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Markets vs. Malthus: Food Security and the Global Economy

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In the past four years, rising world food prices and the global economic downturn increased the ranks of the world's food insecure[1] from 848 million to 925 million by September 2010, reversing decades of slow yet steady progress in reducing hunger (WFP and FAO 2010). While the human costs have been considerable, the political consequences have been significant as well. Food prices sparked demonstrations and riots in 48 countries 2007–08. While prices receded in 2009, they reached historic highs in February 2011—and were once again implicated in political turmoil. High food and fuel prices were among the grievances motivating the demonstrations that led to the ouster of Tunisian President Zine El Abidine Ben Ali and Egyptian President Hosni Mubarak.

These crises have fed concerns of two skeptical groups. For Neo-Malthusians, they are further evidence that food insecurity is the inevitable consequence of overpopulation and outstripping the world's finite resources. For food sovereignty advocates, the blame lays with the developing world's dependence on international food markets. The solution, food sovereignty advocates argue, is to move toward national food self-sufficiency programs, as a matter of both human and national security.

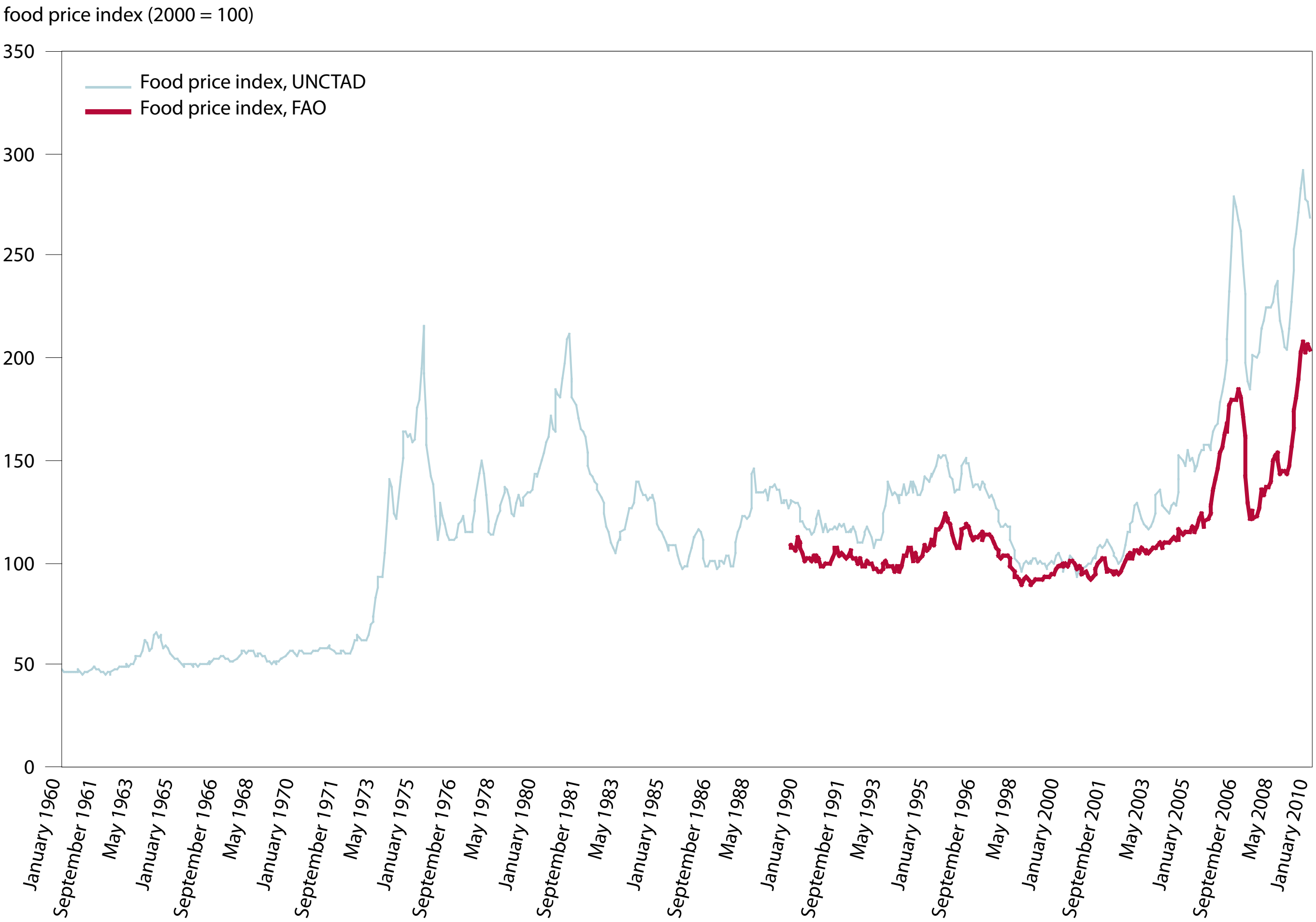
This brief assesses the claims of these two groups. The Neo-Malthusian position is overblown. Population growth and economic development contribute somewhat to price increases, but there are few structural, resource-based impediments to increasing aggregate agricultural production. The biggest near-term threats to food security are not dwindling agricultural inputs and agricultural trade, but rather the familiar problems of poverty and political barriers to market access—in particular, the distortions created by agricultural policy in the United States and European Union. A robust trading system is the best way to address current food security problems. In light of forecast changes in global patterns of agricultural productivity, a robust trading system will become even more important to ensuring that a world undergoing climate change will be able to feed itself.

