

Global Nutrition in the 21st Century: Opportunities and Challenges for the Developed and Developing Worlds

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Introduction: Where we are and how we got here

Food is a basic human need. With roughly 1 billion humans suffering from over-nutrition and a similar number unable to find enough food to subsist, no one seriously disagrees about the urgency of addressing world hunger. Hunger and malnutrition adversely affect physical and mental development, to the point that one in six individuals do not get enough food to be healthy enough to lead a normally active life. Hunger and malnutrition are leading risks to health and well-being worldwide. Those who work to mitigate world-scale hunger and malnutrition generally agree on dimensions of hunger, its causes, and indeed on how to measure and address it [1]. The cost of alleviating hunger amounts to a levy on the rich of less than 1% of their earnings. Implementing remedies takes on a political and economic dimension that is as difficult to resolve as hunger itself. Self-interest conflicts with the good of the planet, and well-intended world leaders seem powerless to leverage the resources needed. Nevertheless steady progress is occurring, albeit below the event horizon of most observers.

In the ensuing analysis, we will address causes and changes. We will: (1) assess where we are in global nutrition and how we got this point; (2) evaluate what is working and what is not; and (3) frame a perspective on what lies ahead. We confront misconceptions regarding world hunger and assess opportunities and challenges to eliminating it. As the chapter unfolds, the reader might expect an uncomfortable mix of optimism, indignation, and impatience.

Global malnutrition is not new, but it was not until 1978 that a commission [2] identified the challenges pivotal to the poor, namely: a) the magnitude of, and trends in, undernutrition¹, b) the relationship of malnutrition to infectious diseases, and c) orienting food policy and agriculture to problems of the neediest². What unfolded rocked the developed world. The figures were, and remain, unimaginable. In 1970, a third of humankind – more than 1.4 billion people, went to bed hungry. Children were especially impacted – undernutrition played a role in more than nine million child deaths annually, two-thirds in their first year of life [3].

Abruptly, the rich nations were convinced that "someone" must "do something". A decade of international ferment led to an unprecedented international consensus – a roadmap framed as eight specific goals, the "Millennium Development Goals" (MDGs), with 21 quantifiable targets, and 60 time-lined indicators [4]. (See Appendix A) The 21st century thus began auspiciously as 189 nations committed to rectify a global crisis, and signed the MDG agreement. What ensued is a cascade of previously unimaginable initiatives that have had varying degrees of success – some spectacular, most steady, and a few catastrophic. To understand these events, we need to know how malnutrition affects people, who the hungry are and how so many came to be in such extreme poverty³.

Malnutrition, health, and the poverty trap

Nutrition is the most immediately modifiable factor that affects individual and public health. A core concern in the science of nutrition is how to deliver the essentials of a healthy diet to a hungry world.

¹ The FAO WHO/UNU definition of undernutrition is habitual calorie intake below the calorie expenditure required to earn an income or otherwise gain access to resources sufficient to maintain a body weight consistent with health and the activities of daily life. There are problems with this, but it has utility in population studies.

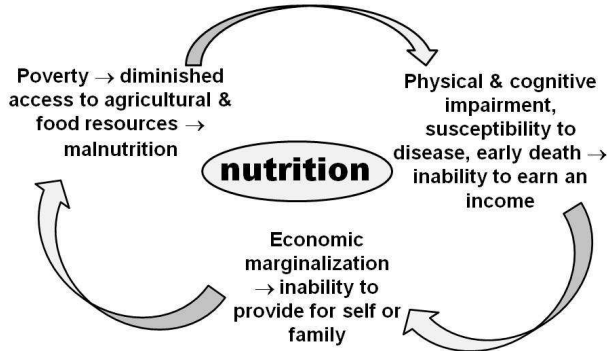
² The question of *causes* of hunger was not raised at this stage, but we will return to these.

³ Extreme poverty refers to the condition of "the poorest of the poor – not having the means to afford basic human needs such as clean water, nutrition, health care, clothing, and shelter. This is also referred to as absolute poverty or destitution. Relative poverty is having fewer resources or less income than others within a society or country, or compared to worldwide averages. Regression analysis shows that for a population the threshold income for extreme poverty is equivalent to US\$1.25 at 2005 international prices. The common reference value "\$1.25 PPP" is corrected for purchasing power and inflation.

Today, poverty is the major determinant of malnutrition. Consequently, there is little debate that improving nutrition contingent on development aid. This interdependence of nutrition, economic development and health is emphasized in Figure 1.

Figure 1: The "poverty trap": roles of nutrition, health, and economics

A vicious cycle: economics, hunger, health



For an individual, a community, or a country, the poverty trap can begin with failure of any of the three links – malnutrition, ill health, or economic marginalization. Once started, it continues, even across successive generations, unless there is outside intervention. When it occurs in a country, the cycle of poverty is called the "development trap". A major purpose of development aid is to get countries out of the vicious cycle and onto the ladder of economic development and sustainable agriculture.

Ironically, most of the hungry are farmers, subsistence farmers on smallholdings in remote areas. They depend for survival on what they scrape from an uncooperative earth. What they eat this month is the yield from last month's planting, or what they can forage within several hours walk. A day's work still leaves the family hungry. In such inaccessible areas, there is no paid work as there is no one to employ them. Even if they have anything left over to sell, there is no one to buy the produce. If there is "spare time", it is invested in fetching water or fuel (often animal dung) for a fire. Construction or repair of rudimentary shelters is preempted by foraging. In a settled community there will be a burial area where many small graves attest that one month's delay in the rainy season can bring a deadly aftermath, or that medical care, drugs, or first aid were more than a day's walk away.

Learning the needs of hungry people need not be difficult. Field workers hear the plea: "Please no more anthropologists, no more needs-assessments. Look around. If you can't *see* what we need, *ask* us. We will tell you". And it *is* obvious, and it is *not* money. Active listening can help. At an Ottawa Global Health someone said quietly: "We in Africa find that when white people come, they have very small ears, and very large mouths. We would prefer it the other way round". Having large ears is a major asset in realizing that the last thing the poorest need is money. It has no intrinsic value – there is nowhere to spend it, no shops. A trading post may be 30 miles away. The needs are much more fundamental than money. The needs are for water to drink and to use on the crops, quality seeds, fertilizers, low technology tools, mosquito nets, perinatal clinics, and dispensaries.

