s, the UN committed itself to improving the economic wellbeing of countries with a high burden of poverty and underdevelopment through an eight-point plan, the so-called millennium development goals (MDGs) in which targets were set for addressing the most pressing needs of poor countries by 2015.

2.2 Populations most at risk

Pregnant women, lactating women and young children are most vulnerable to hidden hunger, mainly because they have a relatively greater need for vitamins and minerals and are more susceptible to the harmful consequences of deficiencies. For infants, breast milk is recognised as the best source of bioavailable nutrients and the WHO recommends exclusive breastfeeding for the first six months of life.^[25] From six months, children should be fed a diverse range of complementary foods (such as milk, eggs, meat and food rich in fats) in addition to continued breastfeeding, ideally until the age of three, to ensure they get their nutrient needs for adequate development.^[26]

In high burden countries, the diets of infants and young children aged 6-23 months generally provide insufficient amounts of key micronutrients (particularly iron, vitamin A, zinc and calcium), and low-income families may not be able to afford animal-source foods to fill the nutrient gap.^[27] Failure to receive sufficient energy or vi-

tamins or minerals at this life stage can result in both immediate and lifelong impacts on child health and functional capacity. Malnutrition can be transmitted from one generation to the next – malnourished women given birth to malnourished daughters who often grow up to become malnourished women often unwittingly perpetuating the cycle when they become mothers themselves.

Other groups at risk include populations facing a disaster, when livelihoods and food crops are lost and micronutrient deficiencies can develop or be exacerbated if they are already present. However, hidden hunger can affect vulnerable populations throughout the life cycle (see *Figure 6*). Although more common in developing countries, it is worth noting that MNM is widespread in industrialised countries, and does affect all age groups, but especially susceptible ones like the elderly.

Table 1

MDGs and micronutrients^[18]

Millennium Development Goal	Micronutrient Role
Goal 1: Eradicate extreme poverty and hunger	<p>iron intake can reduce anaemia – leading to greater productivity and earning potential</p> <p>salt iodization reduces iodine deficiency disorders – increasing learning ability and intellectual potential, and leading ultimately to better – educated citizens earning higher wages</p> <p>zinc reduces stunting among children</p>
Goal 2: Achieve universal primary education	<p>salt iodization reduces iodine deficiency disorders – improving cognitive development and learning potential</p> <p>iron in young children improves cognitive development to help them succeed academically later in life</p> <p>zinc reduces the frequency and severity of diarrhoea – decreasing the numbers of school days lost</p> <p>vitamin A prevents childhood blindness</p> <p>folic acid prevents disability due to neural tube defects</p>
Goal 3: Promote gender equality and empower women	<p>iron improves women’s economic productivity</p> <p>addressing under-nutrition empowers women more than men: improved micronutrient intake by women can help to correct inequalities in their access to adequate and nutritious food</p>
Goal 4: Reduce child mortality	<p>vitamin A significantly improves child survival rates</p> <p>zinc reduces the frequency and severity of diarrhoea, a major cause of child mortality</p> <p>salt iodization reduces iodine deficiency – lowering rates of miscarriage, stillbirth and neonatal death</p>
Goal 5: Improve maternal health	<p>iron improves maternal survival rates</p> <p>salt iodization prevents iodine deficiency disorders and its consequences such as spontaneous abortion, stillbirth, and impaired mental function</p>



Box 6

The first 1,000 days

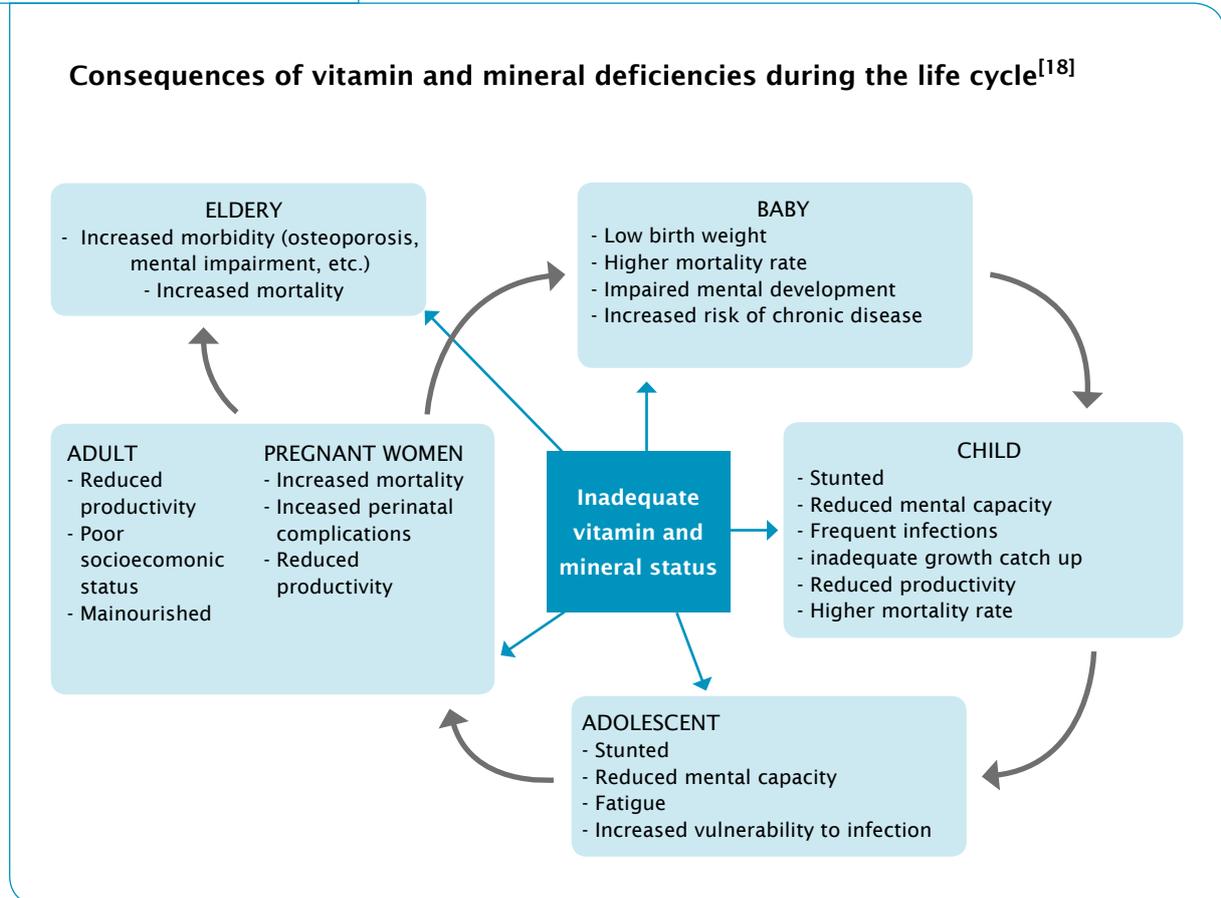
About 50% of all children under the age of five suffer from one or more key micronutrient deficiencies and 25% are stunted.^[6] Nutrition interventions have focused on the critical first 1,000 days of life (from conception to 23 months of age), identified as a “window of opportunity” in which to prevent child deaths and ensure adequate growth. Malnutrition during this period can cause irreversible damage to a child’s brain development, immune system and physical growth. This results in a diminished capacity to learn, poorer performance in school, greater susceptibility to infection and disease and a lifetime of lost earning potential.^[28]

2.3 Causes of “hidden hunger”

Lack of dietary diversity is a key factor in MNM but may be exacerbated by poor access to healthcare and high disease burden (see also *Figure 2* and *Box 8*). Populations living in poverty often do not have the means to grow or purchase more expensive

micronutrient-rich foods, such as animal-source foods (meat, fish, poultry, eggs, milk and dairy products) and fruit and vegetables. Many people in developing countries rely on nutrient-poor staples, such as rice and maize, and the micronutrient content of cereals (especially after milling) and roots and tubers is low, providing only a small propor-

Figure 4



Box 7

Status of women

The poor status of women is a crucial underlying factor in child malnutrition. Key issues affecting women are lack of education, low economic status and a workload that allows little time for altering practices to improve nutrition. Programme effectiveness may be increased by addressing a range of factors that affect the care-giving environment, such as women's workload and household dynamics.^[8] Increasing women's control over resources and incomes has beneficial effects on both their own and their children's health and nutrition status.

tion of the daily requirements for most vitamins and minerals.^[29]

The production of food was transformed in the 1960s by the Green Revolution, which saw the widespread replacement of sustainable farming by large-scale agriculture through the introduction of high-tech farming methods, such as chemical pesticides and fertilisers. The focus on increasing production of high-yielding cereal crops was suc-

cessful in increasing calories and protein to reduce undernourishment, but at the expense of displacing other more nutrient-dense crops such as legumes and vegetables.^[30] The unintended outcome was an increase in micronutrient deficiencies and their associated diseases.^[31]

In wealthier countries, factors such as higher incomes, greater access to a more diverse diet and better health services contribute to the lowering of the risk and prevalence of MNM. However, hidden

Box 8

Common risk factors for micronutrient deficiency in poor countries^[27]

- Monotonous diet resulting in low micronutrient intake, and poor bioavailability, especially of minerals
- Low intake of animal source foods
- Low prevalence of breast-feeding
- Low micronutrient density of complementary foods
- Increased physiological demands for growth during pregnancy and lactation
- Increased demand due to acute infection (especially if infection episodes are frequent), chronic infection (e.g. tuberculosis, malaria and HIV/AIDS) and disease (e.g. cancer)
- Poor general nutritional status, in particular, protein-energy malnutrition
- Malabsorption due to diarrhoea or the presence of intestinal parasites (e.g. giardia lamblia, hookworms)
- Increased excretion (e.g. due to schistosomiasis)
- Seasonal variations in food availability, food shortages
- Social deprivation, illiteracy, low education
- Poor economic status and poverty.



hunger is not just a problem in poorer countries problem, although it is certainly more frequent and severe among disadvantaged populations. Certain deficiencies, such as iodine (thought to have been eradicated from Europe) and iron, are also public health problems in industrialised countries today. Consuming a high proportion of energy-dense but micronutrient-poor processed foods can put some population groups at risk of micronutrient deficiencies. This practice is currently more common in developed countries, but it is rapidly becoming more prevalent among countries undergoing social and economic transition.^[27]

2.4 Micronutrient deficiencies and the nutrition transition

Many developing countries are experiencing a rise in urbanisation and a decline in levels of the population working in agriculture, fuelled by economic and social development. With economic growth come changes in diets and lifestyles known as the “nutrition transition”, from traditional diets of whole or minimally processed foods to highly processed foods and drinks. The food system transforms from a typically “closed” system of subsistence farming, where producers basically eat what they produce, to a system that includes centralised food-processing facilities, large-scale wholesalers, supermarkets and fast-food restaurants.^[33] Popkin^[34] describes two patterns (1-2) that occur simultaneously or before the “nutrition transition” (see Figure 5 - Patterns 3-5), as a shift from high fertility and mortality to one of low fertility and

mortality (typical of modern industrialised countries), and from a pattern of high prevalence of infectious disease to one of high prevalence of chronic and degenerative disease – associated with urban-industrial lifestyles.

Pattern 4 is characterised by increasing reliance on street foods and imported and processed foods, with less fibre and more fat and sugar.^[34] This results in a combination of all three forms of malnutrition, undernourishment, hidden hunger and obesity, and rising levels of nutrition-related non-communicable disease (NR-NCD).