RISING WORLD FOOD PRICES AND PRICE VOLATILITY

Though only 15 percent of world food production is traded on international markets, prices for the remaining 85 percent—which circulates in local, regional, and national markets—are increasingly aligned with world prices. Significant price pass-through to domestic markets occurs even in heavily subsidized markets like the European Union (Ferrucci, Jiménez-Rodríguez

1. The World Food Summit of 1996 defined food security as existing "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life" (WHO 2010). Food insecurity exists when people do not have adequate physical, social or economic access to food as defined above (FAO 2010).

Figure 1 World food prices, UN Conference on Trade and Development (UNCTAD) and Food and Agriculture Organization (FAO), 1960–2011



Sources: UNCTAD and FAO.

and Onorante 2010) and North Korea, the most autarkic food market in the world (Haggard and Noland 2007).

Following a 20-year period of stability and relatively low prices in world food markets, price increases and price volatility marked the 2000s, particularly the period from 2007 to the present. Both the United Nations Conference on Trade and Development (UNCTAD) and the Food and Agricultural Organization (FAO) food price indices set record highs in February 2011, eclipsing the previous highs that were set in April 2008 (see figure 1).

Not only are prices up, but volatility is as well: during 2007–10, mean volatility in both indices was more than double that of 2000–07. Volatility in rice, the world's most widely consumed staple, has nearly tripled (although world markets are thin). Volatility in both wheat and soybean oil has roughly doubled.

Near-term forecasts do not suggest a prompt return to price normalcy. Recent projections by a host of organizations, including the FAO, the US Department of Agriculture, and the European Commission's Department of Agricultural and Rural Development, all point to higher than normal agricultural commodity prices and continued price volatility (FAO, 2010, USDA, 2011, COM, 2011). The sense that a sea change has occurred in food markets is pervasive. The question is why.

Malthus Reconsidered: Demographics and Dwindling Natural Resources

One common argument is that too many mouths are chasing too few calories, and that our capacity to meet our food needs is bumping up against significant structural constraints. Neo-Malthusians contend that and levels population growth, along with increasing affluence and *per capita* levels of food consumption causing exponentially increasing demands on our natural resources. As the resource base dwindles, increases in food production will not keep pace with increases in population, leading inexorably to shortages, land and water degradation, distributional conflicts, and widespread, chronic food insecurity.