How nations become poor

As a prerequisite to becoming populated, virtually all countries once had a sufficiency of food. Hunger came later, almost entirely for reasons unrelated to those affected. Analyses from the developing world often presume that countries fail because of some fault of the inhabitants. In fact, states fail for a multitude of reasons almost all external: armed conflict, being landlocked, uncertain rainfall and drought, being the recipient of international boycotts (e.g., Cuba, Zimbabwe), an initial scarcity of resources (e.g., Lesotho), and appropriation of resources without commensurate compensation [5,6]. Muhammad Yunus likens the process to taking a seed from a tall tree and planting it in a small pot where it becomes a Bonsai. It is futile to examine the seed to learn why it became poor. The causes come from outside, and the cycle of poverty springs the trap. The poverty of a nation can become embedded to where it will not be solved simply by the removing the cause [7].

Most "poor" countries are not poor at all when one considers their natural resources, and could feed all the inhabitants, were they afforded the means to realize their initial endowment [5]. As it is, the copper of Chile or Katanga, or the oil of Nigeria disappears with no sustained trickle-down to the poorest. The Gold Coast of Africa now has no gold and its people are none the richer. However, the matter does not rest there; the discovery of rich new resources in a poor country is usually followed by *deepening* poverty for the

populace [5]. The conclusion that a nation can become poorer by finding resources may elicit skepticism in the wealthy nations, but it has considerable currency in nations recently emerged from colonial status. The hungry of Africa remember the enthusiasm the settlers for their vanadium and chrome, and the settlers remember the glitter in the eyes of the British when they annexed the diamond fields of Kimberly and then declared war on the nascent Transvaal republic when gold was discovered.

Most developed countries experienced dramatic improvements in health, nutrition, and GDP during the decades after they emerged from colonial status [8]. Nations on a trade route or an important canal are at high risk of outside intervention. Thus, Afghanistan seems doomed to unending malnutrition simply from being located astride an isthmus that provided a conduit for silk, spices, commodities, troops, refugees, and now pipelines between Asia, Europe, and the Middle East. This location proved irresistible in turn to Macedonians, Hindus, Greeks, Persians, Turks, Moguls, Sikhs, British, Russians, and now NATO [9].

The loss and alienation of the land and commons are events on the road to poverty. Two examples: Fish were historically a nutrient-rich food source for the poor, but ocean fish are increasingly being priced out of reach. The destruction of the commons of the ocean, to which the developing world contributed little, is a nutritional catastrophe for them. The disappearance of ocean fish stocks as a food source is aggravated by a view in the developed world that farmed fish, The assumption that it is better to eat "wild" salmon puts further pressure on fish stocks, driving prices upward to where they are inaccessible to poor in rich or poor countries. Here again is an imposition, where an indulgence of the wealthy hurts the developing world. In developing countries fish farming is increasingly providing necessary protein to many. To them, attempts in the rich nations to roll back fish farming seem as anachronistic as earlier attempts to disrupt cattle ranching.

People who never thought of land as a commodity, are puzzled when demands of extractive industry or appropriation fence off a long term source of food or water. The process of foreign land acquisition has increased dramatically. In the past five years, developing¹ countries have seen the purchase of 5 million hectares of farmable land by foreign interests. A billion dollars has flowed, and a report from two UN bodies² is titled "Land grab or development opportunity?". The Congo, Ethiopia, Mali, Ghana, Indonesia, and other nations have sold potential farm land to agribusiness in the US, Norway Egypt, India, South Africa, Saudi Arabia, and South Korea [10].

Multinational entities such as Goldman Sachs, Sun Biofuels, Kellogg, Agri-Vie, and others have participated, presumably in the search for profit, with carbon credits and agrifuels providing an added incentive [11]. Given recent swings in food prices, governments may merely be seeking stability by securing alternative food sources. Whatever the cause, global warming or conversion of food to fuel, the consequences to the poor are the same – the loss of farmable land. However, the developing nations are accustomed to transactions on a tilted table [12]: "Market forces aren't just supply and demand. The hidden hand of the market can never operate without a hidden fist ... McDonalds cannot flourish without McDonnell Douglas" [13]. On a fair bargaining table, a government selling land could exact concessions of comparable value³.

Outmoded beliefs about hunger and poverty

It is no longer true that the poor nations are getting poorer Differences in average income *between* countries are diminishing. Most lower and middle income countries are already on the ladder of development. The exceptions are about 30 fragile or failing states, half of them south of the Sahara,. In contrast, *within* most countries rich or poor, the income gap between rich and poor is increasing. By clouding our concept of poverty and its distribution, the misconception impairs our ability to mitigate hunger. It is not true that most of the poor live in African countries with failing economies. Currently, 80% of the poor do not live in Africa or in the poorest countries. Most of the poor live in economies that are growing impressively with increasing numbers of wealthy people; i.e., India, China, and Bangladesh [5].

Conversely, poverty persists even in the richest countries of the world. In America for example, 50% of children will have had to rely on charity (food stamps) by the time they reach eighteen (among ethnic

¹ The term developing country is inconsistently used, and so we will use the imperfect World Bank definition which considers all low- and middle- income countries as "developing". In its most recent classification, countries with GNI per capita below US\$11,905 in 2008 were considered in this category.

² The Food and Agricultural Organization and the International Fund for Agricultural Development

³ Large-scale irrigation projects, leasing as opposed to sale of the land, or a first claim on the food produced, for example

minorities, the proportion is 80%) [14]. In China, which met the first Millennium Development Goal fourteen years ahead of the 2015 target date, stark inequities remain. The richest provinces in China are Macao, Hong Kong, and Shanghai with median annual incomes of USD\$43202, \$37691, \$22,258, [15]. While widespread hunger is no longer a problem in China, average income in the poorest provinces is about one tenth that in the richer. In Canada, too, 70% of Inuit children live in food insecure households, while in the larger population 5.6% of households with children are food insecure [16].

Conversely, there are no longer poor nations in which almost *everyone* is emaciated. They too, contain huge disparities in income, to the extent that problems of overnutrition have become major public health problems. In these nations, obesity and diabetes increasingly contribute to the burden of heart disease. Of the 250 million people with diabetes, 80% live in low and middle-income countries, where 12-20% of adults in countries in Asia, the Middle East, and the Caribbean are affected. By 2025, 80% of the new cases of diabetes will be in developing countries [17]. In these countries, diabetes is diagnosed at a later stage where it is less treatable, and access to treatment is less. Consequently, the burden of diabetes, and the cost to society, affect developing countries much more severely.

