Global Panel
on Agriculture
and Food Systems
for Nutrition

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The Cost of Malnutrition: Why Policy Action is Urgent

The international community is currently seeking to accelerate and sustain reductions in malnutrition globally. This Technical Brief provides compelling evidence on the economic value of these urgent efforts, and shows that no nation can afford to waste the economic potential of its citizens on such a scale.

ABOUT THE GLOBAL PANEL ON AGRICULTURE AND FOOD SYSTEMS FOR NUTRITION:

The Global Panel is an independent group of influential experts with a commitment to tackling global challenges in food and nutrition security. It is working to ensure that agriculture and food systems support access to nutritious foods at every stage of life.

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Summary

Malnutrition, in all its forms, carries huge direct and indirect costs to individuals, families and to entire nations. The estimated impact on the global economy could be as high as US$3.5 trillion per year, or US$500 per individual.[1] Such enormous costs result from economic growth foregone and lost investments in human capital associated with preventable child deaths, 45% of which can be ascribed to poor nutrition, as well as premature adult mortality linked to diet-related non-communicable diseases (NCDs).[2] Further costs are incurred through impaired learning potential, poor school performance, compromised adult labour productivity, and increased health care costs.

Since maternal and child undernutrition contributes to more than 10% of the world's disease burden[3], and at least 2.6 million people die each year as a result of being overweight or obese, it is vital that addressing all forms of malnutrition becomes a top policy priority. A sustained reduction will contribute significantly to poverty reduction and development plans, and to government budgetary savings.

Choosing the right set of actions to resolve malnutrition requires good evidence of what works in policy terms. Policymakers should make decisions based on the known cost-effectiveness of immediate actions, bearing in mind future accrued costs if appropriate actions are delayed. This Technical Brief demonstrates that the status quo carries serious economic implications. All policymakers, but particularly those in economic planning and finance ministries, must draw on growing evidence of how poor nutrition impacts economic growth.

Using a new conceptual framework, this brief illustrates the various pathways by which malnutrition carries fiscal and economic costs. The brief also outlines the impressive returns on investment associated with actions to improve food systems, diets and nutrition worldwide.

Urgent investments are needed in country-specific economic analyses of the costs and benefits associated with an accelerated reduction in all forms of malnutrition, and in improvements in the quality and quantity of diets to support this goal.

> "The socio-economic gains of investing in nutrition are significant and lasting. Shouldn't we do what we can to prepare a healthier future for our children?"
>
> **John A. Kufour, Former President of Ghana, and co-Chair of the Global Panel**

Photo: DFID - UK Department for International Development

Introduction

Poor nutrition carries a significant economic burden for individuals and for entire economies. A recent assessment suggested that undernutrition, micronutrient deficiencies, and overweight at today's levels cost the global economy up to US$3.5 trillion.[1] This level of economic burden acts as a major impediment to government efforts to reduce poverty and to achieve important targets such as the Sustainable Development Goals (SDGs).

No country is immune to the pernicious effects of at least one form of malnutrition, be it chronic or acute undernutrition, deficiencies in essential vitamins and minerals, or the escalating problem of overweight and obesity.[4] Each of these problems is linked in various ways to low quality diets. The World Health Organization (WHO) describes a healthy diet as one that "helps protect against malnutrition in all its forms, as well as NCDs."[5] Few, if any, countries can claim to have solved the challenge of effectively promoting highly productive, market-based sustainable food systems that support diversified, affordable, nutritious and safe foods for all. As a result, poor quality diets have become the single most important risk factor in the global burden of disease.[6]

Understanding the direct and indirect costs of malnutrition and poor diets matters; if decision makers are to prioritise investments according to the causes of malnutrition, they need solid evidence of how malnutrition impacts individual and national economic activity, the costs associated with healthcare, and the costs and savings deriving from effective prevention. Thus, cost calculations have to include the price tag attached to interventions such as the treatment of a vitamin A deficiency or investments in clean water systems to prevent diarrhoeal diseases that in turn impair child growth. Much larger economic impacts derive from government inaction: that is, the costs of malnutrition borne by families themselves, the price of medical treatments, and costs associated with economic growth foregone – what might have been in an ideal world without malnutrition.

This Technical Brief argues that explicit attention to nutrition is warranted as the international community seeks to accelerate and sustain reductions in malnutrition globally. While addressing malnutrition has important moral implications, the Global Panel provides compelling evidence on the economic value of addressing malnutrition. It shows that no nation can afford to waste the economic potential of its citizens on such a scale.

Pathways from Malnutrition to Economic Loss

The direct costs, such as the treatment of overweight- or obesity-related conditions, of undernutrition, including stunting, wasting and micronutrient deficiencies, have been estimated at between US$1 and US$2 trillion globally.[1] In addition, the direct costs of overweight and obesity-related NCDs were put at $1.4 trillion in 2010.[1] Additional costs are borne by families, in the form of higher medical bills, lost income due to illness, reduced school performance and later earnings due to cognitive impairment, funeral bills, and so on. The various health and other risks associated with various forms of malnutrition vary by gender, age and context (geography, urban versus rural setting, etc.). Unfortunately, few data are collected at such disaggregation, making it very difficult to determine the cost and effectiveness of actions for specific groups of individuals. This remains a data gap that should be urgently closed.