Neo-Malthusians like Paul Ehrlich, author of 1968's *Population Bomb*, and the Club of Rome, which published *Limits to Growth* in 1972, looked remarkably prescient in the 1970s, publishing their works just years before world food prices skyrocketed and remained both high and extremely volatile for a decade, largely due to the oil shocks of 1973 and 1979 and the entrance of the Soviet Union as a major purchaser in world markets.

Aside from price spikes in 1988–89 and 1996, however, the next two decades were characterized by falling prices and gains in eradicating world hunger.

Following the 2007–08 price spike, Neo-Malthusian worries returned to the forefront, in the pages of the *Wall Street Journal*[2], in major academic and popular press books[3], and in *Foreign Affairs* ("Against the Grain," January/February, 2010).[4] Jeffrey Sachs, of Columbia University's Earth Institute, argued that Malthus might have been right, at least with respect to Africa.[5] As prices ramped up in the summer of 2007, Niall Ferguson, the Laurence A. Tisch Professor of History at Harvard University and William Ziegler Professor at Harvard Business School, wrote in the *Los Angeles Times* that "a new era of dearth, misery and its old companion, vice, are set to make a mighty Malthusian comeback."[6]

There has been a clear upward linear trend in world food prices over the last half-century. Expanding populations and economic development in emerging economies have no doubt increased demand, especially since 1990. But are higher prices and increased volatility since 2000, especially the recurrent price spikes, due to growing populations and increasing affluence?

The answer is yes—but only in part. These long run, structural processes were well underway during the 1990s, a decade during which world food prices fell and volatility was low. China grew just as fast during the 1990s as it did in 2000s, and India grew only marginally faster (7 percent versus 5.5 percent annually, on average). Global consumption of wheat, maize and rice grew at 0.8, 1.0 and 2.1 percent per year from 2000–07, but grew at 1.4, 1.4, and 2.6 percent from 1995–2000. Changing *patterns* of demand in fast-growing developing economies—in particular, rising demand for beef, which requires more grain to be used as feed—may be part of the story, but again, these changes were well underway in the 1990s. The main effect of the increase in demand has been to decrease world stockpiles, which were at record highs in the late 1990s but dwindled until 2009–10. Stockpiles are crucial to mitigating price shocks for relatively price-inelastic goods, such as basic foodstuffs. As Figure 2 demonstrates, there has been zero aggregate growth in land under cereal grain cultivation since 1990; all increases in grain availability have been due to increasing yields: growing more food per cultivated hectare. As the rate of yield increase has slowed while demand has increased in recent decades, stockpiles have fallen.

The main effect of the increase in demand has been to decrease world stockpiles

While this story is intuitive, it begs the question of why markets have not adjusted by increasing production, either through increases in yields or land under cultivation. Population growth and economic development are structural, slow-moving variables. Generally speaking, it is hard to explain price shocks and excessive volatility with factors that are easily anticipated by markets. No one was surprised that the world added 77 million people between 2006 and 2007, and China and India, the two emerging economies whose growing affluence is most often cited as the cause of structural increases in demand, grew at rates entirely consistent with their recent performance.

Total food production in both real and per capita terms has increased significantly since 2000, even as real prices have risen. World population has increased by 12.7 percent, but world cereal production has increased by almost 20 percent, and meat production by 23 percent. World cereals and meat production per capita were higher in 2008, the worst year of the previous crisis, than at any point in past 50 years. The world has grown steadily more populous and wealthier, but food production has increased as well. And while changing dietary patterns are pushing up aggregate demand for food—more consumption of meat, which requires considerable expansion of feed grain production—the simple Neo-Malthusian notion, that *aggregate* need is outstripping *aggregate* supply, is wrong.

2. Justin Lahart, Patrick Barta and Andrew Batson, "New Limits to Growth Revive Malthusian Fears," *Wall Street Journal*, March 24, 2008.