When comparing countries with widely differing GDP, there is thus a surprisingly large overlap of income range. This phenomenon is called convergence¹. It means that a person's nutritional status no longer correlates strongly with their *location*, but instead closely follow *individual* income regardless of country. Many of the rich nations who give little to overseas development aid also fail to provide food and health services to the poor inside their borders. The burden of the income disparity falls heavier within the developing nations, where the GNP may allow only a few dollars a person per year for health care.

What is working and what is not

Aid as a way out of the poverty trap

Almost no nation has achieved economic success without substantial outside financial help. The richest nations in the world are in the European Union (EU) in part because of the Marshall plan designed to rebuild Europe after World War II. There are, however, those who uncompromisingly object to aid of all kinds. Overwhelmingly they cite two reasons: (1) all the aid given to date "has had no effect"; or (2) aid "ends up in numbered bank accounts of corrupt dictators". Both assertions are wildly inconsistent with reality. As indicated above, over years poverty *is* decreasing, and aid is at least partly responsible. Moreover, while bribery is repellent and spread across all nations, it is no more common among the poor than among the rich [18]. For every corrupt person who accepts a bribe there is a corrupt person who offered one.

Ordinary Africans will applaud the edict that aid must reach those for whom it is intended. When a dishonest official is bribed, the people suffer twice. First, a valuable resource flows out of their country at a fraction of its true worth. Then the proceeds of the bribe go out of the country via a foreign bank account. President Obama addressed corruption in a 2009 pledge to support the MDGs: "Developing nations must root out corruption ... opportunity cannot thrive where ... business have to pay bribes". The implication that western businesses are *forced* to offer bribes is disingenuous. As Dambisa Moyo has pointed out "Western countries ... could begin by stopping the corruption money flowing back" through numbered bank accounts, and track and prosecute those who offer bribes and those who receive them. In fact, the overwhelming majority of countries, whether inside or outside Africa, are rigorous in dealing with bribery, theft, and fraud. Of the 53 countries in Africa less than 10% rank significantly lower than countries we habitually trade with without accusing the leaders of corruption [16]. Twenty-four nations, mostly in Africa, have signed on to the "Extractive Industry Transparency Initiative", which contains rules to eliminate covert deals in this important area of trade [19].

This is not to applaud all kinds of aid. Aid carries risks for both donor and recipient. Indeed, certain kinds of aid are not merely valueless – they are harmful; e.g., food aid originally conceived in the 1950s as a way to dispose of U.S. food surpluses earmarked for burning. While bringing relief to famine stricken recipients, it quickly diminished, and in some cases destroyed, local agricultural capacity. The obvious solution is to give priority to purchasing food from farmers. This lowers cost of both grain and shipping –

¹ The paradoxical term "*convergence*" means that countries are becoming more similar with regard to GDP per capita.

the aid dollar goes twice as far and preserves local capacity. However, the solutions are usually undermined by the agricultural and maritime lobbies in the donor countries. They secured legislation that the food must be purchased in, and shipped under, the flag of their country. Inadequate local food supplies suggest a need to emphasize agricultural aid. However, agricultural aid has drastically declined from 1980 to 2000. For example, Canada, U.S., and New Zealand have each decreased agricultural aid as a fraction of their total aid package by 20% to 4% [20].

Aid can also come with unacceptable strings attached. A common requirement in World Bank loans is that recipients must open their markets to product, including foods from the developed world. Most developed nations subsidize farmers and so their foods can flow, below production cost, into the recipient country, beggaring their farmers [12]. Meanwhile, the rich countries, almost universally, close their markets to food products from the developing world. The most visible critic of this kind of aid is again Dambisa Moyo [21]. She asks: "Why is Africa wasting its time in the World Trade Organization, which will never remove trade barriers. Instead Africa should foster its relationship with countries that are interested in actually buying African produce". "If Western markets don't want to trade with Africa for reasons of protecting their own markets, Africa should focus on China and India" [22].

In most developed countries, the citizenry tend to favor more generous aid policies than their governments. Surveys show that in most countries, people believe that the government provides more aid than it really does. Sometimes governments seem to resort to smoke and mirrors to confuse voters. Despite its name, the US Millennium Challenge Corporation has goals rather different than the MDGs, and bypasses the UN, using political criteria to select recipients. A common belief that "the USA gives more aid than anyone else" should also be questioned. Even in the most recent absolute amounts, the EU gave over \$59b while the U.S. (with roughly the same population) gave less than half that amount [23,24]. Moreover, a major fraction of aid from the NATO states goes to nations that have strategic importance to NATO rather than to the neediest.

Progress toward the MDGs at the half way milestone

All eight MDGs have made steady progress. The rub is that they have moved forward consistent with funding, and funding was overestimated at the outset. The 15-year timescale of the MDGs was set by the professed willingness of the 20 wealthiest nations developed nations to provide resources. They declined to provide 1% of their gross domestic product (GDP) to development aid, but agreed to ramp up to 0.7%. On this basis, a 15-year timeline was agreed to. In the event, five European nations have consistently provided the pledged 0.7% or more (Sweden 0.98%; Luxembourg 0.92%; Norway 0.88%; Denmark 0.82%; Netherlands 0.80%) and most of the others are paying more half (0.35%). Nations outside the Development Assistance Committee are stepping forward – Kuwait reportedly gives 0.82% of its GDP, Saudi Arabia 0.4%. For the rest, well-intentioned heads of state were apparently unable to convince their parliaments or senates to provide the funds pledged, and so the promises evaporated when the media turned their attention elsewhere. Thus Greece, Italy, Japan, and the U.S. are paying 0.2% or less [21] because the vast sums of money promised "have brought no benefits", or that the money promised has turned out to be "excessive".

Steady progress, therefore does not mean that progress is on schedule. In fact only one goal (primary education) is likely to be met by 2015. The first "primary" goal, the mitigation of hunger, is one that will be delayed. We will examine that goal in some detail, because of its centrality, its successes and failures will affect the progress of the other goals.