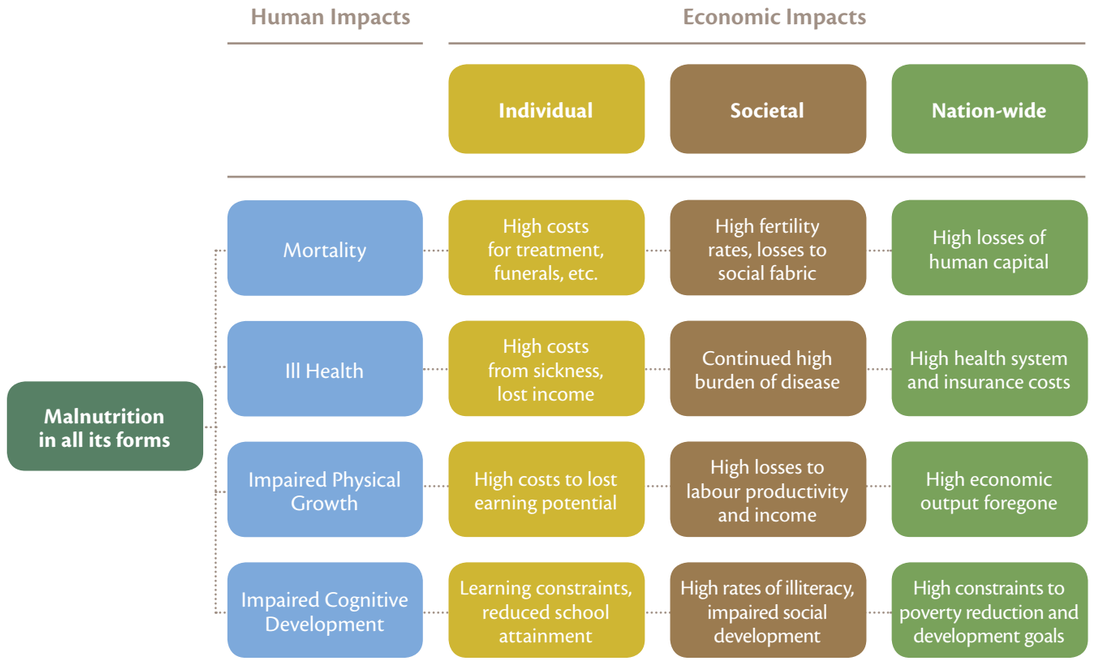
At the national level, costs include the rising bill associated with disability payments, while losses are squarely tied to economic productivity foregone. For the purpose of this brief, these interactions have been grouped into four main pathways, shown in Figure 1.

Figure 1 highlights the many economic impacts that are associated with malnutrition-related outcomes from the level of the individual up to the level of the national economy. Examples presented in each box are illustrative of categories of costs or losses incurred. The main drivers of economic impacts are examined in the following sections through the lens of four main pathways to human impact:

1. **Mortality.** Up to 45% of all preventable child deaths are attributable to undernutrition.[2] Severely undernourished children are up to nine times more likely to die than well-nourished children.[7] Maternal mortality, linked to severe anaemia, and reduced adult life expectancy, linked to obesity and related health complications, are additional manifestations of nutrition-mortality linkages. Preventable mortality represents a loss of human capital that affects families and whole communities.

2. **Ill health.** Treatment costs are borne by families as well as by health and insurance systems. For example, a full course of therapy to save the life of a severely wasted child costs between US$100 and $200 per child.[8, 9] At the same time, the per capita healthcare costs of treating obesity in the United States alone has been shown to be over 80% higher for severely or morbidly obese adults than for adults with a healthy weight.[10]

Figure 1: Conceptual framework for understanding the economic impacts of malnutrition in all its forms



3 **Impaired physical growth.** Sub-optimal physical growth, often coupled with life-long susceptibility to illnesses, reduces economic productivity through lowered labour productivity or absenteeism from work. The losses to individuals from undernutrition in low-income countries has been estimated as 10% or more of lifetime earnings.[11] The cost to low-income nations of productivity foregone due to undernutrition has been estimated as 3 to 16% (or more) of GDP.[12] Similarly, in high-income settings like the United States, job absenteeism linked to obesity causes lost output equivalent to $4.3 billion each year, costing employers US$506 annually per obese worker.[13, 14]

4 **Impaired cognitive development.** Poor nutrition from birth, continuing through school and adolescence, impairs cognitive development, delays school-attendance and reduces attainment, resulting in lost employment and socialisation opportunities throughout life. For instance, in Guatemala it was shown that stunted six-year-old children carried the risk of losing the equivalent of four grades of schooling through impaired cognitive development.[15]

These human impacts are not mutually exclusive, of course. Impaired cognition is often associated with impaired physical growth (child stunting), while (premature) mortality is often the end point of acute or chronic undernutrition interacting with reduced immune system functions. The same applies to economic losses. The boxes in Figure 1 are not discrete categories and also interact across levels. The point of separating out pathways conceptually is to emphasise the fact that the human effects of malnutrition manifest in numerous ways, which in turn have numerous economic ramifications.

Unfortunately, because there are numerous ways by which malnutrition can carry financial costs to individuals and to economic systems, there has been a proliferation of approaches used to estimate costs, losses, and the price of various interventions. Some analysts take a health sector focus to determine the benefit of a death averted or to estimate the years of disability to be expected in the context of untreated malnutrition. Others focus more on the fiscal costs associated with healthcare or on the more abstract economic losses deriving from lowered future productivity.

What is more, calculations of the costs of malnutrition have often isolated one or other pathway to simplify estimates of short and long term impacts to society, which makes it hard to assess packages of, or alternatives among, policy interventions.[16]

The following sections lay out what is currently known about the links between nutrition and economic outputs using the pathways as a guide. Various forms of malnutrition are referred to, and different approaches for costing malnutrition are highlighted. To enhance policymakers comprehension of the economic implications of malnutrition, greater standardisation of terms and comparability of approaches should be a goal for the post-2015 Sustainable Development agenda.

Costs of Preventable Mortality

Undernutrition is currently a major contributor to about three million deaths of children under five years old per year.[4] There are also serious risks to pregnant women associated with deficiencies of specific micronutrients. In 2013, an analysis

Table 1: Economic impacts of child undernutrition in Africa (selected countries)

Country	Underweight children	Annual additional morbidity episodes	Economic Cost		Proportion covered by the families
			National currency	USD (millions)	
Egypt	658,516	901,440	EGP 1.1 billion	213	73%
Ethiopia	3.0 million	4.4 million	ETB 1.8 billion	155	90%
Swaziland	9,645	25,446	SZL 60.7 million	7	88%
Uganda	975,450	1.6 million	UGX 525.8 billion	254	87%

Source: COHA Study

of global risks of mortality showed that six clusters of risk factors stood out, the first of which was "dietary risks", which accounted for over 11 million deaths (all ages) per year.

The risk of death rises steeply as malnutrition becomes more severe. High mortality risks are associated with severe wasting (children being too thin for their height), showing that a severely wasted child has a nine-fold higher risk of dying from, for example, malaria than an equivalent well-nourished child.[2] Recent estimates suggest that roughly one in ten children under five in low-income countries is wasted, and severe wasting accounts for half a million deaths in this age group.[17] Around 37% of child and adult deaths linked to diarrhoea, malaria, measles, pneumonia, and HIV/AIDS combined can be attributed to wasting.[8]

The top 10 countries affected by wasting include emerging economies such as India, Indonesia, Egypt, Brazil and Vietnam. Fragile states and countries facing humanitarian emergencies also have large numbers of wasted children, and include the Democratic Republic of Congo, Niger, Bangladesh and the Sudan.[18] For example, a recent assessment in Malawi showed that child undernutrition cost almost US$600 million in 2012, equivalent to more than 10% of that year's GDP.[19] The main contributor to these costs in Malawi was child mortality associated with undernutrition, the problem primarily being wasting. Between 2008 and 2012, roughly 23% of all child mortality in Malawi was "directly associated with undernutrition."[19]

Chronic forms of undernutrition, such as stunting, also carry elevated mortality risk of death: a moderately stunted child carries double the risk of dying compared to a non-stunted child, while the mortality risk is more than four-fold among severely stunted children. Most of these risks affect poorer families.