With the saturation of markets in high-income countries, transnational food and drink corporations have turned their attention to low and middle-income countries and accelerated the nutrition transition. The substantial growth of ultra-processed products has led to the subsequent rise in obesity, diabetes and other diet-related chronic disease especially in developing countries.^[37] In the global north – i.e. North America and Europe – ultra-processed products have largely replaced food systems and patterns based on fresh and minimally processed foods that have less fat, sugar and salt. In the global south – i.e. Asia, Africa and Latin America – such products are displacing traditional dietary patterns, which are more culturally and environmentally appropriate.^[37]

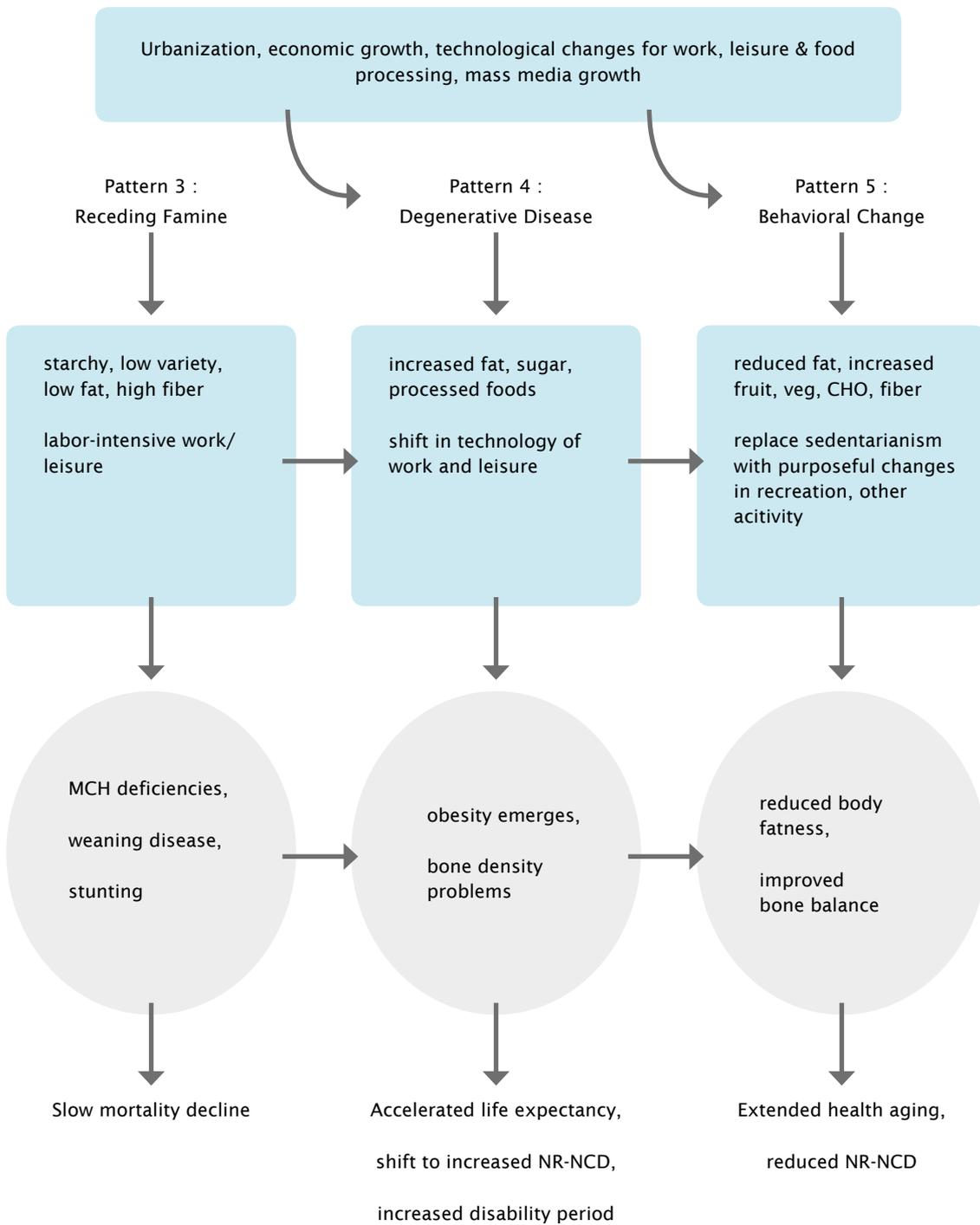
Box 9

The global food price crisis and MNM

Global food prices peaked in 2011, with price increases in the international commodity markets reflected in local markets in developing countries. In 2010 the price of wheat rose by 54% in Kyrgyzstan and 41% in Bangladesh as a result of global prices hikes.^[32] In response to such shocks to food prices or incomes, households will often maintain minimum levels of staple foods while sacrificing more nutrient-rich foods with long-term consequences for micronutrient deficiencies.

Figure 5

Stages of the nutrition transition^[34]



**Box 10****The urban-rural malnutrition divide**

Evidence from 82 developing countries^[35] shows a lower prevalence of child undernutrition in urban areas than in rural areas. With the exception of breastfeeding practices, which are more optimal among rural mothers, toddlers in urban areas have more diverse nutrient-rich diets with a higher intake of meat, dairy products and fresh fruit and vegetables than rural children.^[36] More favourable socio-economic conditions, such as better access to health services, water and sanitation, lead to a healthier environment and better feeding and caring practices.^[6]

Addressing hidden hunger: what works?

3.1 The main strategies

A number of different approaches have been utilised at different times and in different populations, usually in attempts to deliver single nutrients known to be inadequate for a population, but increasingly attention has turned to multiple micronutrients and integrated public health programmes. The Food and Agricultural Organisation (FAO) and the World Health Organisation (WHO) have adopted four main strategies^[27], which are:

1. improving dietary intakes through increased production, preservation and marketing of micronutrient-rich foods combined with nutrition education;
2. food fortification;
3. supplementation;
4. and global public health and other disease control measures.

The choice of approach (or combination of strategies) is dependent on a wide range of factors already discussed (see *Figure 2* and *Box 8*), with their relative importance depending on local conditions and the specific mix of local needs. Nutrient deficiencies are likely to occur therefore together in the long-term. Measures for eliminat-

ing hidden hunger should be based on dietary diversification and consumer education about choosing a balanced micronutrient-rich diet.^[27] Supplementation programmes have the advantage of reaching individuals and targeted populations while not putting other groups at risk of overconsumption or adverse reactions. Disadvantages of supplementation relate to sustainability, coverage and compliance. In contrast, fortification has a less immediate but wider and more sustained impact, with the advantage of requiring either no or minimal behaviour change on the part of the population. Fortification is limited by accessibility constraints due to cost or locality, and cannot help MNM when the deficiency is too severe. Increasing dietary diversity is usually viewed as the most desirable and sustainable option, but it takes the longest to implement.^[27]

Box 11

Food-based approaches to hidden hunger

Food-based interventions focus on food as the primary tool for improving the quality of the diet and for overcoming and preventing undernutrition. The basis of this approach is the involvement of the community and local government in the design, implementation and management of programmes to increase the production and consumption of foods, especially those rich in micronutrients. Both dietary diversity and food fortification are considered food-based strategies.



3.2 Fortification – an overview

Food fortification was first specifically mentioned in the 1992 International Conference on Nutrition declaration as a valid technology to adopt as part of a food-based approach if existing food supplies and limited access fail to provide adequate levels of nutrients.^[38] The World Bank^[39] enthused that: “No other technology offers as large an opportunity to improve lives at such low cost and in such a short time.” As a public health approach, micronutrient fortification of widely consumed basic foods has been widely used and continues to evolve with new developments such as biofortification of staple crops. Fortification has the greatest potential to improve the micronutrient status of a population when it forms part of a comprehensive nutrition strategy.^[11]

As a tool to fight hidden hunger, fortification polarizes opinion among key stakeholders in the nutrition community (see 4.2). Advocates, among them some UN agencies, donors and parts of the research community, view the strategy as a safe, cost-effective approach to reach large target populations at risk, without requiring changes in food habits. Other actors, mainly civil society, like peasant associations and relevant, but not all, NGOs and consumer groups, view the intervention as a threat to human rights and traditional diets, with particular concerns focused on private sector engagement in fortification. Most agree that fortified foods as part of food aid are of value in protecting the nutritional status of vulnerable groups (such as people with HIV) and those affected by emergencies. Fortification of staples (such as wheat flour and cooking oil) seem to be less contentious (with the exception of folic acid fortification), and the biofortification of some crops have been enthusiastically received by many (except for genetically modified golden rice – see *Case study* in 5.2) and strongly questioned by others. More contentious are the use of ‘medicalised’ foods such as ready-to-use-therapeutic foods (RUTFs) for moderate malnutrition and the potential displacement of adequately nutritious and affordable local foods by commercial fortification of processed complementary foods for children aged 6-24 months.^[40]

3.3 History of food fortification

The North

Fortification of foods began more than 100 years ago, when Switzerland and the United States began adding iodine to salt to prevent goiter.^[41] During the first half of the 20th century many vitamins and minerals were discovered, and it was possible to synthesize them on a large scale in order to restore vitamins and minerals lost in food processing. Milk was fortified with vitamin D in the United States and a number of European countries because of the prevalence of rickets. The fortification of cereal products with B vitamins and flour with iron has been widely practiced since the 1940s to enrich processed foods. Foods for young children were fortified with iron, and more recently, folic acid fortification of wheat has become widespread in the Americas, a strategy adopted by Canada and the United States and about 20 Latin American countries to address neural tube defects in newborn babies. The success of fortification programmes such as Universal Salt Iodisation (USI) in many developed countries is attributed to large, centralised food processing plants with the equipment and expertise needed to add nutrients to foods in a safe, consistent and cost-effective way.^[30] Even in Europe in the 19th century – when food-based interventions and mass fortification programmes such as salt iodisation were carried out to reduce hidden hunger – the early successes of such interventions were interrupted and reversed during the two world wars.^[27] A similar pattern and impact of micronutrient deficiency on public health is increasingly being seen in unstable developing countries.

Yet it has been argued that what began in the 1920s as a response to a public health need in developed countries has escalated into an era of industry-driven fortification with frequent conflicts of interest with the public health agenda.^[42] Voluntary fortification in recent years has seen the food industry manufacture calcium and vitamin D-fortified juices, breads (and even eggs) fortified with omega-3 and vegetable oil spreads with plant sterols marketed at well-nourished consumers looking for additional health benefits.

The South

Widespread vitamin A deficiency in Central America was targeted in the 1970s with sugar fortification, the food vehicle chosen as it was the only food widely consumed by the target population.^[30] However, fortification was not generally regarded as a viable option for less developed countries due

to a lack of central food processing and commercial markets, as well as low consumer awareness and demand.^[38] In rural areas, food is grown locally on small farms, with small-scale processing operations that often lack the capital to invest in fortifying equipment. Governments may also not have the resources to monitor compliance, particularly when this involves large numbers of small processing companies.^[30] But since the 1990s and increasing globalisation, interest in fortification has grown in industrialising countries with a number enacting national policies for fortification of major food commodities – such as maize meal and flour in South Africa and Namibia, Nigeria and Zambia, and vegetable oil in Morocco.

Such initiatives require coordinated efforts from many stakeholders, including governments, the private sector, and consumer organisations. The Global Alliance for Improved Nutrition (GAIN), which was established in 2002 at a special session of the UN General Assembly on Children and, in 2003, became an independent non-profit Swiss foundation headquartered in Geneva (see *Box 18*), has launched a number of these public-private partnerships (PPPs – see 4.2). These are coalitions of governments, international NGOs and private-sector stakeholders promoting “nutritionally-enhanced products”, which reflect the increasing role of fortification in international development. Since the 1980s, governments in both the North and South have looked to market-driven solutions to address public health problems. Food value chains are changing rapidly in developing countries with an

expansion in sales of processed/packaged foods. Fears that these may lead to over-nutrition in urban areas are well-founded^[37], but advocates claim that fortification of these foods offer opportunities to improve access to micronutrients among urban and poor people.^[33]

Today, 79 countries require fortification of certain staple foods. However, each country determines its own policy or regulations, and fortification approaches can vary widely throughout the world.^[42] The US and Europe control the fortification of certain types of “unhealthy” foods, such as confectionary and soft drinks. Denmark hit the headlines in 2004 when it banned a number of fortified products on the grounds of food safety (although the decision was later reversed), and the fortification of unprocessed foods is prohibited in a number of European countries.

Box 12

The Codex Alimentarius (1991) definition of fortification of foods with micronutrients:

“The addition of one or more essential nutrients to a food, whether or not it is normally contained in the food, for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups.” (Codex Alimentarius is a collection of internationally-adopted food standards, codes of practice, guidelines and recommendations agreed by more than 30 committees.)^[43]

Organisations such as IBFAN (International Baby Food Action Network) question whether the current Codex Alimentarius food and nutrient standards give business too much freedom to weaken nutritional concerns.^[44]



3.4 Forms of fortification

Food can be fortified at three levels – mass or universal; targeted; or household – and may be mandatory or voluntary. Mass fortification is the preferred approach when a majority of the population is at risk of a particular nutrient deficiency, whereas targeted fortification is designed for defined population subgroups. Commercial or market-driven fortification is more common in developed countries, though its predicted rise in less-regulated low-income countries is causing concern due to the potential disruption to traditional dietary patterns. Home fortification and biofortification are more recent approaches, with evaluations still underway as to their effectiveness.

Definitions of what constitutes a fortified food have expanded to include: a single micronutrient added to food; multiple micronutrients added to foods (e.g. triple fortification of salt); and foods bioengineered to contain micronutrients that are not present in the traditional varieties (e.g. margarines containing plant sterols).^[38]

Box 13

Copenhagen Consensus on “best buys” in development

An economic analysis of the cost-effectiveness of development efforts by the Copenhagen Consensus panel (2008)^[45] ranked fortifying foods with iron and iodine in third place and biofortification fifth out of a total of 30 possible interventions (according to the panel, only vitamin A and zinc supplementation for children offer a higher return on investment).