In part to assess progress to the first MDG, specific measures of hunger and poverty are tracked by numerous organizations including the World Bank, Food and Agriculture Organization of the United Nations (FAO), U.S. Department of Agriculture (USDA), OECD, and others. It should be noted that the organization assesses hunger by differing criteria [25]. The most prevalent measure is the World Bank's USD\$1.25 per day purchasing power parity (PPP)¹ [26]. The major conclusion from all data sources is that more people are fed every year than ever before, with the number doubling since 1980 and increasing by

¹ The figure of \$1.25 represents original World bank \$US1, adjusted for inflation to 2005, corrected country by country for "Purchasing Power Parity", and further adjusted within a country for urban and rural lifestyles reflecting the sources and costs of food, shelter, and other necessities of life. World Bank changed this yardstick in 2008 and have not updated their earlier tables since then, consequently the data do not yet reflect the economic problems of 2008.

32% since 1990. This means that despite population growth, the world's, agricultural productivity has more than kept pace.

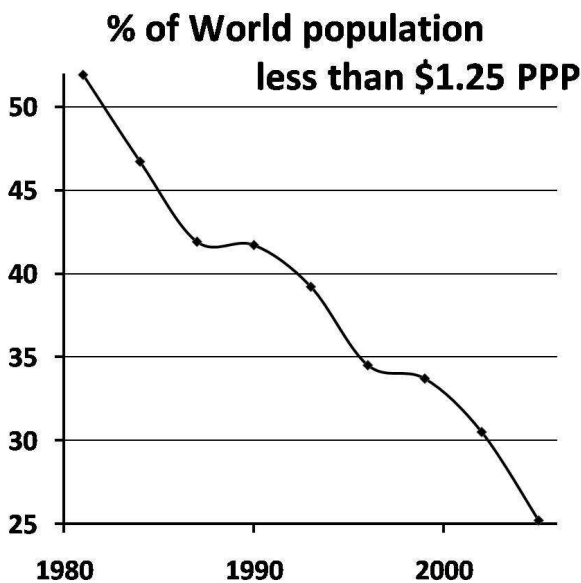


Fig 2 Extreme poverty and hunger (World Bank)

Figure 2, shows the percentage of people below \$1.25 PPP per day based on World Bank data [27].

Note that, between 1980 and 2005, the percentage of people in poverty decreased at an overall average of about 1.25% per year. With the exception of the few failing states, measures of health, such as infant mortality and life expectancy, also improved [28].

A caveat; the world data conceal discrepancies among countries, and most of the overall improvement reflects progress in the large population economies in East and South Asia. In Latin America, improvements are small. While Africa as a whole is improving, the Sahel¹ and war-torn nations inside and outside Africa, are mostly deteriorating [29]. Afghanistan remains one of the poorest countries. Haiti, too, is a example of a failing state . Long the poorest nation in its region, its economy has deteriorated steadily for fifty years, and without help there is little hope for escape

The 2008 world recession has impacted global hunger and this has elicited outrage from those affected. The increased loss of life is immense, unnecessary, and deplorable. The response of the rich has been inadequate, failing even to protect the hungry inside their own borders. The developed nations conclude that, again, they are bearing the major consequences of events caused by irresponsible planning elsewhere. Catastrophic fears that the level of hunger will never recover are, however, unhelpful and unwarranted. On current data and projections, the current recession will have an impact similar to those in 1986 and 1996 (Figure 2). GDP (inflation adjusted) dropped by 2.5% from 2008 to 2009 in sub-Saharan Africa (excluding South Africa). Projecting the data beyond the recession, a minor recovery begins in 2010, and GDP will overtake pre-recession levels in 2012 [30]. This aggregate for sub-Sahara likely reflects worldwide events, since they agree with FAO historical data that recessions typically lead to a one or two year downturn, with 4 to 6 years required to overtake pre-recession levels. Although the setback will be temporary, it will not be without cost. Many lives will be lost.

The increasing population of some developing countries certainly steepens the path to achieving the MDGs, but this was factored into the timeline. There is undoubtedly a limit to the world's agricultural capacity, but it probably will not be reached in the next 15-20 years. Nevertheless, Malthus cannot be ignored indefinitely. Unless the world moves to contain population growth, limits to food and other resources are likely to be reached this century.

Looking at the larger picture, the regional data clarify our priorities so that aid can be focused on a shrinking population, in defined areas. The increasing number and wealth of the rich means that a given fraction of their income has a greater impact year by year. Steady progress, even if slow, means a shrinking problem and greater assurance of continuing or even accelerating progress.

Successes and hopeful signs for MDG early in the century

An inventory of successes in the MDGs is available on the Bill and Malinda Gates Foundation "Living Proof Project" web page in the form of a series of progress sheets. An overall "Successes in Global Health", summarizes eight detailed reports covering progress towards: immunization, maternal newborn child health nutrition, and against malaria, HIV/AIDS, tuberculosis, polio, and neglected tropical diseases [31]. Beyond these progress sheets, the site offers videos, photo galleries, and interactive graphics. Comprehensive,

¹ Defined here as Burkina Faso, Chad, The Gambia, Guinea Bissau, Mali, Mauritania, Niger, Senegal, Sudan

readable, and up-to-date, each category contains quality resources to inform, but also useful as aids in presentations community meetings, conferences, and classroom or web based courses.

Looking beyond the current recession, the number of hungry and the percentage of hungry are decreasing. Detractors emphasize that population growth slows the rate of decrease in the percentage of hungry. Again, by all measures, the number of people fed each year continues to increase significantly. A cautious projection toward the future should assume that the nations that are currently failing to meet their aid commitments will continue to do so, and that the nations that are steadfast will continue to pay 0.4% or better. On this basis, the MDG should be met in 30 years instead of 15, except that we must add a four-year delay from the current recession. Conservatively we would contend that world hunger will diminish to half of its 1990 levels by the mid 2030s, and begin to disappear around mid-century. In the new millennium the above challenges will continue, but there is additional hope in formidable new enterprises that are not dependent on the vagaries of government funding. It is time to examine some of these.

Beyond the MDGs

Among several collections of goals for eliminating global nutrition disparities, the MDGs are considered by many to be the most compelling. They acknowledge the inseparability of health, nutrition, and development, and emphasize poverty as an underlying mechanism impeding progress. They remain the best available path for the elimination of hunger. However, at the international level there are key innovations that are synergistic with the MDGs. Three will be discussed here: (1) the Millennium Village Projects; (2) the Grameen enterprises and "microcredit"; and (3) an unprecedented outpouring of philanthropy in the form of, and beyond the flagship Bill and Melinda Gates Foundation.

While we are applauding these, it will be important to remember that the MDGs remain by far the most important determinant in mitigating hunger and diminishing nationwide health inequities, because of their sheer size. With Overseas Development Assistance at almost \$200b in 2008, the collective capacity of the world's governments dwarfs the collective resources of charitable contributions of even the most generous of humans. Most large philanthropic donations are announced as lump sums that will be given and amortized over decades.