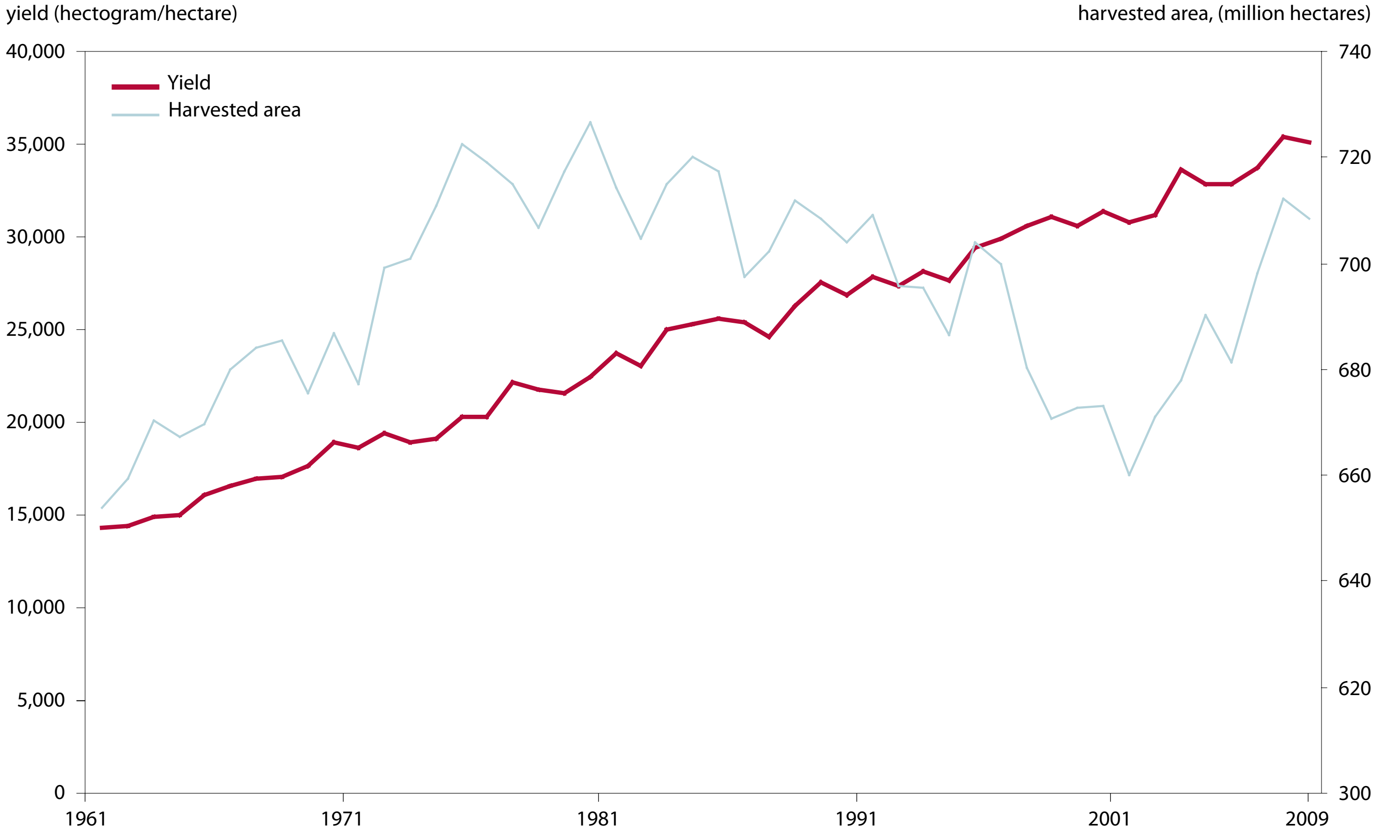
3. Julian Cribb, *The Coming Famine: The Global Food Crisis and What We Can Do to Avoid It*. Berkeley: University of California Press, 2009. Thom Hartmann, *Threshold: The Crisis of Western Culture*. New York: Penguin Books, 2009. Paul Roberts, 2008. *The End of Food*. New York: Houghton Mifflin Harcourt.