The combined effects of in-utero growth restriction, sub-optimal breastfeeding, child stunting, wasting and vitamin A and zinc deficiencies in children are responsible for 45% of deaths among under-fives in low- and middle-income countries.[2] Similarly, maternal undernutrition during pregnancy, often linked to iron deficiency anaemia, contributes to roughly 800,000 neonatal deaths each year.[20]

Overweight and obesity increase the risk of Type 2 diabetes, hypertension, stroke, heart disease and several cancers. WHO calculated that more than 2.8 million people (mainly adults) die annually due to ill-health associated with being obese.[21]

Costs of Medical Care and Income Lost to Ill Health

The cost of malnutrition in terms of healthcare expenditures is "staggering", according to the Food and Agriculture Organization (FAO).[22] This statement relates to resource poor as well as high-income settings. There are two kinds of direct costs in this context: private individual costs borne by the patient or their family, and public costs relating to government or other institutional costs. The latter potentially includes population-wide risk sharing through health and life insurance mechanisms, as well as the added costs of treatment and preventive care that are higher where disease management is compounded by complications due to malnutrition. For example, the very large costs associated with 'overweight including obesity' are disproportionately tipped towards days of work lost and treatment costs of morbid obesity. The costs are much lower in relation to 'overweight, but not obese'. In low-income countries, undernutrition interacts synergistically with poor quality, and sometimes insufficient, diets to increase the frequency and severity of episodes of sickness.

Table 1 shows that for countries like Ethiopia and Swaziland, very large numbers of underweight children (under five years of age) contribute to millions of cases of additional morbidity, resulting in huge direct health costs and economic losses.[23] Importantly, Table 1 also shows that by far the greatest burden of economic loss is borne by families (through lost earnings and the cost of medical care) rather than by government.[23]

Focusing specifically on wasting, India's 45 to 50 million Disability Adjusted Life Years (DALYs) lost to wasting translate to economic losses of more than US$48 billion in lifetime lost productivity (where one DALY is valued at US$1,000—a common way to standardise the value of each DALY). If a DALY is instead valued at US$5,000 (a second common metric for DALYs), India's wasting-related losses climb above US$242 billion, even before accounting for the losses of investments in human capital resulting from preventable mortality. India's losses are large in part because that country has the largest number of wasted

children in the world. Other poorer countries also face devastating economic losses due to wasting, such as US$4.6 billion in Bangladesh, and more than US$3 billion in Ethiopia and the Democratic Republic of Congo.[8]

In addition, the WHO has calculated that roughly 36 million DALYs are caused by overweight or obesity globally.[21] One recent study of trends in overweight and obesity among 28,000 rural children and adolescents over the past 29 years (1985–2014) in Shandong province of China found that the prevalence of obesity increased among boys from 0.03% in 1985 to 17.2% in 2014, and for girls from 0.12% in 1985 to 9.11% in 2014.[24] In other words, even in rural areas of emerging economies, obesity and its attendant health risks have risen sharply and now present as very serious public health concerns.

One of the diet-related NCDs associated with obesity is Type 2 diabetes. Globally, diabetes affects more than 415 million people and in 2012 was the direct cause of around 1.5 million deaths.[25] It is projected that if current trends continue unabated, more than 640 million people will have diabetes by 2040.[25]

The human cost of this particular epidemic is large, but the economic costs already dwarf those associated with the treatment of child wasting: public spending on diabetes in 2010 was already around 12% of total health expenditure worldwide.[25] By 2030, if obesity trends continue, obesity-related medical costs in the United States alone could reach $66 billion a year, contributing to a global total of roughly US$500 billion annually, thereby imposing huge new burdens on the health budgets of emerging economies.[26] India, China, Indonesia, Pakistan, Brazil,

> “Although the price of addressing malnutrition can be huge, evidence shows that the cost of doing nothing is immeasurably greater.”
>
> **Prof. K. Srinath Reddy, President of the Public Health Foundation of India, and Panel Member**

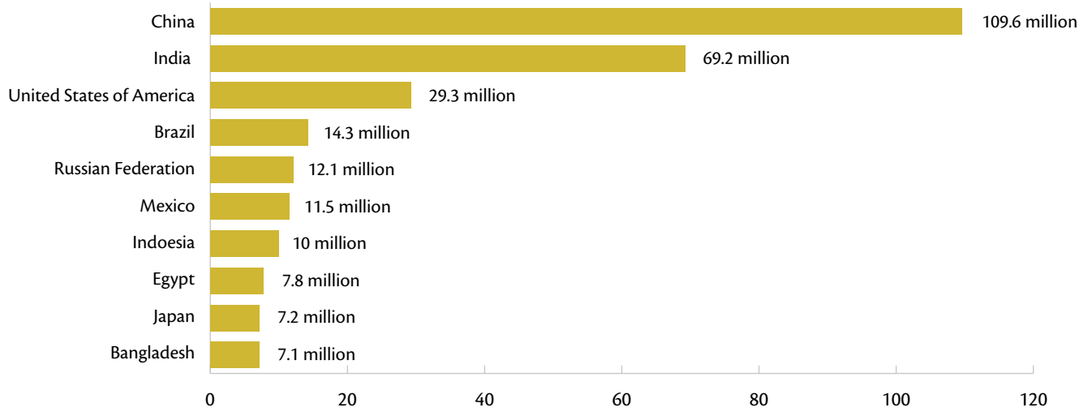
and Bangladesh already rank among the world’s top ten countries in terms of cases of diabetes (Figure 2).[27] Accordingly, a survey by the World Economic Forum’s Future of Health Initiative found that one-in-four private sector leaders in India already expect diabetes to “seriously impact their business.”[28]

In high-income settings, the impact on health budgets of all forms of malnutrition is already widely felt. According to Freijer et al. 2013, “disease-related malnutrition is a worldwide problem” that carries serious economic consequences.[29] Higher costs of medical care are linked to malnutrition because of a greater likelihood of hospital admission due to disease severity, longer hospital stays, increased hospital readmissions, higher long-term nursing care requirements, lower effectiveness of prescribed medicines, and sometimes a higher mortality risk. For the European Union (EU) as a whole, 20 million individuals are affected by disease-related malnutrition, costing EU governments up to €120 billion per year (US$133.94 billion).[29]