The Millennium Village Project (MVP)

This astonishing initiative reflects the energy and infectious optimism of one man, Jeffrey Sachs. A renowned economist, with achievements for the World Bank, he came to see the limitations of free enterprise aid in dealing with the problems of the poorest of the poor. The Millennium Villages are the local expression of the global strategy of the MDGs. To avoid the unreliability of government sources, funding for each village is committed in advance from UN and private sources, often including a university, and one or more non-governmental organizations (NGOs). Each Millennium Village is selected for its suitability for a five-year partnership in a development team. In a village, the MDGs are implemented in a 5-year, 5-step sequence, with specific amounts of funding year by year. Minimum standards for each village are specified, and including, for example, a clinic cum dispensary cum first aid station in the village or reachable in a one-day round trip walk.

By the end of 2008, the MVP had been operating for almost four years. During this time, over 400,000 people in 14 sites in ten countries had been served. By the end of 2009, there were 80 Millennium Villages, each with 5,000 inhabitants. Over half the facilities have three nurses and a clinical officer (nurse practitioner or physician) on staff. A nurse or midwife provides four prenatal visits to expectant mothers. The clinics, in turn, have collaborating district hospitals within reach of ambulances (4-wheel, motorcycle, or pedal-powered). By the end of 2008, 51 clinics were operating, serving 300,000 outpatients. One could make an argument that the rapid success of this venture, including the level of support that they have received from donors, and the recipient countries compensates for the disappointing pace of the government supported MDGs.

The long-term vision is for each Millennium Village to seed itself, spawning a dozen in the surrounding villages. For example, the government of Mali presented a plan to scale up the MVP approach to 166 of its most vulnerable communities covering approximately two million people. Based on its experience, the government of Nigeria is proposing a national MDG scale-up effort in 111 local government administrations, reaching approximately 20 million people. In Uganda, the Ministry of Health has expressed

strong interest in scaling up across the country the midwife program launched in the Millennium Village site of Ruhira.

The Millennium Village Project is being supported by a joint taskforce including the Earth Institute, FAO, Millennium Promise, the MDG Center for East and Central Africa, UNCDF, UNDP, UNICEF, and UNV. Oversight of the work of the Millennium Villages is by a Scientific Council composed of the UN Millennium Project and The Earth Institute at Columbia University, both of which are headed by the Jeffrey Sachs. Millennium Promise, co-founded by Sachs and the philanthropist Ray Chambers is a supporting NGO. In September 2006, the financier and philanthropist George Soros pledged \$50 million to Millennium Promise to fund 33 Millennium Villages. The 2008 MVP report makes breathtaking, heart-warming reading [32].

Microcredit and the Grameen family of social enterprises

If the MDG programs have been slower than predicted, the Grameen programs expanded at amazing speed. They germinated from a \$79 gesture in a small village in Bangladesh by which Muhammad Yunus accidentally initiated a tiny program of microloans. This start led in a few years to a multi-billion dollar enterprise spanning 37 countries. Its success brought the 2006 Nobel Peace Prize which was accepted by Yunus on behalf of the seven million co-owners (borrowers) of the Grameen Bank, nine of whom came with him to Oslo to receive the prize [33]. The trust Yunus inspires has opened door after door, branching into a labyrinth of associations. Worldwide the Grameen Family of Social Enterprises sets the standard for NGOs in its impact on the poor and in public support. Many new ventures have emulated the theme of borrowing from the rich to lend to the poor. Serving a variety of projects, they have in common seed-loans with a business plan that become self-sustaining.

The Grameen Community Development Bank is the micro-loan segment of the family, and it is now dwarfed by increasing number of Grameen Family Social Businesses. The Grameen initiatives comprise some 14 mammoth enterprises crafted specifically to benefit the poor. Their mandates include: (1) risk capital for small to medium business; (2) the largest telephone company in Bangladesh; (3) soft and hardware networking; (4) village aquaculture & dairy; (5) renewable energy in remote regions; (6) educational loans for literacy & technology, (7) nutritious food at near cost, (8) poverty alleviation for the working poor (9) the Grameen Trust which exists to seed social enterprises worldwide – in 37 countries to date [34,35]. Almost half are for-profit enterprises that invest their profits in growth and provide their services at cost. Each will, in the end, be owned by the poor.

In Bangladesh villages, the Grameen Danone Corporation sells a yogurt called Shakti Doi "power yogurt". At a competitive 5c per 100ml it sells well. Being sweeter and richer than most local yogurts it appeals to children, while it provides protein and micronutrient requirements. The enterprise started in 2006 when Danone, a giant dairy company, approached Yunus. Within an hour, they had reached a \$1 million agreement to manufacture and distribute fortified dairy products in Bangladesh. Profits would not be returned to those providing the funding. Instead they would be reinvested "to bring health through food to the people of Bangladesh".

Typically a "Grameen lady", funded initially by a Grameen loan, works a four hour shift daily to sell 100 or more cups of yogurt to wholesale or retail customers. Local farmers with perhaps seven cows each provide milk to the factory. Several hundred farming and distribution jobs are created locally by each factory. The enterprise began in 2005 with a handshake in which the Danone corporation agreed to build a yogurt factory in Bangladesh from which it would never take a profit. In 2007, Grameen-Danone launched a mutual fund to raise \$135 million (paying an interest rate of 3% to 4%) to finance a second facility to generate 3,000 tons of dairy products annually. The business plan calls for 9 more factories and other social businesses to fight malnutrition and poverty. The funders will eventually recoup their initial capital, but not any additional monies. The stock exchange on 17th Dec 2009 approved the second Grameen Bank Mutual fund, the largest mutual fund the Dhaka stock exchange has ever approved.