4. Carlisle Ford Runge and Carlisle Piehl Runge, "Against the Grain," *Foreign Affairs* 89(1): 8-14.

5. Jeffrey D. Sachs, "Are Malthus's Predicted 1798 Food Shortages Coming True?" *Scientific American*, August 25, 2008.

6. Niall Ferguson, "Don't Count Out Malthus," *Los Angeles Times*, July 30, 2007.

Figure 2 Productivity gains and cultivated area losses, 1961–2009



A corollary to the carrying-capacity argument is that while current rates of growth in the food supply are sufficient to keep up with increasing demand, we will soon run up against significant resource constraints that make current modes of agriculture fundamentally unsustainable. These arguments revolve around constraints on four major inputs: arable land, water, oil, and fertilizers. Of the four, a lack of arable land is least compelling. A 2009 joint OECD-FAO report finds that currently available cropland could be more than doubled by adding 1.56 billion hectares of cultivable land without encroaching on forests and protected areas or limiting urban expansion (OECD-FAO 2009).[7] Unfortunately, most of it is located in regions—Sub-Saharan Africa and South America—that face producer disincentives arising from US and EU agricultural policies, and would require higher world prices, or subsidies, in order to induce necessary investment.

Peak water (Gleick and Palaniappan 2010), peak oil (Deffeyes 2008, Pfeiffer 2006) and peak phosphate (Cordell, Drangert and White 2009, Elser and White 2010) advocates contend that modern agricultural production is dependent on the use of non-renewable inputs, which by definition will eventually be depleted. Price increases will accelerate once peak production—the maximum rate of extraction—is reached and the resource enters a terminal decline in productivity and recovery costs begin to increase. Peak arguments must be right in the most general sense: oil, phosphate, and potassium are all nonrenewable resources, and as such are finite.[8] The question is whether the arguments are right on geological or human time scales.

While freshwater resources are globally abundant and renewable, peak water advocates argue that localized scarcity is a significant concern, particularly in the arid and semi-arid regions that are dependent on groundwater aquifers. These sources are technically renewable but can be depleted (Gleick and Palaniappan 2010). More than ten percent of world agriculture depends on groundwater-sourced irrigation, including several major grain producing areas such as Punjab and the North China plain (FAO 2003a). In order for global agricultural production to keep pace with population and demand

7. Though the report acknowledges that doing so would require intense use of other inputs, principally freshwater.

8. Groundwater does not properly belong in this category, as recharge rates for groundwater are highly variable, ranging from very high in wetlands to virtually zero in arid climates.

growth, this figure will likely have to increase. However, the 1.6 billion additional hectares of potential arable land identified by the OECD-FAO study would not be heavily dependent on groundwater.

There is no doubt that rising oil prices have contributed to recent food price increases. Agricultural commodity prices increase 0.17 percent for every one percent increase in oil prices; USDA estimates that a doubling of costs in energy-intensive products—mostly fuel, but fertilizers to a lesser extent—increased export prices of corn, wheat, and soybean by 15–20 percent from 2002–07 (Baffes 2007, Mitchell 2008). These cost increases are smaller than those estimated for diversion of food grains into biofuel production. Energy costs are part of the story, and movement away from fossil fuel dependence is a laudable goal, but the current food-price situation cannot be blamed entirely (or even mostly) on higher energy costs.