More specifically, in The Netherlands in 2011, the total additional costs of managing patients in facility settings who had disease-related malnutrition (beyond regular medical treatment costs)

Photo: European Commission DG ECHO

Figure 2: Top 10 countries for number of adults with diabetes



Source: IDF Atlas of Diabetes

came to almost €2 billion (US$2.23), which was more than 2% of the total Dutch national health expenditure in that year.[29] Similarly, a more recent study in England documented that the added spending on medical and social care associated with malnutrition in 2011-12 was almost £20 billion, or more than 15% of total public expenditure.[30]

These examples underline the huge fiscal costs associated with malnutrition in the context of healthcare in resource-rich environments. However, this has serious implications for the future in resource-poor settings. For example, roughly three-dozen low- and middle-income countries carry the bulk of the world’s burden of both chronic and acute undernutrition. Similarly, almost two billion people suffering micronutrient deficiencies are to be found across all parts of the globe. And although rates of overweight and obesity first escalated in high-income countries, diet-related chronic diseases are now worldwide threats.

Costs of Impaired Physical Growth

Physical growth relates to the physiological processes by which infants grow into healthy adults. Impaired growth can include height restriction (stunting) and/or adipose accretion (development of overweight and obesity). Each is affected by poor nutrition and has multiple links to inadequate or low nutrient quality diets.

Globally, one in four children under five is stunted; that is, they suffer chronic undernutrition that prevents them from achieving their full physical growth potential.[18] Final attained height (stature) matters to earnings, primarily through enhanced learning and school achievement (coming through less ill-health and higher cognitive performance), leading to greater job opportunities and higher labour productivity.[31]

Data from Brazil, Guatemala, India, the Philippines, South Africa and Zimbabwe consistently shows that growth failure in the first 24 months of life is associated with reduced stature in adulthood, often having a considerable impact on final attained height. For example, Senegalese men who were stunted at two years of age were nine centimetres shorter as adults compared with men who had not been stunted as a child.[12]

The economic consequence of height restriction due to undernutrition can be measured in numerous ways. Evidence from The Philippines, Zimbabwe, and Guatemala consistently shows that stunting and other measures of lost growth potential is associated with reduced final grade attainment in school.[32]

Effects of stunted height also relate to labour market engagement. Cross-country data suggests that a loss of 1% of potential attained height in adulthood reduces earnings by 2.4%.[12] For example, a modelling exercise of lifetime earnings in Tanzania, focused on height, found that the eradication of stunting would add US$539 (at US$ 2009 levels) to the lifetime earnings for each individual.[33] Similarly, it was shown in Mexico that height affects hourly earnings as well as type of job available, such that a one centimetre increase in height is associated with a 1.4% increase in wages.[34]

Losses to economic productivity at an individual level also represent losses to government. Where incomes are effectively taxed, revenues will be smaller where absenteeism is high and productivity is low. But there are also losses in the form of economic growth foregone. At the national level, the loss of individual height translates to an annual loss in resource-poor countries; “as much as 12%” of GDP.[35]

In other parts of Africa, such as Uganda, public sector losses exceed 5% of GDP as a result of the long-term effects of lower agricultural productivity, underperformance in schools, and the

cost of treating anaemia, diarrhoea and respiratory infections (Table 2).[22] In Ethiopia, the losses linked to children being undernourished and facing diminished lifetime earnings rise to 16.5% of GDP.[22] This study estimated that between 40% and 67% of the working-age population in the four African countries highlighted in Table 2 were stunted as children.

The implications of undernutrition on a nation's economic performance are clear in terms of losses measured as income foregone. They are perhaps even more striking in terms of potential gains to be derived by reducing the problem. In adulthood, per capita income of individuals who were not stunted at 2 years is higher compared to individuals who were stunted at 2 years. This increase comes about through the impact of improved nutrition on income through higher schooling and better cognitive skills. In fact, a reduction in global levels of stunting by 20% would represent a rise in income of 11%.[36]

If, for example, these same African countries were to achieve the target set by the World Health Assembly (WHA) for a 40% reduction in stunting by 2025, what additional national revenue could be anticipated? Hoddinott (2016)[12] has estimated that this would result in a gain of over US$83 billion dollars over the period of 2035 through 2060 (when 40% fewer undernourished children would enter the labour force at 18 years of age), with, for Ethiopia, the reward being almost US$15 billion (Table 3).

Similar findings from South Asia, which demonstrate the potential gains over time from reducing stunting, also make a very strong case for action. If Cambodia were to achieve the WHA 40% goal reduction in stunting by 2025, the government could prevent a yearly loss of approximately $50 million.[37]

In the coming two decades, global economic output losses linked to overweight and obesity-related NCDs are forecast to reach US$47 trillion, excluding associated healthcare spending.[1] In China alone, it has been calculated that by 2025, obesity would reduce the country's Gross National Product (GNP) by almost 8% per year.[38] The challenge facing the world in terms of obesity (and associated diet-related chronic diseases) is that few, if any, nations have yet successfully reversed recent rising trends. As the evidence of effectiveness of obesity prevention and therapeutic interventions is weak, there is a need for high-quality research in this discipline.[39]

Table 2: Economic costs of child undernutrition to national economies in Africa

Summary of costs of child undernutrition

Country	Losses in local currency	Losses in USD	Equivalent % of GDP
Egypt	EGP 20.3 billion	3.7 billion	1.9%
Ethiopia	ETB 55.5 billion	4.7 billion	16.5%
Swaziland	SZL 783 million	92 million	3.1%
Uganda	UGX 1.8 trillion	899 million	5.6%

Source: COHA Study

Table 3: Cumulative additions to GDP associated with accelerating investments to meet the WHA 2025 target for stunting: 2035 – 2060

Country	Cumulative addition to GDP (millions of 2016 USD)
Benin	1,571
Chad	3,718
Ethiopia	15,908
Lesotho	151
Madagascar	1,800
Malawi	1,513
Mali	2,814
Niger	5,553
Nigeria	29,274
Rwanda	1,028
Senegal	1,723
Togo	842
Uganda	7,464
United Republic of Tanzania	7,952
Zambia	2,513
Total	83,824

Source: Hoddinott (2016)

