Can we free the world of hunger and Malthus's shadow forever?

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Paper prepared for presentation at the "The Scramble For Natural Resources: More Food, Less Land?" conference conducted by the Crawford Fund for International Agricultural Research, Parliament House, Canberra, Australia, 9-10 October 2012

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Abstract

In a little over a decade, the global population is expected to reach 8 billion. The task of feeding this growing population will become harder with rising natural resource constraints, declining or stagnant crop productivity, more frequent extreme weather events, and climate change. These challenges, especially the ensuing increase and volatility of food prices, threaten global food and nutrition security. The Malthusian prediction that population growth would eventually outpace agricultural production growth can be prevented. Technological successes in food and agriculture, such as the Green Revolution, demonstrate that rapid productivity increases in food production can be achieved. However, the goal of achieving global food and nutrition security must encompass food availability, accessibility, and utilisation, as well as the stability of all of these conditions over time. This paper highlights major actions needed to achieve these important objectives while simultaneously adopting a sustainable development approach. The actions include:

- investments in agriculture and technological innovations to boost productivity, especially smallholder productivity, enhance the nutritional value of food crops, and increase resource-use efficiency;
- productive social safety nets to protect poor and vulnerable groups, especially women and children, to ensure their access to nutritious and healthy food in the short run, and improve their human capital for long term prosperity;
- global coordination to reduce food price volatility, including establishing strategic emergency food reserves, ensuring open trade, and eliminating grain-based biofuel production.

Malthus's prediction in a modern context

Two centuries ago, Thomas Malthus made the assertion that population growth, if unchecked, would eventually outpace growth in food production. Through his influential piece, 'An Essay on the Principle of Population', he suggested that food shortages would be imminent, basing his assertion on the theory that food production increases in a linear fashion while population grows geometrically (Malthus 1798). Today, however, Malthus's prediction has not materialised. Hunger and malnutrition persist, but largely due to unequal distribution or access resulting from factors such as poverty, political disadvantage and conflict, rather than an overall shortage in food. What Malthus did not take into account in his prediction was the role of technological innovations in agriculture, in

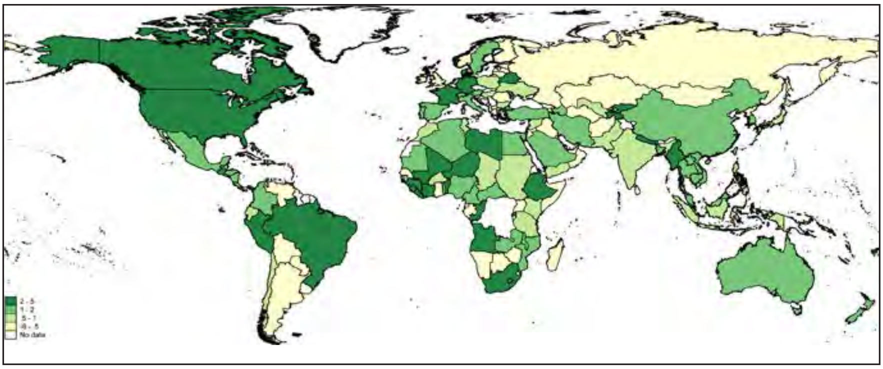

Figure 1. Average annual agricultural growth in total factor productivity (%), 1995–2009 (Alejandro Nin-Pratt & Bingxin Yu, pers. comm. October 2011). White = no data. Cream = -6 – 0.5%. Green: dark 2–5%, paler 1–2%, palest 0.5–1%.

combination with policy and institutional innovations, which have allowed food production, by and large, to keep pace with population growth (Trewavas 2002).

Advances in technology, such as improved high yielding seed varieties and the use of chemical fertilisers, have helped combat food insecurity for millions in recent decades, as well as lift many out of poverty. In this, policy and institutional developments have been a catalyst. Changes and innovations in policy have increased investment in agricultural research, enabled greater access to credit for farmers, allowing them to access improved inputs more easily, and improved other key agricultural components, including irrigation, rural infrastructure, land area, and market access. The Green Revolution is the most prominent example of the preceding, where a concerted effort beginning in the 1960s contributed to a doubling of world cereal production, most notably throughout Asia (Hazell 2002).