Cost-effectiveness analyses have their limitations: although more costly than interventions such as fortification, community health and nutrition interventions have a long-term, intergenerational effect that cannot be measured accurately in this way

Box 14

Fortification terms

Mass fortification: the addition of micronutrients to foods commonly consumed by the general public (such as cereals, milk and condiments).

Mandatory fortification: fortification of some foods (wheat flour) with specific nutrients at specific levels may be instigated, mandated and regulated by the government sector when there is a clear public health need, but consumer knowledge is limited.^[27]

Voluntary fortification: the practice by which different concentrations of vitamins, minerals and other nutrients are added to processed foods, and decisions about which products and how to fortify them are made by food manufacturers.

Universal fortification: the fortification of foods consumed by animals as well as humans (salt iodization of salt is the main example).

Targeted fortification: programmes that are aimed at a subset of the population, for example the distribution of fortified biscuits in school food programmes and humanitarian food aid.

Market-driven fortification: also known as “industry-driven” or “free-market” fortification. This type of fortification is voluntary although it takes place within regulatory limits set by governments.

Home fortification: also known as household and community fortification, is a combination of supplementation and fortification, in particular for complementary foods for young children to be delivered at the household level. Different products, such as micronutrient-based powders (“sprinkles”) and micronutrient-rich spreads, are added to weaning foods and porridges.

Biofortification: the process of generating genetically improved food crops that are rich in bioavailable micronutrients, either through conventional breeding or genetic modification.^[46]

Box 15

Requirements for a food vehicle for fortification^[27]

- Commonly consumed by the target population
- Constant consumption pattern with a low risk of excess consumption
- Good stability during storage
- Relatively low cost
- Centrally processed with minimal stratification of the fortificant
- No interactions between the fortificant and the carrier food
- Contained in most meals, with the availability unrelated to socio-economic status
- Linked to energy intake.



Table 2

Food vehicles for fortification

Vehicle	(Dis)advantages	Example
Cereals	Consumed in large quantities, throughout the year, and by all members of society, as part of the typical diet	Wheat flour fortification with iron (Chile)
Fats, oils & margarines	Intake generally not sufficient to supply 100% of recommended intake	Margarine fortification with vitamins A & D (in many countries)
Dairy products	Favours mothers and children, but poor, rural populations usually have limited access	Fortification of fluid milk with iron (Argentina)
Condiments	Sugar, spices, starches, sauces consumed regularly through the population, particularly SE Asia	Fish sauce fortification with iron (Thailand), sugar fortification with vitamin A (Guatemala)
Value-added products	May be consumed only sporadically by populations with deficiencies	

3.5 Fortification vehicles

The fortification vehicle may be either a staple food, or a processed commercially-available food (see *Table 2*), and requirements for suitable food vehicles are well established (see *Box 15*).

Food vehicles commonly used can be grouped into three main categories: staples (wheat, rice, oils); condiments (salt, sugar, soy sauce); and processed commercial foods (noodles, infant complementary foods, dairy products). Overall, staples have been the primary choice as they are widely consumed by the population, whereas processed foods and cereals have been chosen when infants were the target population.^[27]

There are a number of technical issues involving fortification that still need to be resolved, such as:

- appropriate levels of nutrients
- stability of fortificants and nutrient interactions (e.g. some iron fortificants change the colour and flavour of many foods)
- acceptability by consumers including cooking properties and taste (e.g. iron fortification)
- bioavailability

Several parameters, including the level of fortification, the bioavailability of the micronutrients and the amount of fortified foods consumed, determine whether food fortification has an impact on public health. A number of models have been applied in setting fortificant levels to ensure consumer safety.

Box 16

Safety concerns about food fortification

- Reports of potentially fatal **iodine**-induced hyperthyroidism disease in Zimbabwe and Congo, due to introduction of overly-fortified salt.^[38]
- Appropriate levels of **iron** may be unsafe for a small proportion of people with clinical disorders relating to iron absorption and storage.^[47] An increase in rates of haemochromatosis (a condition of iron-overload) in the US may be linked to increased consumption of fortified foods, although there is no definitive evidence for this.^[48]

NOTE: Iron fortification of staple foods, condiments and complementary foods is recommended by WHO and UNICEF, even in areas affected by high malaria transmission rates because this is thought to avoid the need for potentially toxic preventive supplementation.^[49]



Impact of food fortification on combatting hidden hunger – programmes and players

4.1 Evidence for effectiveness

Long-running fortification programmes such as vitamin A-fortified sugar in Central America have been credited with the dramatic reduction of vitamin A deficiency (VAD) in that region.^[38] Based on such successes as these and universal salt iodisation (USI) (see *Case study* in 4.1), food fortification appears to offer potential as an effective strategy for reducing hidden hunger in low-income countries (LICs). Efficacy trials (involving subjects taking a known amount of a fortified food) to date have shown improved micronutrient status in a range of vitamins and minerals.^[27]

Case study

Effectiveness of universal salt iodisation (USI)

Salt iodisation is probably the first large-scale experience in national fortification of a commodity to eliminate a public health problem. USI (in which all salt for human and livestock consumption is fortified with iodine) is widely credited with reducing the number of countries where iodine deficiency disease (IDD) was a public health issue – from 130 countries in 1990 to 32 in 2011.^[50] Despite substantial progress, an estimated 1.88 billion people globally, including 241 million school children, still have inadequate iodine intakes.^[50] There is also evidence of backsliding among countries that were successful in the past, when political commitment, monitoring and controls are relaxed and governments do not allocate sufficient resources to ensure sustainability.^[47]

Yet evidence for reductions in morbidity (and mortality) and impact on functional outcomes (defined by measurement of functional consequences of specific nutrient deficiencies) from large-scale programmes in developing countries is scarce.^[11] Few fortification programmes are designed with an evaluation component, so that it is difficult to determine whether changes in a population's nutritional status are due to the intervention or to improvements in socioeconomic status or other public health measures during the same period.^[27] Studies where available are generally before-after evaluations, with limited information on confounding factors such as age and nutritional status at the start of the intervention, and a lack of evidence for the direct impact of fortification on anthropometric measures as well as morbidity and mortality.^[51] However, several studies have shown positive effects for fortification in different population groups using control groups to strengthen evidence. A systematic review^[52] of fortified milk and cereal food for infants and children (up to three years of age) in developing countries found increased serum levels of vitamin A compared with control groups consuming non-fortified foods. Gera et al's^[53] meta-analysis of 60 trials showed similar results with iron fortification of food, including a 43% reduction in anaemia and 52% reduction in iron deficiency.

The picture is less clear for other fortification programmes. Conflicting results for iron fortification in Brazil showed women pregnant after the programme started had reduced anaemia levels compared to pregnant women who were tested pre-fortification.^[54] This contradicts findings by Asuncao et al^[55] who found no effect of iron fortification on anaemia in children under six years old over a similar timeframe. Such conflicting findings within the same country illustrate that impact may vary due to different populations and locations. Between countries, many other factors come into play, such as choice of food vehicle and fortificant as well as access to fortified products. Current wheat flour fortification in Guatemala is unlikely to benefit the poorest, rural indigenous populations who suffer the highest burden of nutritional deficiencies, since

they consume a more traditional diet of corn products and have no access to industrially produced (and fortified) corn flour.^[56]

In industrialised countries such as the United States, where fortification is well established, the actual proportion of vitamin or mineral deficiencies eliminated as a result is not easy to determine. The almost complete elimination of rickets, goitre and pellagra, invariably attributed to fortification of foods with vitamin D, iodine and niacin, respectively, is considered one of the great public health achievements of the 20th century, but other factors may have been equally important in eliminating nutrient deficiencies. For example, US pellagra death rates were declining well before the introduction of mandatory niacin fortification in 1938, attributable to changes in economic growth, food prices, income, food availability and consumption habits that were also taking place at the same time.^[34] Nutrients used in fortification make up only a small fraction of the total number of nutrients known to be essential in human diets. The fortification of cereals, milk and margarine address vitamin and mineral deficiencies that are caused largely by poverty or other socioeconomic conditions, and might be more sustainably addressed by education, jobs or income support.^[48]

4.2 Key actors in food fortification

As an intervention, food fortification attracts many differing opinions and perspectives among various stakeholders. And there are many involved, including national governments, international and regional organisations (including UN agencies and development banks), civil society (global and national), bilateral donors, charitable foundations, international research organisations, academia and private sector companies. Understanding and aligning these different positions is crucial for politicians and policymakers who want to prioritise investment in the scale-up of “what works” to reduce undernutrition. As Gillespie et al^[57] emphasise, “political calculations form the basis of effective coordination between sectors, national and sub national levels, private sector engagement, resource mobilisation and state accountability to its citizens”.

United Nations and associated bodies

A process to reform UN governance of nutrition resulted in the Scaling Up Nutrition (SUN) initiative (see Case study in 4.2). SUN engages with over 100 bodies and 51 countries (by June 2014) to make nutritional interventions more effective, and is a driving force behind the adoption of food fortification programmes worldwide. In recent years UN bodies, including SUN, have increasingly formed partnerships with the private sector. These initiatives (more often than not contracted with “for profit” entities), such as GAIN (see *Box 18*), Micronutrient Initiative (MI) and Flour Fortification Initiative (FFI) with a fortification focus (see *Table 3*), have attracted considerable attention and controversy. SUN is currently conducting a consultation process to establish and implement a guidance note on Principles of Engagement within SUN, to address conflicts of interest (to report in February 2015).



Case study

The Scaling Up Nutrition (SUN) initiative

SUN was launched in September 2010 by the World Bank, UNICEF, WHO and the World Food Programme (WFP), along with some country partners, some civil society organisations and bilateral agencies. It aims “to promote targeted action and investment to improve nutrition for mothers and children in the 1,000-day period from pregnancy to age two... in addition to encouraging Governments to adopt national plans to scale up nutrition in their various sectoral policies...”^[58] Many SUN countries are already integrating the protection of breastfeeding and other beneficial foods into their nutrition programmes, fortifying staples wisely and targeting foods for the treatment of “severe acute malnutrition” (SAM) carefully.^[59]

While SUN’s goals are welcomed, critics claim that its methods are controversial. The SUN roadmap prioritises mostly technical interventions (such as fortification), including earmarking just \$2.9 billion to spend on promotion of good nutritional practices while \$6.2 billion is to be spent on preventing and treating malnutrition with special foods.^{[58][13]}

In a report to the Human Rights’ Council^[15] the UN’s former Special Rapporteur on the right to food, Olivier de Schutter, highlighted his concern (echoed by others) that SUN and GAIN failed to “explicitly align their initiatives with human rights, including the right to food”, and overlooked the “entitlements that have been established under international law for women, children, minorities, refugees and internally displaced persons and other groups that may be subjected to marginalisation and discrimination” (see *Box 17*).

Public-private partnerships (PPPs)

WHO defines a PPP as “a collaboration between public- and private-sector actors within diverse arrangements that vary according to participants, legal status, governance, management, policy setting, contributions and operational roles to achieve specific outcomes.”^[60]

The World Economic Forum suggests that innovative PPPs can create incentives to develop business models targeting undernutrition.^[61] The counter-claim to fears that sales of processed/packaged foods may lead to over-nutrition in urban areas is that fortification of such foods may also alleviate micronutrient deficiencies, especially where PPPs have nutritional goals (see *Table 3*).

PPPs are considered by many to be a necessary and ideal instrument to fund development work. Others challenge the view that PPPs offer “win-win solutions”, suggesting that the costs for the private sector seem to be relatively small in relation

Box 17

Former UN Special Rapporteur on the Right to Food^[15]

Olivier de Schutter called on countries committed to scaling up nutrition to begin by regulating the marketing of commercial infant formula and other breast-milk substitutes (in accordance with World Health Assembly resolution 63.23), and by implementing the full set of WHO recommendations on the marketing of breast milk substitutes and of foods and non-alcoholic beverages to children. He also called for a “clear exit strategy to empower communities to feed themselves”. In such circumstances, “when ecosystems are able to support sustainable diets, nutrition programmes, policies and interventions supporting the use of supplements, ready-to-use therapeutic foods (RUTFs), fortificants and infant formulas are inappropriate and can lead to malnutrition, and the marketing of these food substitutes and related products can contribute to major public health problems.”