Finally, others are concerned about major non-renewable and non-substitutable fertilizer inputs—principally phosphate. A recent article in *Global Environmental Change* placed the timing of peak world phosphate production at 2033 (Cordell, Drangert and White 2009). However, this estimate was based on world reserves of 16 billion metric tons (mt); the 2011 US Geological Survey Rock Phosphate world reserve estimate was revised to 65 billion mt. Assuming peak methodology is applicable to phosphate production, this pushes the "peak" year of production back at least fifty years, to 2090, at which time annual rock phosphate production would be have to be 456 million mt—nearly two and half times total production in 2010 (176.5 million) (USGS 2011a). To reach peak in that year, annual production would have to grow at an average rate of 1% for the next 72 years, almost double the average rate of growth in the past twenty years (0.54 percent). Potash reserves tell a similar story: peak production, given current reserve estimates, will occur in 2076 at 59 million mt. To reach peak in that year, annual production would have to grow at an average rate of 0.8 percent for the next 65 years, only half the average rate of growth in the past twenty years.

While we can ill-afford to be sanguine about depleting any non-renewable resources, the application of peak methodology to phosphate and potash is problematic. On theoretical and empirical grounds, peak methodology has been demonstrated to produce unstable peak production and reserve estimates, especially when applied to less comprehensively surveyed resources like rock phosphate (Hendrix 2011, Giraud 2011). The most basic reason is that peak production estimates are dependent on present reserve estimates, but survey effort, and thus reserve estimates, are highly price-elastic. Until 2007–08, when food prices drove up demand for agricultural inputs, prices for rock phosphate and potash had been falling for thirty years. Higher prices spurred both survey effort, i.e., the search for new concentrations of valuable minerals, and the conversion of known geologic resources—mineral concentrations that have been sampled and surveyed—to reserves, the extraction of which is economically feasible given prevailing technology and market prices. The result has been much higher reserves estimates. By comparative standards, survey effort is still relatively low. Barclays Capital estimates that the energy industry will spend $490 billion on oil and natural gas exploration globally against world oil production valued at $2.5 trillion in 2010[9]; industry-wide spending on rock phosphate exploration, in contrast, was $2.6 million against $21.6 billion in FY 2010–11. Regarding potash, 9.5 billion mt are currently classified as reserves, but 250 billion more are classified as resources (USGS 2011b). Aggregate availability of key fertilizer inputs does not rank highly in terms of present causes for concern.

Moreover, increasing fertilizer input prices have not been a large contributor to food price levels or volatility. Fertilizer input price pass-throughs to food, even for input-intensive crops, such as US maize, are low: a $100/mt price increase of diammonium phosphate (DAP), the main phosphate-based fertilizer, only increases maize prices by $0.79/mt. Potash ($1.18/mt) and urea ($3.54/mt) have similar price pass-through levels.[10] At the then-historic high price levels for DAP reached in 2008, DAP still only accounted for 9.3% of corn production costs. Rising fertilizer costs have had small impacts on crop prices, even as prices for both have risen. Rather, rising energy prices have been driving both (Baffes 2009).

THE ALLURE (AND ILLUSION) OF NATIONAL SELF-SUFFICIENCY

While some point the finger at demographic patterns and depleted resource bases, others lay blame on the international trading system. Following the events of 2007–08 and in the midst of the current crisis, the food sovereignty movement has gained significant steam. Proponents of national food sovereignty movements generally favor agricultural policies that promote domestic production as an alternative to reliance on food imports. Especially in times of crisis, such as war or surging prices on global markets, food sovereignty holds the allure of insulating domestic consumers and producers from wild fluctuations in prices.

Beginning with the Agricultural Act of 1949 in the United States and the Treaty of Rome in the European

9. "Oil Industry Set for Record Exploration Spending in 2011," *Voice of America*, December 29, 2010.