Growth in global agriculture has been steady and is now productivity driven, but it is uneven

Growth in global agricultural output has steadily increased in recent decades — averaging 2.7% per year during the 1960s and between 2.1% and 2.5% per year in each decade that followed (Fuglie & Wang 2012) — and has become increasingly productivity driven. Total factor productivity (TFP) has increased dramatically in many areas, but growth varies significantly across countries because input intensification, resource-use efficiency and their effects on productivity differ greatly among developed and developing nations (Fuglie & Wang 2012). In developed countries, resource use has been falling steadily for the past several decades while output has continued to grow in most areas, suggesting that input and resource use are becoming more efficient. Results for developing countries, however, are mixed. For some countries, especially Brazil and China, as well as others in South-East Asia, North Africa, and Latin America, TFP growth has been relatively high in recent decades. For other developing countries, TFP growth has been relatively low, especially in Africa south of the Sahara (SSA) (Figure 1). An average of country-level TFP measures for SSA from 1964 to 2006 shows that annual growth was near 0% (0.02) (Yu & Nin-Pratt 2011) where many countries do not have access to quality inputs, are using inefficient and outdated machinery and irrigation techniques, and do not have policy environments which effectively support agricultural development.

Current and future challenges remain large

Significant strides have been made in freeing the world from Malthus's shadow over the past two centuries, especially in recent decades. However, many current and future challenges remain large and complex, and will threaten future food production.

Global hunger and undernutrition still persist at significant levels. Based on the International Food Policy Research Institute (IFPRI) 2012 Global Hunger Index, over 50 countries have levels of hunger that are 'extremely alarming', 'alarming', or 'serious'. A large portion of those are in Asia and SSA (von Grebmer et al. 2012). According to the UN Food and Agriculture Organization (FAO), nearly 870 million individuals on the planet are undernourished, roughly one out of every eight people. Of these, 850 million live in developing countries (FAO 2012). Further, micronutrient deficiencies plague more than 2 billion people on the planet. Again, a significant portion of this burden falls on the developing world (WHO & FAO 2006).

A growing, urbanising, and more affluent global population will put enormous stress on global food and nutrition security going forward. The Earth will not only need to support more individuals in coming decades but, as urban populations increase and global incomes grow, people will demand more and better food. They will move away from traditional staple crops towards a more diversified diet consisting of larger quantities of meats, vegetables, and fruits. By 2050, the global population is expected to reach 9.3 billion (UN 2011). A significant portion of this growth will occur in urban areas of developing countries. From 2010 to 2050, the world's urban population is expected to increase by 75%. Further, most of this growth is predicted to occur in Africa and Asia, where urban populations are estimated to increase by 47% and 45%, respectively. Global per capita income is expected to more than double throughout developing countries in coming decades, from $2905 in 2012 to $6393 in 2030, and triple globally, from $7754 to $12,045 for the same period (ERS USDA 2012).

Growing natural resource constraints will have a significant effect on agricultural productivity. Resource constraints will mean the increasing demand for food resulting from a growing and more affluent global population will have to be met with less means. A survey of land and water — the two most essential components to agriculture — illustrates this. Arable land degradation is occurring rapidly, and nearly a quarter of all global land area has been affected by degradation. This is equivalent to a 1% loss in global land area annually. That area of land could produce 20 Mt of grain per year (IFPRI 2012). In terms of water stress, 2.4 billion people, or 36% of the global population, live in water-scarce areas, and 22% of the world's gross domestic product (GDP) is derived from water stressed areas as well. Going forward, if agricultural resource use continues at its current rate, 52% of the global population, 45% of global GDP, and 49% of global grain production will be at risk by 2050, as a result of water stress (Veolia Water 2011).

Moreover, the argument has been made that not only the scarcity of resources but also the services provided by ecological systems impose limits to the carrying capacity of the planet (Arrow et al. 1995). Similarly, human activities, including innovation, are seen as having driven global environmental changes to such an extent that they are set to push the planet's biophysical systems and processes out of their current stable state and beyond planetary boundaries, thus eventually affecting human well-being and in particular harming the poor (Stokstad 2005). Hence, to avoid a Malthusian scenario of eventual widespread misery, humanity does not only have to sustain a growing population from a limited resource base; the challenge is to do so without upsetting ecological balances (Rockström et al. 2009).