Table 3

Types of public-private partnerships with nutritional goals^[33]

Partnership goal	Desired nutrition impact	Examples
Development of new products	Design modify existing food products to address specific micronutrient deficiencies	<ul style="list-style-type: none"> - Iodine Network: working with local processors and developing “best practices” for iodine fortification - fortified yogurt from Grameen Danone Foods for the Asian market
Expansion of distribution networks	Make existing micronutrient-fortified products available in remote areas	<ul style="list-style-type: none"> - Coalition in Mozambique (CONFAM) to expand production and distribution of fortified foods - Scale UP Nutrition Network partners with food manufacturers with strong distribution networks to distribute fortified foods
Strengthen consumer demand	Expand local and regional preferences for purchasing packaged foods rich in micronutrients	<ul style="list-style-type: none"> - <i>Future Fortified</i> campaign by the Global Alliance for Improved Nutrition (GAIN) to encourage expectant mothers to consume nutrient packets that have micro and macro nutrients - <i>Hellen Keller</i> International partners with edible oil processors in West Africa to market Vitamin A-fortified cooking oil

to overall gains: “A potential small loss of resources if programmes do not work but huge benefits (increased corporate influence in global and national policy making; direct financial returns, such as tax breaks market penetration; and positive public relations) when they succeed.”^[62] Richter suggests that a more appropriate description would be “who-wins-what” and “who-loses-what?” and “to check whether the gains or ‘wins’ for the commercial sector are based on, or result in, losses from a public interest-perspective”.^[63] Opponents claim that PPPs have further reinforced selective

programmes by focusing on what they view as “non-sustainable techno-centric and market-based solutions to single issues” (such as fortification), while not addressing the underlying social determinants of health and nutrition.^[13]

Private sector

Private sector involvement in food and health-care choices includes not just large multinational food and pharmaceutical companies, but agri-food businesses, medium- and small-scale processors of



staple foods, and private health networks.^[65] Companies have identified opportunities to increase market share in untapped new markets at ‘the base of the pyramid’ – in other words, the poorest socioeconomic groups affected by malnutrition.^[66] Despite what has been labelled the “inextricable” role of the private sector in nutrition, too few independent evaluations have been done on the effectiveness of the commercial sector’s involvement.^[57] Distrust of the food industry remains high and linked, partly, to decades-long issues related to the marketing of breast milk substitutes in developing countries and around continued marketing of sugar-sweetened beverages and fast foods worldwide.^[37] Many businesses involved in fortified products are the same multinationals violating the BMS code (the International Code for the Marketing of Breast Milk Substitutes).^[59] Experience gained with ICMBMS should be applied to the promotion of other harmful, widely-consumed food products that are being marketed for young children.^[57]

Case study

Soft drinks as a solution to childhood malnutrition?

While public policy efforts in industrialised countries are focused on limiting consumption of soft drinks due to their harmful effects on obesity and tooth decay (both rising in lower Income and middle income countries – LIMICs), little attention has been paid to their contribution to undernutrition in children, pregnant women, and other vulnerable populations in the developing world.^[67] In Sub-Saharan Africa, for example, distribution of soft drinks and other beverages produced by soft drink companies is extensive, and consumption is high, with costs of Coca-Cola and other such products kept low in African markets so that they are affordable to the population.^[67] It begins at an early age (six to 24 months) in both urban and rural settings, with soft drinks frequently given as a weaning drink.^[68] Given the extensive reach of soft drinks’ companies, Wojcicki and Heyman^[67] suggest that such products, if fortified, could play a role in improving child health, given the roadblocks to African fortification programmes, such as small-scale production and home processing of staple foods.

In a strongly-worded response to the article, Monteiro et al^[69] emphasised that “what the impoverished populations of Africa, Asia and Latin America

need are secure local food systems and supplies; access to safe water and adequate sanitation; decently resourced primary health care services; ability to produce and prepare meals from immediate and local resources; universal primary education; and empowered mothers and other caretakers.” Not more Coca-Cola!

Civil society/NGOs

Many NGOs have been drawn into collaborating with business, government and international organisations, claiming that it was time to stop chastising corporations, elites and “the system“, and start engaging more constructively with processes of policy and institutional reform.^[70] NGOs are directly engaged in fortification programmes such as Helen Keller International (HKI) and the Fortify West Africa Initiative, and Médecins Sans Frontière’s (MSF) distribution of Plumpy’nut RUT-Fs manufactured by French company Nutriset (see Case study in 5.4). However, NGO partnerships with global companies have attracted controversy over inadequate management of conflicts of interest and perceived co-option of public health goals by commercial interests, with limited guidelines for NGOs to manage the opportunities and challenges presented by such partnerships.^[71]

Donors

The support of high profile donors, such as the Bill and Melinda Gates Foundation, for programmes targeting global health and undernutrition has provided funding for governments in developing countries to implement programmes, as well as funding for research into biofortified crops and other areas of fortification. At the same time, the Foundation has generated some of its wealth through investments in companies that produce and market products linked to rising obesity and non-communicable disease (NCD) rates, including the McDonald’s Corporation and the Coca-Cola Company.^[71]

Governments/public sector

Perhaps more than any other public health intervention, food fortification requires collaboration and cooperation between industry and government agencies.^[30] Yet substantial information and power imbalances exist between large multinationals and under-resourced governments.^[57] National fortification programmes require large resources, along with research facilities and industrial support.^[51]

Box 18

Global Alliance for Improved Nutrition (GAIN)

Launched in 2002 to focus on micronutrient deficiencies, GAIN is the major convening vehicle for governments, international NGOs and private-sector stakeholders to promote food fortification. Initially investing in staple food fortification, GAIN currently works with over 600 companies and civil society organisations across almost 40 countries, reaching an estimated 859 million people (by May 2014), with nutritionally enhanced food products.^[64] This indicates that market-based solutions can play an important role in sustainable improvements in food quality for low-income populations.^[13] However, GAIN's Business Alliance (superseded by the SUN business network, launched in 2014, of which GAIN and the World Food Programme are co-hosts) included corporations such as Unilever, Cargill, Danone and Kraft Foods, many of which have been indicted by civil society organisations with breaches of human rights and code violations that contribute to malnutrition.^[13]

Critics claim that governments committed to fortification policies end up spending their limited health and nutrition budget on enriched products, rather than investing in long-term solutions like diversification of agriculture and diets, education, and in tackling the social determinants of poor nutrition.^[13]

Consumers

Despite the low costs associated with fortification itself, the price of fortified products, such as iodised salt, may be higher, and it is the consumers that end up bearing the cost of the refining, packaging, branding and marketing of such goods.^[47] Even with consumer awareness of the nutrient deficiency and demand for the fortified food, price can remain a constraint since the targeted groups are often those with the least purchasing power.^[38]

4.3 Public health impacts and sustainability

Fortification as a promising public health policy tool arguably requires more collaboration than any other public health intervention.^[30] However the policy process, which needs active governmental leadership and political will based on scientific evidence, has proved to be a complex stumbling block in some situations.^[72] Lack of effective government regulations can lead to ineffective implementation. For example, the fortification of brown bread in South Africa did not affect the iron status of South African schoolchildren due to both the level and type of iron fortificant used being inappropriate.^[73] Changing economic and political contexts often threaten the sustainability of fortification programmes, as seen in USI (see *Case study* in 4.1).

Industrial food processing is now the main shaping force of the global food system almost everywhere, making mandatory fortification of staples a more viable option in developing countries. The primary advantage of this as a public health approach is that relevant nutrients can be delivered to large segments of the population without requiring radical changes in food consumption.^[27] However, the sustainability of fortification programmes is dependent on many variables, including continued financing (from donor support), government infrastructure and ongoing monitoring. In contrast, community-based solutions that



focus on education and behaviour change, and home and food-based strategies to improve micronutrient deficiencies, have the potential to be culturally acceptable, economically feasible and truly sustainable.^[72] Unlike fortification, such interventions may have other non-nutritional benefits, including empowerment of women in the community, training and income generation.

Box 19

Concept of a sustainable diet

Sustainable diets are: “those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources”.^[74]

Opportunities and challenges

Food fortification offers both opportunities and challenges in addressing hunger and undernutrition, as evidenced by the current discussions around the topic. Almost every opportunity could also be interpreted as a risk, depending on the perspective of different stakeholders. This section will explore both sides of the debate by focusing on four key areas (mass, commercial and home fortification, plus biofortification) to highlight the main contentious issues involved.

5.1 Mass fortification

Mass or universal fortification is now widespread throughout industrialised and developing countries, often involving more than one food vehicle and/or multiple micronutrients. Globally 80 countries have legislation to mandate fortification of at least one major cereal grain, with the majority (79 countries) fortifying wheat flour, 12 fortifying maize products and five countries fortifying rice.^[75] A number of other countries have voluntary rice fortification (a country is classified as „voluntary“ if at least 50% of the industrially-milled grain is fortified through voluntary efforts). Nearly 2 billion people now have potential access to fortified flour – 858 million more than in 2004.^[64]

Advocates argue that fortifying widely distributed and consumed foods has the potential for reaching large numbers of the population, improving the

Figure 6

Global coverage of grain fortification^[75]

Grain Fortification Legislation

80 countries require fortification of wheat flour, maize flour, and/or rice





nutritional status of the poor, pregnant women, young children and at-risk groups, such as the elderly and those with an unbalanced diet. Moreover, such an approach requires neither behavioural change in food patterns or individual compliance – both notoriously difficult to achieve.^[27]

The limitations of this approach are well documented. Fortified foods often fail to reach the poorest groups most likely to be suffering from hidden hunger since they are less likely to purchase processed foods, due to lack of purchasing power or access. Even with more developed distribution channels, vulnerable groups, such as children under five, may be unable to consume large enough quantities of the fortified food to meet adequate daily requirements. Fortification is also unable to supply adequate amounts of some micronutrients, such as iron for pregnant women.^[27] Conversely, universal fortification exposes everyone in the population to increased micronutrient levels in food, whether they will benefit from them or not. This raises issues both of human rights, regarding consumer choice, and potential safety concerns (see Case study on folic acid fortification). A recent in-depth analysis of three mass fortification programmes (universal salt iodisation, mandatory milk fortification with vitamin D, and mandatory flour fortification with folic acid) argued for the need to consider separately the public health benefits, risks and ethical considerations of each intervention.^[76]

Case study

Folic acid fortification – an “uncontrolled clinical trial”

Since 1991, it has been known that low folate intakes in early pregnancy increase the risk of neural tube defects (NTD). NTDs lead to miscarriage, neonatal death or lifelong disability. Taking folate supplements within the first 12 weeks of pregnancy leads to 70% reduction in the risk of NTDs.^[77] Mandatory fortification is effective in helping prevent NTDs (the US, Canada and Chile have all achieved reductions in NTDs of 27->50% through mandatory fortification), though the level of effectiveness depends on baseline prevalence and folate status of the target group. However, critics have described its action in increasing the population’s folic acid intake as a form of “uncontrolled clinical trial” since it exposes everyone in the population to novel levels of a synthetic vitamin for the rest of their lives.^[78] Some countries (UK, Ireland and New Zealand) have

suspended implementation of folic acid fortification due to concerns regarding masking of vitamin B12 deficiency and animal experiments showing links with cancer.^[78]

As of 2012, 66 countries have instituted or agreed mandatory fortification of flour with folic acid as national policy, mostly in wheat flour and within the range 100-300 mg per 100 grams.^[79] Supplementation (not fortification) was used in the original clinical trials in the late 1970s-1990s, but commentators claim that this policy option requires a more sophisticated approach and sustained investment, despite being more ethical and with a low level of public health risk.^[78] In a recent analysis of the policy-making process it was found that certain powerful actors such as the US Centers for Disease Control and Prevention (CDC), the Flour Fortification Initiative (FFI), MI and GAIN used their influence to promote food fortification over alternative policy options.^[76] Another option – improving food systems to provide better sources of folate (found mostly in fresh whole plant foods) – seems to have got lost in the debate.

Mass fortification is presented as a cost-effective option to combatting hidden hunger, particularly when the appropriate technology and food distribution systems are in place. Salt iodisation can reach 80-90% of a target population at an annual cost of approximately US\$0.05 per person, while costs for fortifying flour with iron are estimated at US\$0.12 per person.^[47] And business actors appear willing to engage in PPPs promoting fortification in a way not seen before in food security projects, primarily because it uses a market-based, technical solution with which businesses can identify.^[80] Stakeholders such as GAIN (see *Box 18*) offer co-financing opportunities and technical advice to governments in order to strengthen local capacities for country-level fortification initiatives. The opportunities for business, as previously highlighted in 4.2, is access to new markets and an enhanced reputation for corporate social responsibility (CSR).