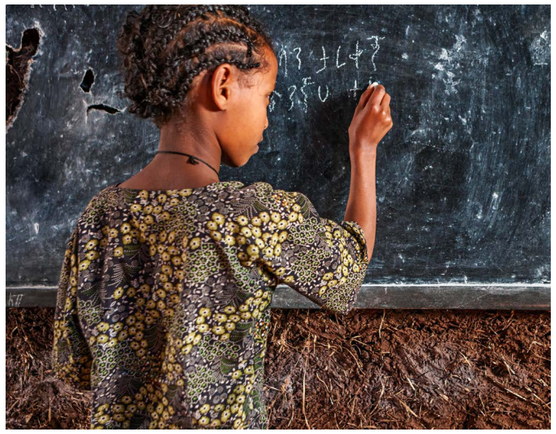
Costs and Losses Linked to Impaired Cognitive Development

According to the United Nations Children's Fund (UNICEF), children who are undernourished "achieve less in school" and "are paid less when they enter the workforce."[40] The reasons are many, including constraints to optimal brain development, reduced ability to respond to psychosocial stimulation (if present), and problems relating to psychomotor development and fine motor skills.[41] It has been known for decades, for instance, that "malnutrition in early childhood is a factor likely to result in reduced intellectual potential"; a cognitive link to physiological status that recent developments in brain scanning technology has confirmed.[42, 43, 44]

A multi-developing country study that explored the impact of impaired cognitive development on wages suggested that adults who were stunted as children receive almost 20% less in annual income than if they had not been stunted. [45, 46, 47] Even in resource-rich countries, like the United States, studies of twins have shown that each additional inch of height gained among women is associated with a 3.5% to 5.5% increase in wages, and that these are in large part determined by mental acuity linked to years of schooling.[48]

Poorly nourished children tend to enrol in school later than other children. They also tend to progress more slowly across grades (in part due to higher rates of absenteeism), have lower levels of scholarly achievement, perform poorly on cognitive achievement tests, and carry these deficits into adulthood.[49]

Physical growth interacts with cognitive development and both have links to another category of undernutrition that is often called 'hidden hunger'. This refers to age- and sex-specific deficiencies of important vitamins and minerals needed by the body and the brain to grow appropriately, for example, iron, zinc, vitamin A and iodine.



Deficiencies in a single micronutrient can carry serious health, as well as economic, costs. Severe vitamin A deficiencies, for example, contribute to blindness as well as death. A 2010 study calculated that low vitamin A status among mothers and children across Africa can be associated with an annual loss of up to 1% of GNP.[50] The cumulative economic cost of cognitive impairment and lower labour productivity due to iron-deficiency anaemia is on average 4% of GDP for low-income countries.[51] In fact, the gap between infants with good iron status versus chronic iron deficiency was shown in Costa Rica to result in 10% lower cognitive test scores at infancy and 26% lower test scores for the same subjects at age 19.[52]

A deficiency in iodine has very close links to cognitive development and performance, with implications for earnings later in life. According to Hunt (2005), 10% of babies born to iodine-deficient mothers suffer severe mental retardation.[53] A meta-analysis of 20 studies demonstrated that, in endemic iodine-deficient communities, the IQ of children is reduced by 13 points.

But where there is one nutrient deficiency there are often others. Often, multiple forms of undernutrition coexist at household and even national levels. Thus, policies and programmes need to consider integrated solutions across food and health systems, to improve diets and consumption patterns, as well as healthcare and clean water use, and income flows and educated consumer choices.

Often multiple forms of malnutrition coexist. Wasting and stunting can manifest in the same child, leading to a further increase in mortality risk.[54] It is also increasingly understood that overweight and/or obesity can be associated with various micronutrient deficiencies, in particular with lower levels of vitamins C, D and E, and possibly iron. [55, 56, 57, 58]

Further estimates show that stunting, and vitamin and mineral deficiencies together result in losses of up to 3% of GDP in low-income developing countries.[1] These losses are due mainly to productivity and economic growth potential foregone. Four of the main drivers of economic loss are iron-deficiency anaemia, diarrhoeal episodes associated with zinc deficiency, low immunity to diseases linked to a lack of vitamin A, and lowered intellectual potential due to iodine deficiency. For example, from 1960 through 2006, lower rates of anaemia and iodine deficiency can be linked to higher IQs, and that a 10% rise in IQ leads to a 1% rise in annual growth rates. [59]

Alderman and Behrman (2004) also found that the cumulative economic losses resulting from low birth weight (less than 2.5kg) amount to US$580 per child because of a lifetime of impaired labour productivity and cognitive losses.[60] Also in Norway, it has been shown that low birth weight represents a drag on annual taxable earnings of full-time workers, such that a 10% increase in birth weight increases earnings, on average, by 1%.[61]

To address such inter-connected problems requires inter-locking solutions framed by an understanding of the critical barriers and entry points along the entire food chain. It is not always clear if the co-existence of multiple forms of malnutrition represents co-morbidity (the spectrum of manifest deficiencies derive from the same underlying cause or causes) or if one form of nutrient deficiency actively drives others (in terms of a causal relationship). Greater understanding is needed on how food can contribute to broad-based solutions, but also of the limits of investment in increased food supply alone. Dietary quality matters to all forms of malnutrition.

The Price of Investing in Good Nutrition – and the Rewards

As noted by Alderman (2010), while the economic consequences of malnutrition in all its forms are substantial, "the economic returns to preventing malnutrition are on a par with those investments generally considered at the heart of economic development strategies."[62] The body of evidence supporting this view that has accumulated over recent years is substantial and robust.

For example, FAO has calculated that an annual investment of US$1.2 billion just in improving the micronutrient supply globally, through a) supplementation, b) food fortification and/or c) biofortification of staple crops, would result in "better health, fewer deaths and increased future earnings" of up to US$15.3 billion per year: a 13-to-1 benefit-to-cost ratio.[1, 63]