There is some protest from those who believe that the poor are hard-pressed enough in seeking salaried employment and that it is asking too much to set them on a path to entrepreneurship for which they may have neither the risk-tolerance nor the aptitude. Others point out that the poor are already entrepreneurs for whom meeting the day's needs is a challenge. In a softer stance for the very poor, Grameen has features applicable to very poor communities, including loans to beggars with no payback date. Some critics hold

that it should be possible to invest money for profit; but a reduced profit with the balance going to charity. The Grameen model, however, seeks to avoid the thin-edge-of-the-wedge where an increased profit is greeted with applause plus an inflow of donations while setbacks receive hints of a transfer of funds elsewhere. Overall, many believe that microcredit is an idea whose time has come. It has had a visible impact on the economy of Bangladesh. As of 2008, four million poor have been helped and 1,000,000 microloans have been generated with almost no defaults. (See the Grameen Foundation Report. [36])

An unprecedented outpouring of philanthropy

In terms of overseas development aid, individual contributions are usually dwarfed by the sums that governments provide. However, in recent years there has been a cascade of extremely large donations from the super-rich. Forbes Magazine identifies fourteen of the world's 793 billionaires who have each given away more than a billion dollars, "the Kings of Philanthropy". Some are young and accompany the donation with a passionate idealism to invest in a cause. Consequently, the funds are rigorously monitored. Sums that rival the income of many small nations, and initially obtained from the public, are channeled without public accountability. Some of the goals may seem idiosyncratic, but it is churlish to complain about such overflowing generosity. At the same time, philanthropy is rightly held to high standards, and those giving away large sums may have to go to extremes to get honest criticism [37]. The Forbes survey covers only individuals foundations, not families or institutions, and so it does not include many worthwhile charity foundations such as the Ford Foundation, the Rockefeller Fund, the Clinton and the Carter Foundations, to name a few. The Foundation Center lists the US sources of funding by asset size [38].

Among the philanthropies that relate to global health, nutrition, and development The Bill and Melinda Gates Foundation is not only the largest, but the most influential, having received the confidence of at least two other billionaire-philanthropists Warren Buffet and George Soros. Consequently it deserves special attention. To those engaged with global health, whether academics seeking to mitigate inequities, or those experiencing inequities the priorities of the Gates Foundation are important. A major priority is laid out in a webcast: "Living Proof: Why we are Impatient Optimists" and its accompanying website [39]. The foundations sees great urgency in ensuring a continued and expanded commitment of his government to overseas development assistance, including the MDGs. The magnitude of the US contribution is crucial. Given the track record, budgetary deficits and competing demands for funding global warming, it should not be taken for granted. The webcast suggests the importance of public support for aid, and the associated website provides a kaleidoscope of resources that give access to provides accurate, well organized information regarding the myriad successes to date [40].

The 2010 priorities for the Foundation are outlined in the Annual Letter from Bill Gates [41]. They include innovations in agricultural techniques, means to improve seed quality including transgenics gene sequencing of plants, and marker-assisted breeding. Also the need to improve access to markets. There is stress on the importance of involving farmers in selection of capacity-building tools that fit local needs. On the educational front, there is a need to strengthen the quality of teaching, the use of new tools in education, including of web-based education and the development of quality products. Accreditation services, improved access and quality control measuring tools for classroom and web-based resources. The commitment to immunization, micronutrients, and mosquito nets continues.

There are many examples of synergism between the MDGs, the Millennium Villages, Microcredit. Thus the Gates Foundation is supporting both these initiatives. The foundation provides general funding for Millennium Village Projects. It also supports micro-financing with \$38m in grants to make financial tools more available in the developing world. In addition, a feasibility study is positive about scaling up micro-lending schemes for water and sanitation projects to a market estimated at \$12 billion over the next 10 years [42].

Where are we headed in the second decade of the 21st century

Malnutrition: problems, and what is making a difference

Six million children die unnecessarily each year. Five million of them die from *protein-energy malnutrition* and its common complication – diarrhea from an unsafe water supply. Of earth's six billion people, a billion lack safe drinking water. Clean water and sanitation can do much to reduce poverty, decrease the number days away from feeding the families. Providing safe drinking water and sanitation is

part of the MDG, but progress is slow. In India alone, contaminated water kills 300,000 children annually. Simple and relatively inexpensive solutions exist; i.e., boiling, chemical treatment, or filtration. Breast-feeding is the simplest way to provide safe milk to babies and at the same time to confer substantial immunity. "Kangaroo care" where newborn spend time on a mothers bare chest can promote breast-feeding, or provide a makeshift incubator for premature babies. "Safe-water drinking straws" can filter pathogenic bacteria from two liters of water a day over a 2-year life. While much remains to be done to provide clean water to those in need, clearly initiatives are being made in many parts of the world [43].

One million individuals a year die from lack of vitamins and minerals – *micronutrient deficiencies*. Oral rehydration solutes (ORS) are the most dramatic success against deaths from *protein-energy malnutrition* due to diarrheal dehydration following starvation or kwashiorkor. Simple and inexpensive, ORS are astonishingly effective, and have saved an estimated 500,000 lives a year for the past ten years. ORS come in pouches that simply require the addition of water (or a vegetable soup) to dissolve the salts. Where ORS are unavailable, 1 teaspoon of salt plus 8 teaspoons sugar dissolved in a liter of water can substitute. Now, one of every four of the world's children have access to ORS. Where not available, however, diarrhea remains the leading cause of death of children, still responsible for a quarter of child deaths [44]. *Ready to use foods* (RTUF) are now used by many agencies for famine relief or prevention, or just provided to the mother of a child in fragile nutritional status [45]. *Novel foods*, nutritionally adequate bread and cereals and fortified cookies, have been developed; however, few proved popular among the people who most needed them.

Micronutrients are pivotal to survival in developing countries include forty vitamins and minerals. These are required for optimal physical health and development through the life-cycle. Worldwide, vitamin A, folic acid, iodine, iron, and zinc are the most crucial micronutrients. One million deaths from lack of micronutrients are reported in toddlers annually. Deficiencies in these nutrients are most prevalent in Africa and Asia. For over 100 million children under five years old, vitamin A supplements, for example, could reduce mortality significantly. In parts of Africa, 60% of children are anemic – often they are iron deficient as a result of bleeding from parasitic infections. WHO in 2003 estimated that 1.6 billion people lack adequate iodine, and hundreds of millions of children suffer variable degrees of IQ loss as a result of hunger. The nutrients themselves are inexpensive, and the consequences of a deficiency so devastating. A recent analysis ranked micronutrient provision as the most cost-effective way to improve global health . The Micronutrient Initiative [46] and the Global Alliance for Improved Nutrition GAIN [47] have taken up this challenge.

Excellent summaries of progress in promoting better global nutrition come from the Gates Foundation Progress towards Nutrition [48], and from the International Food Policy Research Institute's Millions Fed [49].