Case study

GAIN and its choice of government partners

The projects GAIN funds and arranges on a national level need to be heavily co-funded by domestic actors. In a collaborative project GAIN was under-

taking with the government of Morocco to increase amounts of fortified flour and oil, GAIN contributed about \$3 million while the Moroccan government and the Moroccan Miller's Association invested \$15 million each.^[81] In this case, the share of domestic sources was about ten times higher than the share of GAIN – so that a small share of the project funding tied up a much higher share of public funds.^[80] The redirection of public spending for an externally determined goal is thus likely to shorten funds for other urgent problems. Consequently, GAIN has mostly cooperated with developing economies that are able to co-fund the projects, and less with least developed countries where the need to fight hunger and malnutrition is even greater.^[80] 70% of GAIN's budget focuses on partnerships in India, Brazil, Indonesia and China.^[8]

The risk of extensive use of mass fortification in low-income countries is that it may be a diversion of scarce funds from the longer-term goal of ensuring food security and sufficient sources of nutrients from culturally appropriate foods suited to the local climate and terrain.^[82] Moreover, to impact on the hard-to-reach population groups most at risk of hidden hunger requires greater inputs for small-scale fortification. Local cottage industry, usually with a diesel-operated hammer mill, producing low-extraction flours, is the main source of flour for rural subsistence farming families and peri-urban populations.^[30] Sustainability is dependent on yet-to-be developed business models concerning who will supply the fortificant, a cost recovery mechanism and whether clients will pay for fortification. Critics claim that the financing of industrial food production by actors such as GAIN might create problems for local producers that lack the adequate technology, by supporting access to food that is produced and processed where the technology is available.^[83]

5.2 Biofortification

Biofortification is a new strategy that uses conventional breeding techniques and biotechnology to improve the micronutrient quality of staple crops. As such, the innovation is seen as an opportunity to deliver naturally (as opposed to processed) fortified foods to poor people in rural areas of developing countries with limited access to commercially marketed fortified foods, more readily available in urban areas. Moreover, marketed surpluses of these crops may make their way into retail out-

lets, reaching customers in both rural and urban areas.^[84] Biofortification is promoted as a comparatively inexpensive, cost-effective and sustainable, long-term solution to micronutrient deficiencies: a one-time investment in plant breeding that can yield micronutrient-rich varieties for farmers to grow for years to come.^[85]

The risk of biofortification is that it is another “technical fix” to the problem of hidden hunger, offering a centralized, single-factor solution that may fail to address social, economic and cultural determinants underpinning food systems. As a technical solution, Tripp^[87] suggests that “governments may be tempted to believe they do not have to worry about nutrition because the plant breeders are handling this”. Another concern is that the strategy potentially undermines dietary diversity, by aiming to concentrate more nutrients in a few staple foods, further simplifying diets already overly dependent on a limited number of carbohydrates.^[88] The consequences of reducing food diversity in favour of less complex high-energy diets has already been recognised in this report, by its contribution to rising levels of non-communicable disease including diabetes and heart disease.^[34]

There is growing evidence that fortification, including biofortification, is contributing to the neglect of food-based approaches that depend on access to and consumption of the diverse crop varieties, and plant and animals species, available within local environments and food cultures.^[46] In its focus on producing and promoting a few superior crop varieties, biofortification may undermine national and local biodiversity, including biological assets such as seeds.^[46] Orange-fleshed sweet potato (OFSP), for example, is a North American import, introduced to replace local varieties of white and yellow potato because of its higher vitamin A content. Instead, biofortification efforts could contribute to environmental sustainability by focusing on local crops and varieties, rather than global staples.^[46]



Table 4

Schedule of product release of biofortified crops^[85]

Crop	Nutrient	Countries of first release	Agronomic trait	Release year*
Sweet potato	Provitamin A	Uganda, Mozambique	Disease resistance, drought tolerance, acid soil tolerance	2007
Bean	Iron, Zinc	Rwanda, Democratic Republic of Congo	Virus resistance, heat and drought tolerance	2012
Pearl millet	Iron, Zinc	India	Mildew resistance, drought tolerance	2012
Cassava	Provitamin A	Nigeria, Democratic Republic of Congo	Disease resistance	2011
Maize	Provitamin A	Zambia	Disease resistance, drought tolerance	2012
Rice	Zinc, Iron	Bangladesh, India	Disease and pest resistance, cold and submergence tolerance	2013
Wheat	Zinc, Iron	India, Pakistan	Disease and lodging resistance	2013

* Approved for release by national governments after intensive multilocation testing for agronomic and micronutrient performance.

Box 20

Scaling up biofortified crops (adapted from Bouis & Islam 2012^[86])

Effort are underway to scale up orange-fleshed sweet potatoes (OFSP) to reach more than a million households in Sub-Saharan Africa over the next five years. A scaling-up pathway might include:

1st level: critical mass of farmers adopts the biofortified crop and feed it to their families. The food is introduced to others in the community.

2nd level: reaching out to medium-scale producers and developing local demand, still largely in rural areas, develops markets for the biofortified crop.

3rd level: private sector becomes main driver of diffusion process through value chains, with sufficient surplus generated to reach urban consumers, including the urban poor.

Case study

Vitamin-A enriched “golden rice”

Vitamin A deficiency (VAD) is a serious nutritional problem among poor people in developing countries, exacerbated in Asian rice-based diets because rice does not contain carotenoids, the precursors to vitamin A. The introduction of genes for beta-carotene into rice through public funding and private-sector research has cost some \$100 million to develop and the resultant “golden rice” has become the focus of much scientific and public criticism, with concerns that it has been used as a propaganda tool by the GM industry.^[89]

Field trials began in 2008 and the rice is still not in production, with issues of consumer acceptance, bioavailability and stability of beta-carotene during storage and cooking, and costs of production and costs to consumers remaining unresolved.^[46]

5.3 Commercial fortification

Commercial or “market-driven” fortification involves food companies voluntarily fortifying products, such as cereals or porridge for infants and young children, within regulatory limits set by the national government. This is a business-oriented decision taken by food manufacturers, since micronutrients are added to products primarily to increase their appeal to health-conscious consumers. Commercial fortification can play a positive role in public health by improving the supply of essential nutrients that are sometimes difficult to provide in sufficient amounts via mass fortification.^[27] In Europe, for example, fortified processed foods comprise an important source of micronutrients such as iron, and vitamins A and D.^[90]

To date, the public health impact of fortified processed foods has been predominantly in industrialised countries but this could be rapidly changing with increasing urbanization. Sales of processed and packaged foods are growing quickly in developing countries: growth rate per capita in retailing of these foods grew by 28% in lower-middle income countries and 12% in low-income countries, compared to only 2.5% growth in high-income countries between 1996 and 2002.^[91] For advocates of market-driven fortification, private sector involvement offers opportunities to reach remote rural areas and urban neighbourhoods through the

marketing and distribution of fortified products via traditional retail outlets where poor consumers still purchase most of their food.^[6] However, a market for such foods is not guaranteed. The food industry has also expressed their reticence in fortifying due to insufficient market demand since issues such as price, taste and accessibility can have higher priority for consumers than “scientifically proven” health benefits (see *Case study: Local businesses and fortified foods*).

Yet the rise in the availability of fortified processed foods in developing countries is also perceived to carry a number of risks. One fear, already discussed, is that in the global south (i.e. Asia, Africa and Latin America) ultra-processed products containing high sugar, fat and salt are displacing usual dietary patterns, based on fresh and minimally processed foods.^[37] Another concern is that there is little regulation of commercial fortification in developing countries, even though such foods are intended for general consumption. There may be potential risks to children if the same serving size of fortified food (such as breakfast cereals or nutrition bars) is intended for all household members.^[27]

Case study

Local businesses and fortified foods

Research into two Nigerian businesses, developing packaged traditional foods and fortified products, found that the companies faced a number of constraints preventing them from providing these foods at prices poor people can afford.^[92] Both businesses cited low consumer awareness about nutrition, low sales volumes (therefore limited incentives for distribution to rural areas), unreliable product labeling and a fragile business environment as barriers to investment in nutrient-rich foods. There were similar findings from a case study of one local manufacturer in Tanzania.^[93] In contrast, non-profit distribution through governments or donor agencies in systems such as school-feeding programmes bypasses such business constraints and targets the most vulnerable groups.^[92]



5.4 Home fortification

Community level (home) fortification is an increasingly common approach to addressing hidden hunger particularly in early childhood (6-24 months), and several forms have been developed (see *Table 5*). These fortificants are designed to be added directly to a child's usual foods prepared at home, without affecting the taste or colour, and are currently distributed through the health system, community nutrition programmes and markets.^[40] Only a handful of countries have implemented large-scale distribution to date, although the number of sachets bought and supplied by UNICEF and the World Food Programme (WFP) increased from 50 million in 2008 to about 350 million in 2010.^[94]

Evaluations for home fortification have found them to be both effective (a review of eight trials concluded that home use of multiple micronutrient powders (MMPs) reduced anaemia and iron deficiency in children aged 6-23 months^[95]) and affordable (a cost of US\$3.60 per child 6-23 months of age per 60-day course of MMPs equals an annual investment of US\$ 216 million to reach 34 million children^[96]). However, this approach is viewed by some as pharmaceutical and less protective than food-based strategies that are locally based and address protein-energy malnutrition along with with MNM, which are often found to co-exist.^[97] A wider focus on improving energy quantity and micronutrient quality of the diet, with supplements where required, may be a more appropriate and sustainable solution than home fortificants.^[6]

Case study

The “Plumpy’Nut” debate

Ready-to-use therapeutic foods (RUTFs) are energy-dense, mineral- and vitamin-enriched products currently used by community-based programmes, mostly in Africa, and widely credited with reducing mortality rates by enabling safe and effective outpatient treatment of severely malnourished children.^[98] (Although there is recent evidence that RUTFs may only help in the short-term, unlike natural foods which restore gut flora, affected by malnutrition.) The predominant RUTF is Plumpy’nut, a patented paste made from peanuts, milk powder, sugar, oil and a mineral/vitamin mix, with a long shelf life that does not need to be mixed with water and is easy for home-based feeding.

The patent for this product (described as “fortified Nutella”) is owned by French-based company, Nutriset, criticised for their legal action in stopping others from manufacturing similar (cheaper) peanut-based products.^[99] Plumpy’nut is manufactured under franchise in developing countries such as Sierra Leone and Malawi, but 50% of the ingredients have to be imported.^[100] Some countries, most notably India, which banned Unicef from importing “culturally inappropriate” Plumpy’nut in 2009, have expressed concern that if RUTFs are distributed widely and for free, people will become dependent on them and stop growing and eating local crops.^[99] The other risk is the development of RUTFs as “magic bullets” for preventing moderate malnutrition – a much bigger market than acute malnourishment – and one that Nutriset has already targeted with its Plumpy’Doz ready-to-use supplementary foods (RUSFs). There is less evidence of the efficacy of these products and critics claim that it would be more cost effective to develop programmes to feed mothers and encourage them to keep breastfeeding even in crisis situations where their lives are disrupted.^[99]

Table 5

Foods for fortification at the household level^[27]

Product	Comments
Micronutrient powder which can be sprinkled onto food	Contain several micronutrients, including iron, encapsulated to minimize adverse interactions between micronutrients and sensory changes to the food to which they are added; available in sachets
Soluble micronutrient tablets which can be dissolved in water and fed as a drink	Suitable for young children; tested by WHO
Crushable micronutrient tables for adding to foods	For infants and young children; tested by UNICEF
Fat-based spread fortified with micronutrient	Popular with children; can be produced locally as the technology required is easy to implement



New developments and strategies

6.1 A global overview

UN Millennium Development Goal 8's (MDG 8) aim is to "engender collaborative partnerships to enhance human and economic development". As such, private sector engagement and involvement is widely viewed as an essential element in efforts to scale up successful nutrition interventions. Global movements such as SUN and GAIN (see 4.2) have business networks that have fostered multi-stakeholder partnerships to identify, tackle and prevent hidden hunger – and food fortification is identified as a key tool in the nutrition "toolbox". While the Copenhagen consensus has been actively making the case for food fortification using economic arguments (see 3.2), WHO, FAO and the SUN movement have included food fortification as a cornerstone of food-based solutions to micronutrient malnutrition, particularly for improved maternal and infant nutrition and health in the first 1,000 days. Similar endorsements have come from the research community, such as the influential Lancet series (see 1.3). Major players in fortification globally such as MI, FFI, Helen Keller Institute (HKI), World Vision International (WVI) and Save the Children (see 4.2), have formed alliances with bilateral agencies such as UNICEF, WHO and FAO, and with government development agencies, such as the US Agency for International Development (USAID), the British Department for International Development (DFID) and the German International Development Agency (BMZ, see *Box 22*). Initiatives, such as mass fortification of staples, and more recently, biofortification development and home fortificants, have attracted investment from some of the world's largest manufacturers of vitamins and minerals, such as DSM (the Netherlands) and FORTE (US), and the world's largest chemical company, BASF (Germany).