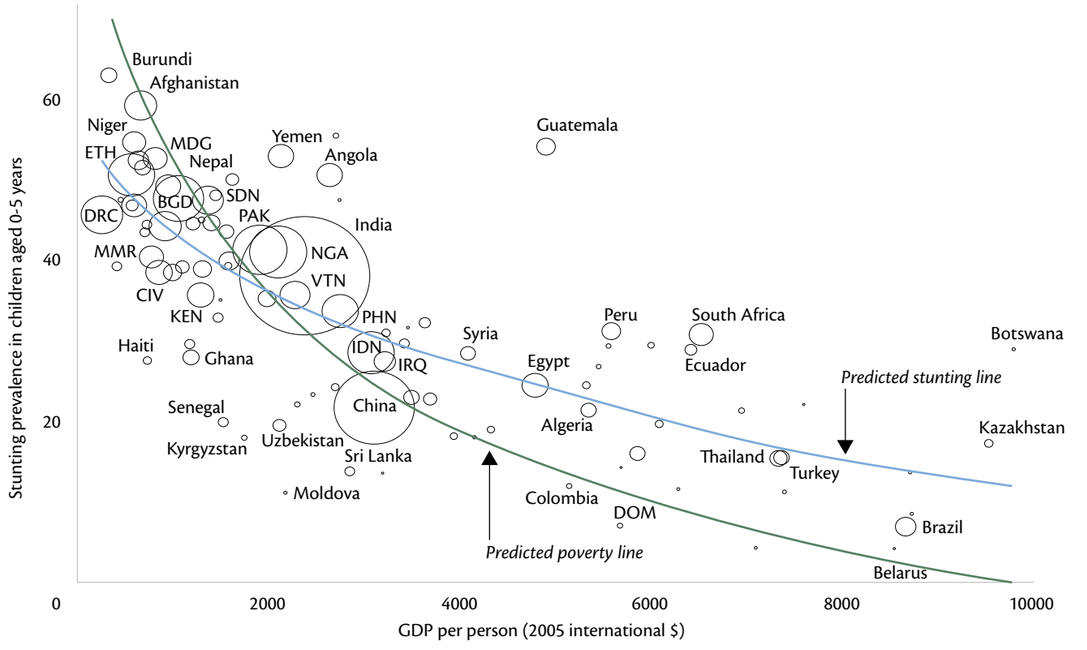
Looking beyond micronutrients, the World Bank calculated that $7 billion per year, in addition to existing resource allocations over the next ten years, would allow the world to reach global WHA targets by 2025 for reducing stunting, anaemia in women, and increasing exclusive breastfeeding, while also better managing the impacts of wasting. Estimates indicate that an investment of $7 billion would result in 3.7 million child lives saved, more than 65 million fewer children being stunted, and 265 million fewer women suffering from anaemia compared to 2015.[64]

The recent 'Cost of Hunger' analysis for 12 countries in Africa also undertook a modelling of returns to investing in halving prevalence rates of child stunting by 2025. This reduction in stunting would lead to a decrease in medical treatments, lower repetition rates in the education system and an increase in manual and non-manual productivity and subsequently to national savings. It was shown that the average annual savings from achieving the 50% reduction amounted to US$3 million per year for Swaziland, to US$133 million for Egypt and as high as US$376 million in Ethiopia.[22]

For obesity, a recent study on conditions in the United States projected that rising federal tax revenues combined with reduced public health spending on obesity-related treatment would exceed US$20 billion per year by 2035.[65]

To achieve economic gains across many different sectors will require numerous coordinated actions by different stakeholders;

Figure 3: Prevalence of children (<5y) stunted mapped against GDP per capita



Source: Ruel et al., 2013

simply waiting for national economies to grow and for households to become less poor will not be sufficient to improve nutrition. That was shown recently by Ruel et al. (2013), who used a large cross-country dataset to assess the impacts on stunting associated with GDP growth and poverty reduction.[66] They found that a 10% rise in GDP per person predicts an 11% decrease in extreme poverty (individuals living on US$1.25 per day), but less than a 6% reduction in child stunting (Figure 3).

The effects of GDP growth on nutrition derive from a combination of increased household resources, improved infrastructure, and increased coverage and quality of nutrition-specific services. However, national income growth alone can only partially and slowly reduce stunting. The effects of income growth on the prevalence of overweight and obesity are different in that reduced poverty is strongly associated with rising obesity among children and adults alike.[67]

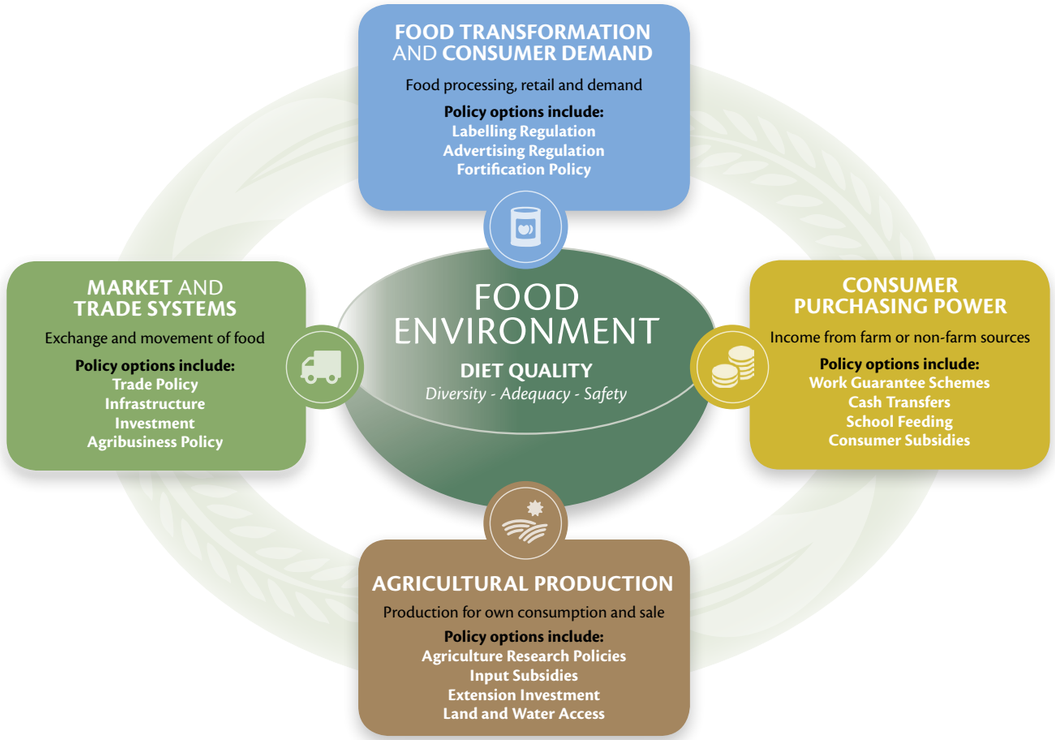
For policymakers to achieve the goal of ending all forms of malnutrition will therefore require actions that go beyond macroeconomic growth and promoting sufficient household incomes that meet the basic needs. Some of the actions will involve investment in expanding global coverage of health services, access to clean water, enhanced hygiene, but also actively promoting women's empowerment through national policies, legislation, education, credit access and programming targeted to women's access to productive resources. Investments in nutrition-sensitive social protection programmes also have the potential to improve nutrition and contain costs by strengthening household resilience. [68, 69]

There is a need for prioritising spending on evidence-based nutrition specific actions to reduce undernutrition. These include interventions that have been shown to be cost-effective and needed at scale in all countries carrying high burdens of undernutrition. Such interventions include universal salt iodisation, the distribution of some micronutrients as supplements (such as vitamin A, iron, folic acid and calcium) and others through staple food fortification, promotion of exclusive breastfeeding and use of high quality complementary foods, balanced energy protein supplementation of undernourished individuals and the treatment of severe and moderate wasting.