Advances in appropriate technology for agriculture

Soil impoverishment has long been a problem to be solved by peoples recently turned from hunter-gatherers to settled farming. Pre-modern intensive farming utilized very effective techniques, including *contour plowing* – which decreases rain runoff and mitigates soil loss to erosion; *terracing* – which brings previously unavailable land into productive use; and *crop rotation* – which helps impoverished soils to recover. An innovation in more recent times has been the use of informally trained "barefoot" agronomists who learn these tools on educational farms, and travel from region to region teaching others to teach them. South Africa, China, India, Bolivia and other countries have used such advisors, to good effect, and these farming strategies are now widely practiced [50]. At another level, the African Centre for Crop Development at University of KwaZulu-Natal and Rockefeller University, is a training program for PhD students in Africa. Here students from all over Africa train in selection and improvement of seed quality. They will return to rural areas to implement grass-roots programs for seed improvement. The goal is to contribute to food sufficiency in Africa and eventually to a continental surplus [51].

Water is a crucial commodity in drought-prone regions. Where water is scarce, as in the desert regions, "ownership" may well become vested in those with the most political or military power. Apart from these issues, a number of technological solutions to extend water resources are available.

Sub-surface drip irrigation may seem like a low cost substitute for watering cans, but it allows a given amount of water to be used many times more efficiently. The strategy has spread rapidly One model is

simply a drum on a pedestal with a ¼" diameter pipe long enough to siphon water (often mixed with manure) to plants. The outlet end is pushed about 2-5 inches into the soil among the roots and a roughly metered amount of water is applied to where it diffuses and evaporates more slowly than the surface water. More complex (and more expensive) systems allow unattended drip irrigation over many acres.

Deficit irrigation [52] involves supplying crops with far less than the amount of water needed to promote optimal growth. In regions where rainfall is intermittent but heavy when it comes, much is lost in runoff and evaporation.

Rainwater collection pits are dug, perhaps 6' wide and 6' deep and 20-30' long, with rows of stones to direct runoff into them. These can be surfaced with foam sheets or pellets to deter evaporation, or plastic lining to deter seepage. When empty the bottom remains damp and crops are planted there.

Low technology \$25 treadle pumps can irrigate ½ acre, increasing crop yield by \$100 per year compared with watering cans or bucket brigades. For the initial start-up, four factories were set up to make treadle pumps, produce spare parts, and repair them. Two years later there were 75 factories [53].

"Playground pumps" are a novelty which has attracted multimillion dollar funding from US sources. Several hundred have been installed in African locations. They consist of a merry go round which turns an underground pump that drives water into a high water-tank. The Play Pump can lift 1,400 liters of water per day to an elevated 2500 liter tank [54].

Zero-tillage wheat-seeder drill. This device looks like a rotary plough and costs \$100 in its simplest form. Farmers who buy one rents it out to pay off the loan. It has been successful enough that the original two factories have grown to 100 in Haryana & Punjab. A labor-saving device, it increases yield by getting the work done faster. Earlier planting increases yield, and may allow a second crop in a growing season.

Simple donkey carts for transporting crops or fertilizer can be sold for \$200 which among several farmers can be recouped in a couple of months.

"Agrobiodiversity" may include drought-resistant seeds or hybrid rice which is credited in China with nourishing tens of millions of additional people¹.

Where not otherwise specified, descriptions of most of the above can be found at [49].

Village health workers (VHWs)

Village health workers² are chosen by the community to cope with critical shortages of conventionally trained skilled professionals. They are given a limited training to provide health, nutritional, perinatal, or agricultural services. Programs in China, Brazil and Iran have demonstrated that VHWs help improve health outcomes for large populations in under-served regions. Shifting functions from professionals to VHWs has been shown to improve the health of millions at low cost. The number of barefoot doctors in China in the 1940s grew to 1.7 million shortly before their replacement with professionals in 1981. A similar plan in Brazil in the 1990s covered 36% of the population by 2002 during which the infant mortality rate fell by half to 29 per 1000 live births. In Iran, VHWs do home visits from 14000 "health houses". They teach breast-feeding, contraception, provide vaccinations, and monitor child growth, and infant mortality dropped by half; immunization rates rose from 20 to 95%; annual fertility dropped from 5.6 in 1985 to 2 in 2000, while maternal mortality dropped from 140 in 1985 to 37 per 100,000 in 1996. Similar results have been obtained for programs in which VHWs received a few days of pre-natal training. In Ethiopia, with one year of intensive post high school training in first aid, sanitation, disease prevention, "Health Extension Workers" relocate to "Health Outposts" in rural areas to provide basic medical services and preventive health care, on site and by home visits to the most remote areas.

Biofortification

The promise of selective breeding and biotechnology to yield crops with enhanced nutrient density, remains elusive. Testing of novel foods is costly and onerous. High lysine wheat has for decades been in the development phase. High lysine maize with a nutritional value reportedly approaching that of skim milk proved unpalatable. A more palatable variety was approved for food use in Japan, South Korea, Canada,

¹ Where not otherwise specified, descriptions of most of the above can be found at [49].

² VHW is to be preferred over the more common community health worker. The latter term is most often used to refer to someone coming from outside the community. VHW is intended to suggest someone chosen by the community to be sent away for informal training and return with solutions for specific local problems.

Australia and New Zealand but, because of an EU presumption of risk for genetically modified foods, production has for the moment been abandoned. A few promising initiatives are in progress include carotene-enriched (orange fleshed) sweet potato that improves the vitamin A status of children. The 2009 World Food Prize went to Dr. Gebisa Ejeta of Ethiopia. In 1992 he developed a high-yield sorghum, then added drought resistance, and finally weed resistance. Since crop yields in times of drought were 5 to 10 times higher than the native seeds, the cultivars spread widely and they currently improve the food supply of hundreds of millions of people in sub-Saharan Africa.

Supplementation of cereal grains

Thanks to sponsorship from the MDG programs and Gates Foundation, the use of fortified foods is continuing to spread in the developing world. In Egypt wheat flour supplemented with folic acid and iron is widely used in a staple flat-bread; in South Africa a similar program with folic acid supplemented maize meal and wheat flour decreased folic acid-related birth defects by 30%; in China soy sauce supplemented with iron is decreasing the incidence of anemia; Table salt supplemented with iodine remains one of the most widespread and cost-effective means of saving lives [55]. A manufactured rice grain supplemented with vitamin A, zinc, folic acid, thiamin, and iron, is intended to be mixed in small amounts with local rice. It has passed tests for efficacy and acceptability and production is being expanded.