Climate change is another major challenge, and stands to exacerbate all of the preceding. The effect of a changing climate — including variations in seasonal patterns, temperature and precipitation — will negatively affect the productivity of many farmers around the world, especially those in developing countries. As conditions change, adaptation will need to take place. This adaptation will compete with resources that could be used for other purposes, and farmers all over will have to adapt. For the aggregate food system, climate change poses the risk of inconsistencies in food supply, price volatility, stress on national governments attempting to respond through policy measures, and imbalanced trade (Nelson et al. 2010). Biofuel production will also put pressure on the food system, especially if it is produced from food crops. Biofuel production is expected to nearly double from 2009–11 to 2021 (OECD & FAO 2012).

An integrated approach is needed

An integrated approach is needed to both enhance global food and nutrition security and free the world of Malthus's shadow. As Malthus saw it, careful policy-making is needed to achieve global food security. However, the picture is more complex than simply meeting population growth with technology-driven increases in the aggregate food supply. The challenge for humanity today is to improve agricultural productivity, but also to address the problem of distribution by implementing policies that help allocate agricultural output across societies, and within societies across individuals. In addition, the international community needs to promote efficient and sustainable use of resources, drive the development of renewable energy sources, and protect and where necessary restore the functioning of crucial ecosystems and biophysical processes. In this, it is critical to improve smallholder productivity and resilience, increase global coordination aimed at reducing price volatility, promote low carbon agriculture, and boost developing country capacity. Major actions needed are as follows.

1. Accelerate investments in agriculture, especially in smallholder productivity, improve nutrition, and increase resource-use efficiency

Boosting smallholder productivity is crucial not only for advancing food security, but in raising the incomes of farmers and spurring overall economic growth, especially in resource-rich low-income countries. Increased investments must be made in agricultural research and development that focus on:

- new agricultural technologies which have low adoption barriers and are suitable for small farmers;
- rural infrastructure which provides market access for farmers;
- providing access to quality inputs, such as high-yielding seeds and synthetic fertiliser; and
- institutional innovations required to promote the use of new technologies, including financial (e.g. community banking) and extension services, as well as risk management mechanisms (e.g. weather-based index insurance).

Productivity investments should also be used as a basis for improving the nutritional and health status of consumers, especially women and children. Biotechnology and biofortification have the potential to improve both the productivity and nutritional outcomes of specific crop varieties. For example, from 2007 to 2009, HarvestPlus (a joint venture between the International Center for Tropical Agriculture (CIAT) and IFPRI) and its partners disseminated new orange sweet potato varieties to more than 10,000 farming households in Uganda, resulting in significant reductions in vitamin A deficiencies throughout the country (HarvestPlus 2012). Next to this, although it is critical to forge links between agriculture and nutrition through the development of more nutritious staple food crop varieties, it is also important to have safety regulations to ensure that agricultural intensification does not harm people's health, and more efficient postharvest handling to reduce deterioration in the nutritional quality of foods.

Investments are also needed in resource-efficient technologies and practices which have high payoffs. This entails the adoption of inputs and practices which boost productivity and reduce the current use of essential resources such as land and water. For example, 'business as usual' approaches to water management have been estimated to expose 4.8 billion people (or 52% of the world population) to severe water scarcity by 2050. Sustainable water management can de-risk from water stress more than 1 billion people and roughly $17 trillion of GDP (Veolia Water 2011). Further, to fully reflect the value of natural resources and set appropriate incentives, the full cost of environmental degradation as well as all benefits of ecosystem services should be taken into account by decision makers. The prices of food and natural resources must include social and environmental costs and benefits, such as impacts on climate change and health, which can be achieved through taxation, regulation, and improved economic incentives. Together with research, extension services, and communication campaigns to build awareness, higher costs will promote the adoption of resource-saving technologies and practices while encouraging all actors along the food value chain to reduce waste.