A review by Bhutta et al (2013), suggested that there is compelling evidence of the positive impact of these interventions on reducing stunting between birth and 36 months, and they argue that policymakers should support their implementation at large scale (aiming to achieve at least 90% coverage rates at population level).[39]

There are numerous estimates of the set-up and recurring costs associated with these measures to reduce undernutrition. Unit costs per child reached can be kept relatively small – for example US$4.80 per child reached with twice yearly vitamin A supplements, US$1 per child for deworming treatments, or US$100 or more per child treated for severe wasting.[70] Others have calculated that achieving a 40% reduction in stunting by the year 2025 would cost US$8.5 per child per year over ten years.[71] This figure translates into US$49.6 billion over ten years in the form of additional investment required to scale up interventions that work. Bhutta et al. 2013 estimated that the cost of providing

Figure 4: How agricultural and food system policies link to diet quality as a measure of good nutrition (Global Panel, 2014)



the 10 evidence-based interventions at 90% coverage in all the world's high stunting burden countries would amount to US$9.6 billion per year.[39] The World Bank puts the figure a little lower, at US$7 billion per year, without including actions to prevent the continued rise in obesity or reduce the high global prevalence of low birth weight.[64]

Returns on investment are high. The 10 nutrition-specific interventions promoted by Bhutta et al. (2013)[39] would reduce wasting by 60% and stunting by 20%, resulting in returns to investment on the order of 18-to-1 on average across high-burden countries. This means that for every US$1 spent on implementing effective programmes that achieve desired results there would be US$18 in economic benefits.[36]

The range is large around that average, such that some countries would gain higher returns than others. The benefit to cost ratio for Madagascar is ten, for Yemen it is 28, roughly 39 for India, and as high as 48 for Indonesia. That is, each dollar invested in nutrition-specific interventions in Indonesia would generate US$48 in economic returns.[36] Put another way, increased investment in nutrition in Bangladesh would cost between US$130 to $170 million per year, which is less than 11% of the total health budget. Yet, net benefit of these investments in terms of increased economic productivity alone could exceed US$10 billion by 2021.[72]

However, even evidence-based nutrition-specific interventions effectively implemented at scale can only reduce stunting and micronutrient deficiencies by an estimated 20% in coming decades.[39] More needs to be done to complement targeted interventions with action in other policy domains. Following the Global Panel's conceptual diagram (Figure 4) which traces policy entry points to improve diets and nutrition across the entire food system, actions can take many forms, including i) investments in agriculture to ensure a sustainable, predictable supply of diverse and nutritious foods available year-round, ii) facilitating marketing and trade of food that limits post-harvest food losses, iii) engaging with the private sector actors that generate processed and otherwise transformed foods to promote high quality nutrient-rich and healthy food products, and iv) ensuring healthy diets among nutritionally-vulnerable groups through social protection and income-support.

For example, actions in the agricultural production domain matter not only in terms of promoting higher farmer incomes (through productivity gains) and securing food supply, but also by supporting greater availability of a diversity of safe, nutritious food products.[73] The policy and programming interventions to support these kinds of outcomes represent important nutrition-sensitive actions to enhance nutrition outcomes. Webb and Block (2012)[67] showed that child stunting declines at a faster pace in countries where governments support agriculture through a range of policy, price, and protection policies than in countries that do not (Figure 5). This suggests that favouring agriculture as a policy decision can, in itself, help accelerate improvements in nutrition.[67]

Gains to nutrition can be traced to policies and programmes in other domains, including investments in marketing infrastructure, legislating for micronutrient fortification of certain staple foods, and establishing effective social protection systems to allow for stability of food consumption among vulnerable groups during times of food price stress.

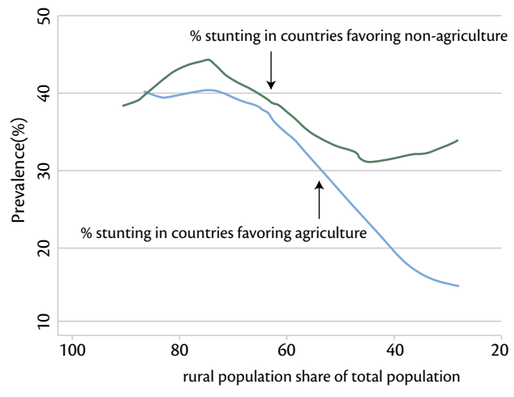
However, in addition to nutrition-specific coupled with nutrition-sensitive actions, there is also often a need for additional investments in more effective governance for nutrition,[74] such as establishing and supporting institutional and individual capacities and resources needed to promote good policies and ensure effective implementation of good programmes. For example, the Scaling Up Nutrition movement undertook a costing exercise relating to nutrition plans approved by the governments of 20 low- and middle-income countries. The average annual cost associated with these individualised plans for nutrition-specific interventions is estimated to be US$200 million.[75] The average annual cost of nutrition-sensitive actions such as food security, production diversification, food safety promotion, food pricing and distribution systems and also, in some cases, improved food packaging and food processing certification, totals US$1496 million. Investments in nutrition governance mechanisms, typically involving information management and coordination, advocacy and communications, and systems capacity building, comes to US$114 million.[75]

It is now widely acknowledged that tackling nutrition in all its forms is no luxury – it is an economic necessity as much as a moral imperative. The value of resolving malnutrition far exceeds what can be captured in numbers. But it can only be effectively addressed at scale through coordinated multisectoral actions that have effects across the food system as a whole. This requires a much better understanding of the relative costs and benefits of investment options in very different sectors of food system activity.

However, as noted by Webb et al. (2007), "it is paradoxical that while nutrition science offers increasingly sophisticated age- and gender-specific dietary recommendations for micronutrients, most food and nutrition policies continue to be formulated in the absence of information drawn at a comparable level of disaggregation. Knowledge of who is most affected by what deficiencies, when and where, is still limited."[76]

Politicians and policy makers need to better understand the economic costs and benefits involved if they are to prioritise healthy diets and nutrition among competing development agendas. The costs associated with undernutrition, including micronutrient deficiencies, are estimated at 2 to 3% of global GDP.[1] When combined with the cost of diet-related NCDs associated with obesity, malnutrition in all its forms costs up to 5% of global income or US$3.5 trillion per year.[1] While the price of addressing these economic and human impacts of malnutrition is huge, the cost of doing nothing is immeasurably greater.