Great advances in web education

Teaching materials are increasingly available online and barriers to bringing these into the classroom are now permanently breached. Materials for classroom use are increasingly available. The Global Health Educational Consortium provides, at no cost, modules on health inequities (including nutrition for developing countries) for classroom or web teaching. Commercial materials for nutrition instruction accompany textbooks too expensive for use in the developing world.

In the developing world, web based education is flourishing because it is cost-effective. For example, the University of South Africa now has over 200,000 distance-learning students and it now has satellites in four countries. In nutrition education, we have recently seen the first product to utilize the computer as an intelligent assistant in the learning process. In 2002 a consortium of universities in the US produced a set of CD modules for teaching nutrition to medical students [56]. From the opening meeting of the student with a patient, it is a stunning example of an on-line course that makes most classroom instruction seem pedestrian in comparison. Subsidized by the NIH it is affordable at \$100 per set. Modules cover the full range of topics for medical students, including perinatal nutrition, pregnancy, and lactation. When adapted to needs of developing countries, it will be invaluable where there are shortages of skilled personnel. This is a foretaste of the future when it will be eclipsed by even more brilliant products. For better or for worse, a few superb products will set the standard across universities where they will replace hundreds of mediocre courses.

Abundant low-cost energy will characterize the second half of the 21st century

The emphasis on green energy could yield cheap portable energy sources and wireless transmission of power. "Low-energy nuclear reactions" (LENR) and cold fusion are being actively explored. Low cost energy has enormous implications for nutrition, especially in areas with a short growing season. In the developed world, there is already a striking proliferation of greenhouses. With inexpensive energy, greenhouses become feasible even in the developing world and colder climates. Year round inexpensive local food then becomes feasible.

The second half of the 21st century will be seen by a redistribution of economic and political power

The emerging nations of Asia and Latin America are predicted to grow strongly in the next two decades. It is estimated that by 2020, India and China together will control 65% of the world's economy. China will overtake the U.S. as the world's largest economy by 2032. By 2050, China will be 20% larger than the US, and the emerging Asian nations will match the economic strength of the U.S. and EU combined. A shift in political power is occurring already as the newly industrialized nations assert their voices. The G20¹ currently represents 85% of the global GDP, and the increasing economic power of the emerging nations is signaled by their recent announcement that they have assumed the financial decision-making role previously held by the G8 [57]. Both China and India have extracted themselves out of extreme poverty and hunger. In

¹ The Group of 20 consists of Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, United Kingdom, USA and EU.

1981, for example, the incidence of extreme poverty in China was 53%. Four years later the proportion was 18%. Currently, the incidence of extreme poverty in China is below 8%.

Concluding thoughts in a perspective for the end of the 21st century

Hunger is as old as humanity, but the current scale and severity are unique. The response at the start of this century is an unprecedented commitment to action. Secular trends over decades or centuries predict that extreme poverty, hunger, and malnutrition will be dealt with decisively over a time-horizon of 25-40 years.

There is danger in naivety. Warfare is almost as old as poverty and there are no signs of its disappearing.. Those with wealth and political or military power will continue to tilt the rules in their favor. The players will change, but armed conflict and exploitation will continued unabated. There will be pockets and flare-ups of extreme need and suffering.

Through the ups and downs, the challenges to the poor and the rich are old ones, to exercise forbearance. The rich are challenged to forbear from taking an unfair advantage where they have the power to do so, to avoid the myopia that what is good for our nation is good for the world, and to see the global, good as the rising tide that lifts all. The poor nations will be challenged to exercise forbearance as they ascend the ladder of development. The sudden attainment of power brings many temptations. It seems safe to assume that both rich and poor will repeatedly fail these challenges. Yet perhaps it is allowable to hope that China, India, Brazil, South Africa all of whom are well acquainted with poverty, will remember from where they came and deal more gently with the vulnerable than did the recent imperial or colonial powers. Having seen these nations bootstrap their way out of poverty, the developing nations – for better or for worse – will look to them as role-models.

There are compelling reasons for optimism, impatience, and indignation. There is optimism that from the perspective of centuries the trend toward alleviation of hunger, malnutrition and poverty is robust and formidable. There is impatience that the pace is so slow. There have been repeated defaults and delays, Milestones have been missed rescheduled and missed again, while those who defaulted almost seem to be deliberately dragging their feet. There is indignation that millions will die undeserved, miserable, and unnecessary deaths because the world has not given the issue of hunger the priority it deserves. The UN's Ban Ki-Moon's declaration at the end of the 2009 Rome Food Summit sums up the sentiment: "Today, more than one billion people are hungry. Six million children die of hunger every year – 17,000 every day. Urgent action is critical. In 2050, the world will need to feed 2 billion more mouths – 9.1 billion in all". The hungry are aware that there is no worldwide shortage of food. The cost of an adequate diet for all is for less than one nation spends on warfare in a month. To focus finally on the practical, here are Ban Ki-moon's closing words: "Our job is not just to feed the hungry but to empower the hungry to feed themselves ... The small-holder farmers are the heart and soul of food security and poverty reduction. A major goal is to provide them with seeds and land and offer them access to better markets and fairer trade"[58].

Appendix The eight MDGs and the roles of nutrition in each - Adapted from [59]

Goal	Relationship of nutrition to the goal
1. Halve the percentage of extremely poor and those suffering from hunger	Poverty is the main determinant of hunger. In turn, malnutrition irreversibly compromises physical & cognitive development & thus transmits poverty & hunger to succeeding generations.
2. Achieve universal primary education	Malnutrition diminishes the chance that a child will go to school, stay in school, or perform well in school
3. Promote gender equality, empower women	Women's malnutrition impairs the whole family's health & nutrition, in pregnancy, perinatal health, child-rearing, and contribution to family income
4. Reduce by two thirds the under 5 mortality rate	Delivery of a live healthy child is dependent, above all, on a well-nourished mother. Protein & folic acid are critical here
5. Reduce by two thirds the maternal health	Malnutrition accentuates all major risk factors for maternal mortality. NB protein, iron, iodine, vitamin A & calcium intake
6. Combat serious infectious diseases	Malnutrition aggravates infections, weakening defense systems. Loss of immune competence increases transmission/mortality in HIV, malaria, tuberculosis
7. Global partnership for development	Agricultural and economic development leads to improved nutritional status
8. Mitigate impact of global warming	Climatic deterioration directly impacts food production

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