The view of UN organisations such as WHO is that such partnerships are crucial since no single entity has sufficient funding, resources, influence, expertise or reach to tackle the complex nutrition challenges in communities, at national and regional levels, or worldwide.^[60] However, a range of contentious issues have been raised, including: power imbalances among partners; ineffective manage-

ment of inherent conflicts of interest; failure to establish strong safeguards to protect public health goals from being co-opted by commercial interests; inappropriate co-sponsorship and co-branding arrangements involving unhealthy food and beverage products; and a lack of clear boundaries between public-interest NGOs (PINGO) and business-interest NGOs (BINGO).^{[71] [101] [63]} Although these issues have been extensively documented for tobacco, pharmaceutical and infant formula companies, there are limited evaluations of PPPs involving UN organisations, government agencies, NGOs and global companies to address a spectrum of nutrition-related issues including global hunger, food insecurity, and the double burden of malnutrition.^[71]

How to address these controversies and risks with regard to initiatives such as food fortification is a heated debate. Options can appear to be limited to either developing "partnerships," or issuing guidelines and conflict of interest statements that seem to aim to prevent engagement from happening at all.^[102] However, with the widespread use of different forms of fortification as documented in this report, the debate tends to be less about whether to engage with the private sector but rather, how – in other words, what is the governance agenda? This is particularly relevant for new developments and strategies such as biofortification and the increasing penetration in developing countries of commercially fortified foods, for all sectors of the population but particularly complementary foods for infants and young children, such as RUSFs (see 5.4).

Case study

Accountability frameworks

At the World Economic Forum in Davos, Switzerland, in 1999, former UN Secretary-General, Kofi Annan, launched the UN Global Compact to stimulate private sector actions to support UN goals. The Compact promotes 10 voluntary principles of responsible corporate citizenship to support human rights, labour, the environment and anti-corruption.^[103] By 2007, more than 3,000 companies from 100 countries, and over 700 civil society, international and national labour organisations and academic institutions were engaged in the Compact to encourage businesses to contribute to solving globalization challenges.^[104] Yet Kraak et al's^[71] analysis of 15 global food companies to the UN Global Compact found that over half of them were not signatories to the Compact (including Burger King, Heinz, Kellogg Company, Mars Inc., McDonald's Corporation, The Hershey Company and Yum! Brands).

Moreover, explicit principles to guide corporate activities that will promote optimal nutrition and health through sustainability planning are noticeably absent from the Compact, prompting some UN bodies such as WHO to develop specific private sector engagement guidelines.^[71] A 10-year evaluation of the UN Global Compact Office criticised the initiative for lacking a clear focus, failing to develop clear criteria to admit participating companies, and inadequate monitoring of signatory companies successful implementation of the voluntary principles.^[103]

Among others calling for more guidance are the **Conflicts of Interest Coalition**, which consists of 147 civil society organisations (CSOs) and networks. It proposes a Code of *Conduct and Ethical Framework* for interactions with the private sector and differentiates between policy development and appropriate involvement in implementation.^[105]

6.2 Private sector strategies

A recent Micronutrient Global Forum conference (2014) had a GAIN seminar, entitled *Harnessing markets for the 1,000 Day Window*: Experiences with complementary food, that sums up the current situation. Food fortification – and all the different forms that it encompasses – is now firmly on the private sector's agenda and likely to remain so, as companies pursue multisectoral collaborations, coalitions, strategic alliances and public-private partnerships (PPP) to reach new markets in developing countries.

The challenges and risks of various fortification strategies have been widely discussed in this report (see 5). So, too, has the role of PPPs in delivering such interventions (see 4.2). Evaluations of food fortification programmes in low income countries suggest that cost-effective and sustainable results are feasible through close collaboration of the public sector and the private sector's expertise in food production, marketing and consumer reach.^[106] However, it is arguable whether markets can deliver both short-term financial returns for companies and long-term social, economic health benefits to tackle global malnutrition challenges.^[63]

Moreover, the marketing strategies employed by the private sector to increase market share are of particular concern to consumers in these emerging markets, since they have limited discretionary income and are vulnerable to persuasive marketing practices, while being disproportionately affected by NCDs.^[71] Commercialization of products such as RUTFs, branded with the logos of transnational companies, may increase consumers' brand loyalty for a company's unhealthy product line such as soft drinks and snack foods.^[101] As Monteiro et al put it, companies like Coca-Cola, whose theme song was once *We'd like to teach the world to sing* now want to teach the world to snack – PepsiCo is now the biggest producer of globally branded processed snack foods!^[101]



Case study

Another PPP – “Popularly priced products”

Door-to-door selling schemes for fortified foods are a growing strategy to increase market share. Two examples of these include the Nestle “PPP” initiative in Brazil where women are trained to sell global brands such as Mucilon (instant baby food) and Nesquik (instant powder milk chocolate drink) alongside fortified products, which are 10-20% more expensive than those sold in supermarkets.^[101] These products are targeted at middle and low-middle income families, rather than low-income households. An alternative model, the Grameen Danone Foods (GDF), involves an alliance between Groupe Danone and Grameen Bank, a Bangladeshi NGO known for its micro-credit initiatives. Together with GAIN, GDF developed a fortified yoghurt using milk supplied by local dairy farmers and sold by saleswomen, thereby promoting local community growth.^[6] Despite the positive aspects of this scheme, detractors point to Danone’s record as a known Code violator, which saw the company being forced to step down from GAIN’s board of directors.^[14]

6.3 Alternative strategies to food fortification

To address the wider issues of food insecurity in general and food poverty and chronic hunger (MDG1) in particular, a number of other options have been adopted over the years with varying degrees of success and sustainability. Such strategies include targeted agricultural programmes that support livelihoods and enhance access to dietary diversity, and social safety nets that provide cash or food transfers. Although investments to enhance agriculture productivity are crucial for long-term reductions in poverty and malnutrition, they may not solve the problem of scarcity of access to nutritious diets (as opposed to scarcity of calories) that poor people face.^[12] There is a new emphasis on programmes such as home gardens and home-stead food production and biofortification of staple crops (see 5.2). These are nutrition-sensitive interventions aimed at enhancing poor households’ income and access to micronutrient-rich diets.^[12] Key mediators to enhancing the nutritional impact of agriculture are pathways that empower women, their social status, time allocation and health status that in turn affects child nutrition.^[57] In one review of such agriculture interventions, impact on micronutrient intake was more likely when nutrition education and gender objectives were included.^[107]

Social safety nets are a powerful means of reducing poverty and have been shown to improve household food availability and dietary quality among chronically poor households in a number of countries. Ethiopia’s Productive Safety Net reaches 10% of the country, while transfer programmes in Brazil and Mexico reach 25% of the population.^[12] Although the main goal of social transfers is to supplement income, some are conditional on interventions that enhance nutritional impact, such as linking transfers to health or nutrition services, or targeting individuals within the household for nutrition behaviour-change communications.^[12]

Box 21

Traditional food processing methods

Household processes to prepare and cook food in the home can also contribute to micronutrient intakes, with some activities such as germination and malting, for example, improving iron bioavailability.^[108] Soaking grains, such as maize, and legumes can remove anti-nutrients that inhibit nutrient absorption.^[109] Traditional food preservation techniques, such as sun-drying, preserving and pickling of fruits and vegetables can preserve surplus micronutrient-rich foods for year-round consumption.^[110] A long-term study in Malawi found that a range of traditional strategies, combined with nutrition education promoting micronutrient-rich foods, resulted in improvements in haemoglobin levels and lean body mass.^[111]

Box 22

German development cooperation (BMZ)^[112]

BMZ's focus is on a three-pronged approach to reducing hidden hunger involving: short-term supplementation; medium-term food fortification; and a long-term focus on balanced nutrition (dietary diversification).

Projects include:

- the Strategic Alliance for the Fortification of Oil and Other Staple Foods (SAFO) – see also the Global Food Partnership – is BMZ's flagship project, implemented through GIZ (the Deutsche Gesellschaft für Internationale Zusammenarbeit) in partnership with chemical company BASF in the framework of the public-private partnership "develoPPP". BMZ has supported research, advised local partners and trained government food inspectors with a view to strengthening the effectiveness of national fortification programmes in countries.
- Biofortification projects invest in farmers in Nigeria and Kenya to grow manioc and sweet potato with higher vitamin A content. This approach is funded by BMZ through the Advisory Service on Agricultural Research for Development (BEAF) and supported by GIZ.
- BMZ's 10-point programme for rural development and food security (now followed by the new Africa Strategy and the initiative "A world without hunger" („Eine Welt ohne Hunger")) makes explicit reference to measures to reduce undernutrition and malnutrition (point 3) and to integrate food security in bilateral development cooperation. These are particularly effective among children and mothers (4, 9).



Role of food fortification in food security and child wellbeing

7.1 Rights-based approach to food security/sovereignty

The search for new approaches to accelerate uneven progress towards achieving the MDGs has led to conflicts of interest between different actors and human rights-based policymakers, with particular implications for the health and nutrition of mothers and children.^[14] Tension exists in reconciling the profit-making initiatives of PPPs, which are supported by the UN, with the UN agencies' duty to promote the public sector's interests, as enshrined in constitutional mandates to respect and protect human rights.^[14] Some NGOs and human rights' groups claim that PPPs have been used to undermine internationally agreed public health policies, such as the 2003 Global Strategy on Infant and Young Child Feeding, by pressing for voluntary (i.e. non-legally binding) measures to "self-regulate" their conduct.^[59] Moreover, UN-business initiatives such as the Global Compact (see 6.1) are voluntary networks involving UN institutions, governments, business and civil society that "seek to promote principles of accountability, transparency and partnership in the field of labour, environment and human rights", but are, in reality, very weak monitoring mechanisms.^[63]

In his final statement in his role as the UN Special Rapporteur on the right to food (see 1.4), Olivier

de Schutter^[113] declared that the food systems of developing countries are "at a major crossroads - millions of people have been lifted out of poverty, yet whole communities have been left behind".^[113] Key to laying the foundations for fair and sustainable food systems lies in ensuring the right to food - and governments and transnational corporations should support, rather than risk undermining, local food systems.^[113] Several countries, such as South Africa and more recently, Brazil and Mexico and Kenya, have been pioneers in putting the right to food into law as a separate and stand-alone right, thereby strengthening accountability. A rights-based approach to food and nutrition security is rooted in the search for long-term solutions to undernutrition, based on concepts such as food sovereignty (see *Box 23*) with its focus on people's right to define (and determine) their own food systems.

Box 23

What is food sovereignty?

This is a term coined by members of the Via Campesina movement in 1996 to refer to a policy framework advocated by a number of farmers, peasants, pastoralists, fisherfolk, indigenous peoples and environmental organisations to define their own food, agriculture, livestock and fisheries systems, in contrast to having food largely subject to international market forces. It signifies looking at food as a human right, protecting natural resources, reorganising food trade and ending the globalisation of food.^[114]

Box 24

Key policies for the right to food of children^[59]

WHA Res 55.25 (2002), which urges governments: “to ensure that the introduction of micro-nutrient interventions and the marketing of nutritional supplements do not replace, or undermine support for the sustainable practice of, exclusive breastfeeding and optimal complementary feeding.”

Global Strategy on Infant and Young Child Feeding (2003), which recommends: “... infants should be exclusively breastfed for the first six months of life... Thereafter... infants should receive nutritionally adequate and safe complementary foods while breastfeeding continues for up to two years of age or beyond... diversified approaches are required to ensure access to foods that will adequately meet energy and nutrient needs of growing children, for example use of home- and community-based technologies to enhance nutrient density, bioavailability and the micronutrient content of local foods... Providing sound and culture specific nutrition counselling to mothers of young children and recommending the widest possible use of indigenous foodstuffs will help ensure that local foods are prepared and fed safely in the home.”

WHA Res 58.32 (2005), which urges governments: “to ensure that financial support and other incentives for programmes and health professionals working in infant and young child health **do not create conflicts of interest.**”

WHA Res 63.23 (2010) urges governments “to end inappropriate promotion of foods for infants and young children” and specifically “to ensure that health and nutrition claims shall not be permitted except where specifically provided for, in relevant Codex Alimentarius standards or national legislation.”

WHA 65.6 (2012) requests WHO “to provide clarification and guidance on the inappropriate promotion of foods for infants and young children cited in resolution 63.23, taking into consideration the ongoing work of the Codex Alimentarius Commission” and to “develop risk assessment, disclosure and management tools to safeguard against possible conflicts of interest in policy development and implementation of nutrition programmes consistent with WHO’s overall policy and practice.”

7.2 Children’s right to food

The right to food of children is present in the constitution of nine countries, including Brazil, Mexico, South Africa and Guatemala. There are also a number of key policies and reports that seek to protect the health and lives of the youngest “consumers”, with particular regard to micronutrient interventions and the marketing of fortified foods. Many of these initiatives have their roots in the 1981 International Code of Marketing of Breastmilk Substitutes (the Code) and subsequent relevant World Health Assembly (WHA) resolutions^[59] (see *Box 24*).

Despite such initiatives (see *Box 24*) to protect the child’s right to food, a recent analysis of spending on nutrition aid found that 44% of investments in direct nutrition interventions were allocated to projects to reduce micronutrient deficiencies, 40% to treat malnourished children with special foods and 14% to promote good nutritional practices (breastfeeding promotion was the third least popular in terms of funding). Comprehensive programmes which deliver the full package of direct nutrition interventions only accounted for 2% of funding.^[115] In a meeting with the Committee on the Rights



of the Child (CRC) in 2012^[116], de Schutter claimed that in circumstances where ecosystems could support sustainable diets, nutrition programmes and policies supporting the use of supplements, RUFTs, fortificants and infant formulas are inappropriate and can lead to malnutrition, and the marketing of these food substitutes... can contribute to major public health problems.