Figure 5. The effect of policy support for agriculture on stunting



Source: Webb and Block 2012

Recommendations to Policymakers

In order to make accelerated and sustained gains in meeting people's nutritional needs, promoting safe and diversified healthy diets and improving nutrition outcomes globally, in line with agreed international SDG targets for 2030, the Global Panel recommends that:

1. **Governments should calculate the direct and indirect costs of malnutrition in all its forms for their own country.** The calculation of costs in national plans must be explicit regarding assumptions made, and transparent in methodology used, to promote credibility and buy-in. There should be a commitment to link regular updates to costing of interventions and parallel estimates of economic benefits accrued. For instance, the African Union Heads of State committed to developing 'cost of hunger' analyses for all 54 countries on the continent as part of their Malabo Declaration.[77] A similar process is needed beyond Africa, along with high-level commitment to using these assessments to guide national spending priorities and to regular updating of the analyses over time.

2. **Standardised metrics must be developed to support more effective communication of findings to policymakers.** To be useful to decision makers, data on the costs of various forms of malnutrition and potential solutions need to be **comparable and more comprehensible**. At present, numerous competing approaches are used to derive costs and benefits, and it is not always clear how these can inform approaches to prioritisation of investments. Greater clarity and consistency in use of economic and nutrition terminology is seriously needed. In addition, researchers and development partners advocating a data revolution for development should promote standard approaches to costing that would generate comparable estimates within and across countries.

3. **Viable options for policy and programme interventions across the food system must be identified and costed.** Researchers and other development partners must collaborate to identify locally appropriate scalable evidence-based actions, supportive of nutrition. The evolving portfolio of potential actions should guide policymakers on priority investments and legislated actions.

4. **Establish a national *Common Results Framework* to shape the monitoring and reporting on progress.** The need for actions throughout the food system requires multi-stakeholder partnerships, both public and private, aimed at cost-effective investment across society in well-priced policies and programmes. One goal should be comparison of programming alternatives based on price per unit of change in various nutrition outcomes.

5. **Generate rigorous data to support ongoing assessment of cost-effective actions across the food system and food environment.** Governments should invest in mechanisms that can support their own learning about alternative investments along the food chain, and how these may affect different people by context, gender and age. Investments in strengthening national nutrition and food security information, and surveillance systems should contribute to such data flows.

6. **Urgently address knowledge gaps and data deficiencies on the costs and benefits** of national investments in, i) infrastructure enhancement for diets and nutrition (via reduced losses and perishability, as well as increased year-round access to nutritious and healthy foods), ii) processing and food transformation, iii) wholesale and retail incentives for delivery of affordable and desirable nutritious and healthy foods (including in processed or packaged forms), and iv) drivers of dietary choices and policy options for supporting better informed choice.

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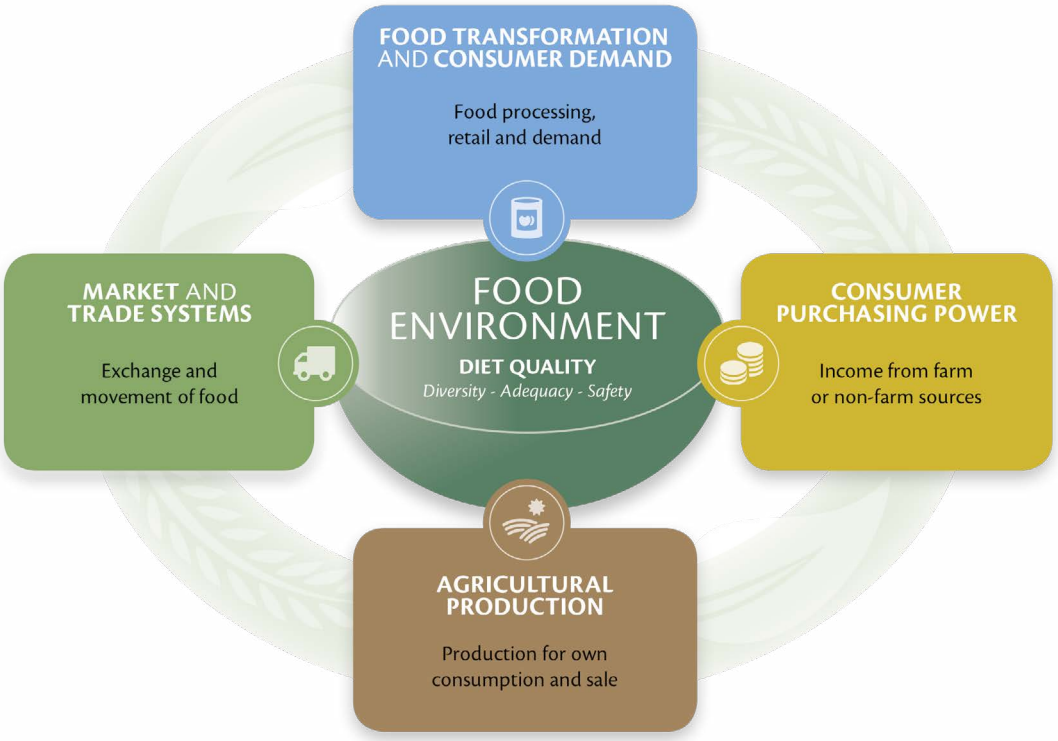
How can Agriculture and Food System Policies improve Nutrition?

The multiple burdens on health created today for low and middle income countries by food-related nutrition problems include not only persistent undernutrition and stunting, but also widespread vitamin and mineral deficiencies and growing prevalence of overweight, obesity and non-communicable diseases. These different forms of malnutrition limit people's opportunity to live healthy and productive lives, and impede the growth of economies and whole societies.

The food environment from which consumers should be able to create healthy diets is influenced by four domains of economic activity:



In each of these domains, there is a range of policies that can have enormous influence on nutritional outcomes. In the Global Panel's Technical Brief No. 1, we explain how these policies can influence nutrition, both positively and negatively. We make an argument for an integrated approach, drawing on policies from across these domains, and the need for more empirical evidence to identify successful approaches.

Download Technical Brief No. 3 here: glopan.org/cost-of-malnutrition

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