2. Scale-up productive social safety nets to protect poor and vulnerable groups

Better-targeted and more productive social protection policies are needed, both to cushion livelihood shocks that are facing poor and vulnerable groups, and to offer opportunities to escape poverty. Agricultural growth alone is not sufficient.

Possible interventions include conditional cash and food transfers, maternal and child health and nutrition programs, public works programs and insurance schemes. New approaches, such as cross-sectoral social protection initiatives, should be explored to reach the poor more effectively. For example, families who had access to Ethiopia's Productive Safety Net Programme, implemented in 2005, and other complementary food security programs were able to build up more assets, improve their food security, and attain higher crop yields than families that did not participate in these programs (Gilligan et al. 2008).

3. Improve global coordination to reduce food price volatility

National governments should be encouraged to eliminate harmful trade restrictions, such as countercyclical trade policies particularly banning food exports, and refrain from imposing new ones, in order to reduce food price volatility and enhance the efficiency of agricultural markets. Although export bans may help to secure domestic food supply in the short term, they have been shown to exacerbate global price hikes, thus hurting the poorest of the poor, particularly in import-dependent countries. In addition, trade can also increase the efficiency of natural-resource use, when it helps optimise resource allocation across countries in line with their comparative advantages. For example, countries can import crops that were grown under rainfed conditions instead of producing them using irrigation.

A regional emergency grain reserve is also needed to address food price volatility. Owned and managed by an institution like the World Food Programme, such a reserve should be created through donations of grain stocks from large food exporters, such as the United States, Canada and France, and large food producers, such as China and India. This emergency reserve should be strategically positioned in these large food-producing countries and, more importantly, in food-importing poor countries, such as Bangladesh, for efficient and timely access in times of crisis. To some extent, this process is already underway. The emergency rice reserve of the Association of South-East Asian Nations plus China, Japan, and South Korea (ASEAN+3) is an example and a step in the right direction.

Food crop demand for biofuels, particularly in the United States and European Union, must also be cut substantially to help relieve the pressures on both domestic and global food markets and reduce food price volatility. By supporting effective biofuel policies and technology investments, and removing counterproductive measures such as subsidies that encourage the use of food crops for fuel production, public policies can help to lower the cost of food.

A mechanism should also be set up to systematically monitor developments in food supply, consumption, prices and trade, as well as agricultural commodity speculations. Governments should use existing platforms, such as the IFPRI Food Security Portal, FAO's World Food Situation, and G20's Agricultural Market Information System, to generate solid evidence on developments in global markets and their likely implications, in order to avoid generalisations and thus potentially misguided responses by member states.

4. Invest in agricultural climate-change mitigation/adaptation and promote low-carbon agriculture

Agricultural investments should target measures that provide productivity, mitigation, and adaptation benefits. 'Triple win' solutions are required to increase the adaptive capacity of farmers to climate change, promote the mitigation of greenhouse gases, and boost crop productivity in a synergised manner. A recent study from Kenya shows several triple-win practices which can help farmers in developing countries combat climate change while boosting their agricultural output. For instance, soil nutrient management using combinations of inorganic fertiliser, mulching and manure, proved to increase soil carbon sequestration and crop yields. That helped to improve farmers' incomes and create a buffer against the effects of climate change. Leaving crop residues on cropped fields also proved to have high potential for carbon sequestration and yield increases, though results varied depending on location, portions of residues left and management practices. Overall, triple-win innovations and related technology must be smallholder friendly, and policies should mitigate risk for rural farmers in switching to new technologies and practices (Bryan et al. 2011).

5. Support country policymaking capacity and enhance institutions and governance in agriculture and the system

Improving the ability of low-income countries to develop, test and evaluate new policies which support agricultural development is crucial. Policies should come from developing countries to maximise local impact and should be contextually sound but also designed with the global agenda in mind. Countries must develop capacities for data collection in order to improve evidence around what policies have, and have not, been successful. Country-owned policies should be continually tried, evaluated, adjusted and tried again before being scaled-up. The international community should play a role in facilitating this process through knowledge, resources and best-practice sharing.

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