Case study

India's School Mid Day Meals' Scheme (MDMS)

India's school feeding programme is the largest in the world, providing free school lunches to about 120,000,000 children in over 1,265,000 schools.^[117] Among the Indian Right to Food Campaign's essential demands^[118], it called on the National Food Security (NFS) Act to incorporate all entitlements currently existing under Supreme Court orders including the right to hot, cooked, nutritious mid-day meals in all state primary schools. The MDMS became a legal right after a 2001 ruling directed all children (or their parents) to demand home-cooked school meals (as opposed to dry rations, such as fortified biscuits) as a matter of right, and enforce this right through the courts if necessary.^[118]

However, campaigners are concerned that the NFS Act, passed in 2013, has made provision for ready-made meals, which they fear could lead to the use of packaged foods, manufactured and supplied by private sector companies, thereby undermining the current community-based food security system.^[119]

To conclude, different types of fortification could form part of an integrated strategy to address micronutrient malnutrition, with a number of recommendations. To ensure their success and sustainability, especially in resource-poor countries, fortification programmes should be implemented together with poverty reduction initiatives and other agricultural, health, education and social intervention strategies that promote the consumption and utilisation of adequate quantities of nutritious foods. Otherwise, they risk ending up as a short-term technical fix to the multi-faceted problem of hidden hunger.

The following 10 action-oriented recommendations, though not fully comprehensive, give some indication of important areas to address when considering fortification initiatives.

1. Identify nutrient gaps, then develop a comprehensive national nutrition strategy of direct nutrition interventions to address hidden hunger, including increasing dietary diversity, food fortification, supplementation and public health measures;
2. Address specific opportunities and risks (technical, economic and regulatory) with reference to the fortification of a specific food and type of programme;
3. Develop effective training to build capacity at all levels including technical expertise, quality assurance, data collection and effective monitoring, as well as public education and awareness campaigns;
4. Support academic/research institutions that provide the scientific evidence for assessing the need, the progress and the impact of the programmes;
5. Adopt systematic and transparent accountability processes to balance private commercial interests with public health interests and manage conflicts of interest and biases, through using frameworks such as the United Nations Standing Committee on Nutrition (UNSCN) private sector engagement policy;^[71]
6. Challenge the PPP model and support actions that call on the UN to develop a comprehensive ethical and policy framework to deal with individual and institutional conflicts of interest;^[14]
7. Where suitable, identify opportunities for the local production of fortified foods, using local businesses to produce culturally appropriate foods;
8. Monitor and document Code violations where fortified foods threaten optimal breastfeeding practices;
9. Restrict the marketing of unhealthy fortified or processed foods, through measures such as advertising or pricing controls;
10. Integrate fortification programmes into poverty reduction strategies and food security initiatives through a rights-base approach.



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Food Fortification – a silver bullet in the fight against micronutrient deficiencies?

I welcome this debate about food fortification, which can only be in the interest of finding workable solutions to the health and development needs of the poorest.

In a better world, food fortification would not be necessary. Adding essential micronutrients to basic, staple foods would be redundant; everyone would have access to diverse diets, naturally rich in fruits, vegetables and whole grains, which would provide the nutrients we need to live healthy, productive lives. With over half the world's population suffering from malnutrition in one way or another, clearly this goal is a long way off. Until that time, although it is not a silver bullet, food fortification remains one of the most affordable and powerful tools we have to tackle one of the world's most pressing global issues.

The World Health Organisation (WHO) estimates that more than 2 billion people are deficient in key vitamins and minerals, particularly vitamin A, iodine, iron and zinc.^{[1][2]} The results can be devastating. Micronutrient deficiencies are associated with serious physical disabilities including life-threatening disorders, as well as incidence and severity of infectious illness and mortality from diarrhoea, measles, malaria and pneumonia.^[3]^{[4][5][6]} Most vulnerable to micronutrient deficiencies are pregnant and lactating women and young

children^{[2][3]} and tragically, most of those who are affected live in low-income countries. Given micronutrient deficiencies also have far reaching effects on economies – through secondary physical and mental disabilities, and altered work productivity – the problem will massively impact on the ability of people and countries to escape poverty. Indeed, the success or failure of the Millennium Development Goals and the post-2015 development agenda are tied to the issue.

The fortification of staples and condiments has been used safely and effectively to prevent micronutrient deficiencies and has been practiced in developed countries for well over a century. It has also been scaled up significantly over the past decade in developing countries.

The evidence is compelling, strong in developed countries and growing rapidly in lower income countries. In the early 20th century, salt iodisation began in Switzerland and the United States, vitamin A fortified margarine was introduced in Denmark in 1918, and in the 1930s, vitamin A fortified milk and iron and B complex flour was introduced in a number of developed countries. These fortification strategies are now common in the developed world and have led to the virtual eradication of goitre, pellagra, beriberi and rickets in these countries. There is also strong evidence in North America for significant reductions of folate-related neural tube defects (NTDs) due to folate enriched flour.

In the developing world, a review of multiple micronutrient fortification in children showed an increase in haemoglobin levels and 57% reduced risk of anaemia.^[7] A review on mass salt fortification with iodine concluded that iodised salt can improve the iodine status.^[8] Zinc and vitamin D fortification have also been effective to a varying extent.^[9] Micronutrient fortified milk and cereal products

1 WHO. World health report. Geneva: World Health Organisation. 2000.

2 WHO. Global prevalence of vitamin A deficiency in populations at risk 1995–2005. WHO Global Database on Vitamin A Deficiency (whqlibdoc.who.int/publications/2009/9789241598019_eng.pdf). 2009.

3 Caulfield LE, Zavaleta N, Shankar AH, Meriardi M. Potential contribution of maternal zinc supplementation during pregnancy to maternal and child survival. *The American journal of clinical nutrition*. 1998;68(2):499S.

4 Benoist B, McLean E, Egli I, Cogswell M. Worldwide prevalence of anaemia 1993–2005: WHO global database on anaemia. 2008

5 McLean E, de Benoist B, Allen LH. Review of the magnitude of folate and vitamin B12 deficiencies worldwide. *Food & Nutrition Bulletin*. 29(Supplement 1):38–51. 2008.

6 Bhutta ZA. Micronutrient needs of malnourished children. *Current Opinion in Clinical Nutrition & Metabolic Care*. 2008;11(3):309

7 Eichler K, Wieser S, Rüttemann I, Brügger U. Effects of micronutrient fortified milk and cereal food for infants and children: A systematic review. *BMC public health*, 12(1), 506. 2012.

8 Jiang. Fortified Salt for Preventing Iodine Deficiency Disorders: A Systematic Review. 2010.

9 Das JK, Kumar R, Salam RA, Bhutta ZA. Systematic review of zinc fortification trials. *Ann Nutr Metab*. 62 Suppl 1:44–56. 2013.

have also proven to be a complementing strategy in improving health problems of children in developing countries.^[10] A recent review has identified it as an effective and potential strategy although more rigorous evidence is required especially from LIM-IC.^[11] With regards to GAIN's own fortification projects, evidence of impact includes contributing to reductions in NTDs in South Africa (through flour fortification); iron deficiency anaemia in Nigeria, Jordan and Morocco (through flour fortification), and vitamin A deficiency in Indonesia (through oil fortification). Vitamin A is vital to immunity and improving levels of vitamin A among woman and young children can be a life-saving intervention. Iron deficiency is a killer in pregnancy. Iodine deficiency can cause lifetime mental disability.

Food fortification also provides significant economic benefits and the low unit cost of food fortification ensures large benefit: cost ratios, with effects via cognition being very important for iron and iodine.^[12] Folate fortification of wheat flour reports an average reduction of 46% in NTD and favourable benefit: cost ratios of 12–48:1.^[13] It is also shown that vitamin A fortification is effective and disproportionately benefits the poor.^[14] Economic analysis suggests that fortification is indeed a very high-priority investment.

GAIN believes that food fortification should be an integral part of national and regional nutrition strategies where existing food supplies and limited access fail to provide adequate levels of nutrients

in the diet. Of course, the aim in the long-run is to make people's diets more diverse so that most of their needs can be met from food, as fortification alone cannot solve all micronutrient problems. But it is utopian to think that this is possible at present.

Criticisms of food fortification simply do not tally with reality for many of the world's most vulnerable and nutritionally-insecure people. It is unhelpful to assume that very low-income households have the knowledge of how to diversify their diets. Even if they did, it is unreasonable to expect them to have the financial means to do so. Food fortification allows anyone with access to basic staple foods that they eat day in, day out – such as flour or vegetable oil – to get the nutrients they need. All this can be achieved without changes to consumption and feeding habits. Also, in some cases, it is almost impossible to actually attain enough key micronutrients through natural foods that are available in sufficient quantities. Consider folic acid and iodine – Japan is the only country where the latter can be found in a natural diet, due to large quantities of iodine-rich seaweed.

GAIN currently reaches, with its partners, over 860 million people through food fortification programmes. These are typically delivered via low cost staples such as salt, flour, and cooking oil that we know even the poorest consume regularly. Contrary to the impression given, very few of these products are marketed by large global companies, they are almost all manufactured and distributed by local and national millers. Our model for fortification is also very clear – a national coalition led by government, with the participation of the producers, consumers and experts. Indeed, national governments lead most fortification efforts, but many international partners within, and outside, the UN system play a critical role in helping countries implement these programmes.

Of course, these programmes are just part of the solution to malnutrition. The food system is broken and we need to fix it. Supporting fortification does not mean that the effort to reform food systems should stop. But time is pressing – with hunger and

10 Eichler K, Wieser S, Rùthemann I, Brügger U. Effects of micronutrient fortified milk and cereal food for infants and children: A systematic review. *BMC public health*, 12(1), 506. 2012.

11 Das JK, Salam RA, Kumar R, Bhutta ZA. Micronutrient fortification of food and its impact on woman and child health: a systematic review. *Syst Rev*. 2:67. 2013.

12 Pachón H, Kancherla V, Handforth B, Tyler V, Bauwens, L. Folic acid fortification of wheat flour: A cost-effective public health intervention to prevent birth defects in Europe. *Nutrition Bulletin*, 38: 201–209. doi: 10.1111/nbu.12023. 2013.

13 Pachón H, Kancherla V, Handforth B, Tyler V, Bauwens, L. Folic acid fortification of wheat flour: A cost-effective public health intervention to prevent birth defects in Europe. *Nutrition Bulletin*, 38: 201–209. doi: 10.1111/nbu.12023. 2013.

14 Fiedler JL, Afidra R. Vitamin A fortification in Uganda: Comparing the feasibility, coverage, costs, and cost-effectiveness of fortifying vegetable oil and sugar. *Food & Nutrition Bulletin*. 31(2):193-205. 2010.



malnutrition the number one risk to health worldwide – more than AIDS, malaria and tuberculosis combined. We simply cannot wait for long-term reforms to agriculture, nutrition and social systems to take place. Food fortification is the best weapon we have to help us while we begin to address these wider, more fundamental problems. The method is a proven and useful tool to improve micronutrient intakes, which people in rich countries have enjoyed for generations. We should not deny it to the poorest and most vulnerable people on our planet.

Fabio da Silva Gomes, Officer of the *National Cancer Institute of Brazil*, Ministry of Health, External Affairs Secretary of the *World Public Health Nutrition Organisation*

Artificial mends to food systems

All forms of malnutrition are expressions of food systems' failures. Adopting artificial and simplistic measures to fix one of these expressions might result in the perpetuation and production of old and new problems.

In order to analyse how valid and reliable are the approaches taken to identify the problem, its causes and solutions, it is key to start by the concepts that frame the debate, scientific and political ones.

From Latin, *fortis* means strong, physically powerful. For this reason the term fortification or biofortification is very inappropriate as a conceptual basis for both theory and practice. The addition of micronutrients (MN) to foods, culinary ingredients or ultra-processed products (UPP) does not make them stronger. Besides, the term itself is equivocally applied to food without distinguishing food, from culinary ingredients and UPP. In addition, biofortification equivocally implies that bios, in this case, plants, fruits, tubers, are weak, and inferior to the fortified bios, which is also not true. The power of nature relies on diversity, evenness and richness of the whole ecosystem and not on the individual capacity of a few species to exert super powers.

The simplistic pathway taken to fix MN deficiencies implies that by artificially adding these missing nutrients to specific foods and products, the problem would be solved. Sounds logical, and there is proof of efficacy, but there is no robust evidence showing it works in the real world, and there is even less evidence on the side effects of such strategies. This happens because this approach misses completely the roots of the problem, and introduces more problems.

Take the example of the genetic manipulation to achieve plants with higher contents of a given MN, or even the election, without any manipulation, of a given food as a super food. Up scaling the demand alongside the area harvested and the production of this given food will push more farmers to produce this specific variety. Meaning they will stop or re-

duce the production of other foods, provoking loss of biodiversity, which will limit dietary diversity. For this reason, the dietary diversification, pointed out as the most desirable, sustained and sustainable approach, is undermined by artificial measures. Measures that are told to be complementary become competing.

Policies of adding nutrients to foods, culinary ingredients or UPP are biologically and socio-politically artificial ways to mend the failure of a food system. When a country decides to adopt them, it means that they are endorsing that its food system and biodiversity have collapsed and are no longer able to solve the expressions of malnutrition resulting from this failure. By taking that premise as truly fatal and irreversible, countries may simply drive all their efforts to artificial measures. However, this is the case of the minority of the countries worldwide, where people mostly eat UPP and rarely have meals. Most countries count on rich, even and diverse ecosystems, which are naturally capable of providing the necessary sources of nutrients.

Even if the addition of MN to foods or products is judged necessary as a transitory, artificial, corrective measure, firstly it is essential to verify if the problem exists and what is its size. In most cases there is no evidence on that, or severe issues arise related to methods for measuring deficiencies and sampling, as well as conflicts of interest as those wanting to prove there is a problem can also provide the solution they have in hands to profit from. Adding MN to foods, culinary ingredients or UPP also results in unnecessary exposure of people to an excessive amount of these MN, creating new problems as a result. For this reason, besides knowing if the problem exists, it would also be inappropriate to proceed with this strategy without knowing precisely the size of the problem.

Even considering it is widely known and recognised that the dietary diversification is the most desirable, sustained and sustainable approach; that there is not compelling evidence that increasing the concentration of MN in specific foods and products works; that artificial measures deepen the prob-



lems and distract policy attention away from real solutions – despite all this, these artificial measures have been very popular around the world for decades and remain so.

One of the discourses behind this perpetuation is the one that implies that “while we cannot solve the structural problems, and prevent this from happening, we must find a remedy for the symptoms”. This gives governments the chance to say and sense they are doing something, which ends up feeling like it is all about artificial measures. This causes a vicious circle as problems are provoked by these measures, which were supposed to be adopted as transitory remedies, but end up being implemented for one, two or three decades – a long time in which a lot of progress towards strengthening food diversity could have been made. That also indicates how ineffective these policies are on enabling food systems to provide proper foods and meals. Instead, they are meant to create dependence and progressively undermine natural diverse sources.

The other pillar of this perpetuation is political inertia and the tendency to stay with the *status quo*, strengthened by supra-national encouragement fuelled by donors and investors who profit from these policies. Countries rarely have evidence on whether what they have been implementing for years is working, yet even so they insist on following the *status quo*, indicating as reason the fact that this has been done for decades and lots of countries have been doing it as well.

Scientific evidence is also used to support the infiltration of these policies worldwide. Evidence in this field moves fast, massively and is heavily funded by corporate interests. The proportion of papers on the subject that has published results in favour of conflicting supporters/sources of funds of the study prevails (Table 6). For this reason, systematic reviews that do not stratify results according to sources of funds and conflicts of interest also corroborate results found by papers.

As conflicts of interest are becoming increasingly and widely recognised as a severe limitation, public relations must find sophisticated language and strategies to avoid companies' negative exposure.

When the Fact Sheet ¹⁵ of *Scaling Up Nutrition* (SUN) refers to “ensuring access to essential vitamins and minerals”, this translates as adding MN to foods, culinary ingredients or UPP. Through the SUN Business Network, companies such as Britannia, DSM, Nutriset, Cargill, BASF, Unilever and Ajinomoto are interested in expanding the demand for their products worldwide. “Farming practices to increase the availability of nutrient-rich crops” means that companies such as BASF and Cargill are trying to imply that there are crops that are poor in nutrients and that the solution for that is providing GMO seeds or adding chemicals to the soil that will increase the concentration of certain nutrients in the produced foods. This is misleading, since it undermines agro-biodiversity and hence impoverishes the soil and dietary diversity, and it can also induce harmful overconsumption of specific nutrients. Furthermore, it drives countries to higher economic dependence, especially peasant and smallholder farmers.

Investments on sustained, sustainable and sovereign solutions are yet to be strengthened at a global as well as at a local level. Agro-ecological ways of production, for instance, grow foods very high in MN, and by principle, are far more diversity-promoting. However, policies to push this model of production have not received the required attention globally.

Food systems' strengths and the diversity, richness and evenness of natural resources are undermined by the invasion of transnational Big Food corporations, as these drive supply and demand to monotonous diets based on a few ingredients such as flours, sugar, fats, salt and cosmetics. Agriculture accompanies this impoverishment of diets as a result of Big Food marketing strategies. Regulatory measures to reduce the demand of UPP, such as restrictions on advertising and other promotional practices or taxation, are not only beneficial in that they diminish the consumption of unhealthy foods, they also give more space to rich and diverse natural foods in the food system.

It should be recognised that progress towards dietary diversification cannot depend on individual will and behavioural changes. Strategies to drive demand for foods into one or another direction should be implemented at structural levels, and legislative and economic measures must be adopt-

¹⁵ Available from http://scalingupnutrition.org/wp-content/uploads/2012/10/101059_SUN_UNGA_FactSheet.pdf

ed to facilitate and strengthen the presence of culturally and environmentally appropriate, diverse and rich foods in the food systems. Without this, the right to food cannot be realised.

Table 6

Supporters and sources of funds of published studies on the addition of calcium and vitamin D to foods and products

Reference	Conflicting interested supporters/sources of funds (producers/manufacturers of the vehicles used: dairy products, beverages, ice cream, snacks)
Adolphi 2009	DMV International
Biancuzzo 2010	The Coca-Cola Company
Bonjour 1997	Nestec Ltd. (Nestlé S.A. subsidiary company)
Bonjour 2012	Yoplait France
Chee 2003	New Zealand Milk
Daly 2006a	Geoffrey Gardiner Dairy Foundation (as extracted from their website: "The Gardiner Foundation is a proactive investor in projects that have a significant impact for the Victorian dairy industry...")
Daly 2006b	Geoffrey Gardiner Dairy Foundation
Daly 2009	Geoffrey Gardiner Dairy Foundation
Du 2004	Australian Dairy Research and Development Corporation + Australian Dairy Corporation + Nestlé Foundation



Ekbote 2011	Non conflicting
Faghih 2011	Non conflicting
Ferrar 2011	Unilever, Amgen, AstraZeneca, GlaxoSmithKline, Medtronics, Nasteck, Nestlé, Fonterra Brands, Novartis, Ono Pharma, Osteologix, Pfizer, Lilly, Sanofi Aventis, Procter & Gamble, Tethys, Unipath, Inverness Medical, Unipath, Pfizer, Takeda, Lilly, Amgen, GlaxoSmithKline Nutrition
Fisk 2012	GlaxoSmithKline
Green 2010	Fonterra Brands
Gui 2012	Bright Dairy Food Co.
Haub 2005	Non conflicting
Ho 2005	Vitasoy International Holdings
Keane 1998	Not available
Kruger 2006	Fonterra Brands
Kukuljan 2009	Non conflicting
Lau 2001	New Zealand Dairy Board
Manios 2009a	Friesland Foods Hellas
Manios 2009b	Friesland Foods Hellas
McKenna 1995	Not available
Moschonis 2006	Friesland Foods Hellas
Natri 2006	Non conflicting
Neyestani 2005	Dairy Industries of Iran (Pegah Company)
Nikooyeh 2011	Dairy Industries of Iran (Pegah Company)
Rich-Edwards 2011	Gumm Milk, Gossner Foods
Shab-Bidar 2011	Dairy Industries of Iran (Pegah Company)
Tangpricha 2003	The Coca-Cola Company
Tenta 2011	Friesland Foods Hellas
Zhu 2005	Dairy Australia, Nestlé Foundation
Zhu 2008	Dairy Australia

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Voluntary guidelines to support the progressive realisation of the right to adequate food in the context of national food security. FAO: Rome. 2005.

Adopted by the 127th Session of the FAO Council, November 2004

Guideline 10: Nutrition

- 10.1 If necessary, States should take measures to maintain, adapt or strengthen dietary diversity and healthy eating habits and food preparation, as well as feeding patterns, including breastfeeding, while ensuring that changes in availability and access to food supply do not negatively affect dietary composition and intake.
- 10.2 States are encouraged to take steps, in particular through education, information and labelling regulations, to prevent overconsumption and unbalanced diets that may lead to malnutrition, obesity and degenerative diseases.
- 10.3 States are encouraged to involve all relevant stakeholders, in particular communities and local government, in the design, implementation, management, monitoring and evaluation of programmes to increase the production and consumption of healthy and nutritious foods, especially those that are rich in micronutrients. States may wish to promote gardens both at home and at school as a key element in combatting micronutrient deficiencies and promoting healthy eating. States may also consider adopting regulations for fortifying foods to prevent and cure micronutrient deficiencies, in particular of iodine, iron and vitamin A.
- 10.4 States should address the specific food and nutritional needs of people living with HIV/AIDS or suffering from other epidemics.
- 10.5 States should take appropriate measures to promote and encourage breastfeeding, in line with their cultures, the International Code of Marketing of Breast-milk Substitutes and subsequent resolutions of the World Health Assembly, in accordance with the WHO/UNICEF recommendations.
- 10.6 States may wish to disseminate information on the feeding of infants and young children that is consistent and in line with current scientific knowledge and internationally accepted practices and to take steps to counteract misinformation on infant feeding. States should consider with utmost care issues regarding breastfeeding and human immunodeficiency virus (HIV) infection on the basis of the most up-to-date, authoritative scientific advice and referring to the latest WHO/UNICEF guidelines.
- 10.7 States are invited to take parallel action in the areas of health, education and sanitary infrastructure and promote intersectoral collaboration, so that necessary services and goods become available to people to enable them to make full use of the dietary value in the food they eat and thus achieve nutritional well-being.
- 10.8 States should adopt measures to eradicate any kind of discriminatory practices, especially with respect to gender, in order to achieve adequate levels of nutrition within the household.
- 10.9 States should recognise that food is a vital part of an individual's culture, and they are encouraged to take into account individuals' practices, customs and traditions on matters related to food.
- 10.10 States are reminded of the cultural values of dietary and eating habits in different cultures and should establish methods for promoting food safety, positive nutritional intake, including fair distribution of food within communities and households, with special emphasis on the needs and rights of both girls and boys, as well as pregnant women and lactating mothers, in all cultures.

BINGO	Business Interest Non-Governmental Organisation	NFS	National Food Security
BMS	Breast Milk Substitutes	NGO	Non-Governmental Organisation
BMZ	German Federal Ministry for Economic Cooperation and Development (German abbreviation, BMZ)	NTD	Neural Tube Defect
CDC	(US) Centre for Disease Control	OFSP	Orange-Fleshed Sweet Potato
CRC	Committee for the Rights of Children	PINGO	Public Interest Non-Governmental Organisation
CSOs	Civil Society Organisations	PPPs	Public-Private Partnerships
CSR	Corporate Social Responsibility	PPP	Popularly Priced Products
DFID	Department for International Development (UK)	RUSFs	Ready-to-Use Supplementary Foods
FAO	Food and Agriculture Organisation	RUTFs	Ready-to-Use Therapeutic Foods
FFI	Food Fortification Initiative	SAFO	Strategic Alliance for the Fortification of Oil and Other Staple Foods
GAIN	Global Alliance for Improved Nutrition	SAM	Severe Acute Malnutrition
GDP	Gross Domestic Product	SUN	Scaling Up Nutrition
GIZ	German Agency for International Development (German abbreviation, GIZ)	UN	United Nations
GM	Genetic Modification	UNICEF	United Nations Children's Fund
HKI	Helen Keller International	UNSCN	United Nations Standing Committee on Nutrition
IBFAN	International Baby Food Action Network	USAID	United States Agency for International Development
ICMBMS	International Code for the Marketing of Breast Milk Substitutes	US	United States
IDD	Iodine Deficiency Disease	USI	Universal Salt Iodisation
LBW	Low Birth Weight	VAD	Vitamin A Deficiency
LICs	Lower Income Countries	WFP	World Food Programme
LIMICs	Lower Income and Middle Income Countries	WHA	World Health Assembly
MDG	Millennium Development Goals	WHO	World Health Organisation
MDMS	Mid Day Meal Scheme	WVI	World Vision International
MI	Micronutrient Initiative		
MMPs	Multi-Micronutrient Powders		
MNM	Micronutrient Malnutrition		
MSF	Medecins Sans Frontieres		
NR-NCD	Nutrition-Related Non-Communicable Disease		

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