10. Elasticities were estimated by PotashCorp, based on USDA estimates. PotashCorp, "Why fertilizer?" 2009.

Union, enhancing food self-sufficiency through programs of domestic subsidies has been a goal of agricultural policy in the developed world. Japan's agricultural markets are characterized by even more massive distortions. In spite of significant pressure during the Doha round of WTO negotiations, the United States and European Union have been reticent to back away from significant domestic support for agriculture, and Japanese liberalization has been glacial. In the midst of the 2007–08 crisis, Michel Barnier, current EU Commissioner for Internal Market and Services and then French Minister of Agriculture and Fisheries, defended the EU's policy on food self-sufficiency, arguing, "Food is not televisions or cars. You can't leave all that to the laws of the market."[11]

While food sovereignty—or reducing import dependency, at least—has been on the agenda in the United States and Europe for decades, it is back in vogue in the developing world. In 1960, developing countries ran food trade surpluses totaling $1 billion; by the beginning of the 21st century, deficits were the norm and 48 of 63 low income countries, and 45 of the 46 least developed countries, were net food importers. Speaking this year at the World Social Forum in Dakar, former Brazilian president Luiz Inacio Lula da Silva said that African nations should pursue a "green revolution" and move toward food self-sufficiency, noting, "There can be no sovereignty without food sovereignty."[12]

During the price spike of 2007–08, over 85 percent of the 105 emerging and developing countries surveyed by the World Bank had taken some policy measures to reduce the transmission of world food prices to domestic consumers. While these measures included a reduction of import restrictions, they also included releasing food from reserves, price controls and consumer subsidies, direct cash transfers, food-for-work programs, food rations or stamps, and export restrictions, some of which, particularly export restrictions, have large market-distorting effects (FAO 2008, World Bank 2008, 2009).

Acute crises often call for extensive market interventions. In the aftermath of these crises, however, renewed emphasis has been placed on food sovereignty or food self-sufficiency as a durable policy goal by many developing countries. Even Qatar and Saudi Arabia, two arid countries with extremely limited access to renewable water, announced plans to become food self-sufficient through a mixture of increasing domestic production and leasing farmland abroad. Qatar plans to increase cultivated land by over 140 percent in the next decade using water from solar-powered desalinization plants.[13] Olivier de Schutter, UN Special Rapporteur on the Right to Food, recently called on the G20 to help developing countries reverse dependence on food imports via producer subsidies and protected markets.[14]

There is some evidence that agricultural protectionism is rising. Since 2007, global average import tariffs on maize, the main staple in much of Latin American and Africa, have increased by 68 percent, while the percentage of duty free maize imports has dropped by over a third (see figure 3). Tariffs for wheat, however, have seen secular declines throughout the period.

More damaging, however, has been the imposition of export bans. Of the top five food-exporting emerging and developing countries (Brazil, China, Argentina, Thailand and Indonesia), only Thailand and Brazil did not further exacerbate the 2007–08 crisis by imposing export restrictions (FAO 2008). Export restrictions may have contributed as much as 35 percent to world rice prices and 25 percent to wheat prices during the crisis (Martin and Anderson, 2010).

Export restrictions increase domestic food supplies, but impose a variety of losses: in the domestic arena, producers do not get accurate demand signals, nor do they benefit from higher prices. This distorts incentives to invest in expanding productive capacity, which is necessary to increase supply in the long run. These restrictions are a crude means of addressing acute food insecurity, as they subsidize consumption by comparatively well-off households, rather than just by the poor. Moreover, export restrictions are classic beggar-thy-neighbor policies, throwing costs of adjustment back onto international markets.

While export bans flew in the face of long-run economic logic and specific World Bank policy recommendations, doing so earned political dividends. China, India, and Indonesia enacted export restrictions that were largely successful in insulating domestic markets from international price pressures. Incumbent governments in India and Indonesia were both reelected in 2009, partly on the basis of their success in stabilizing food prices (Timmer 2010, FAO 2009). In Russia, both the president and prime minister's approval ratings improved following the August 2010 announcement of an export ban on wheat, meslin, barley and rye.[15]

In the absence of major reform to subsidy policies in

11. Simon Taylor, "If the CAP fits, the EU will grow," *European Voice,* January 31, 2008.

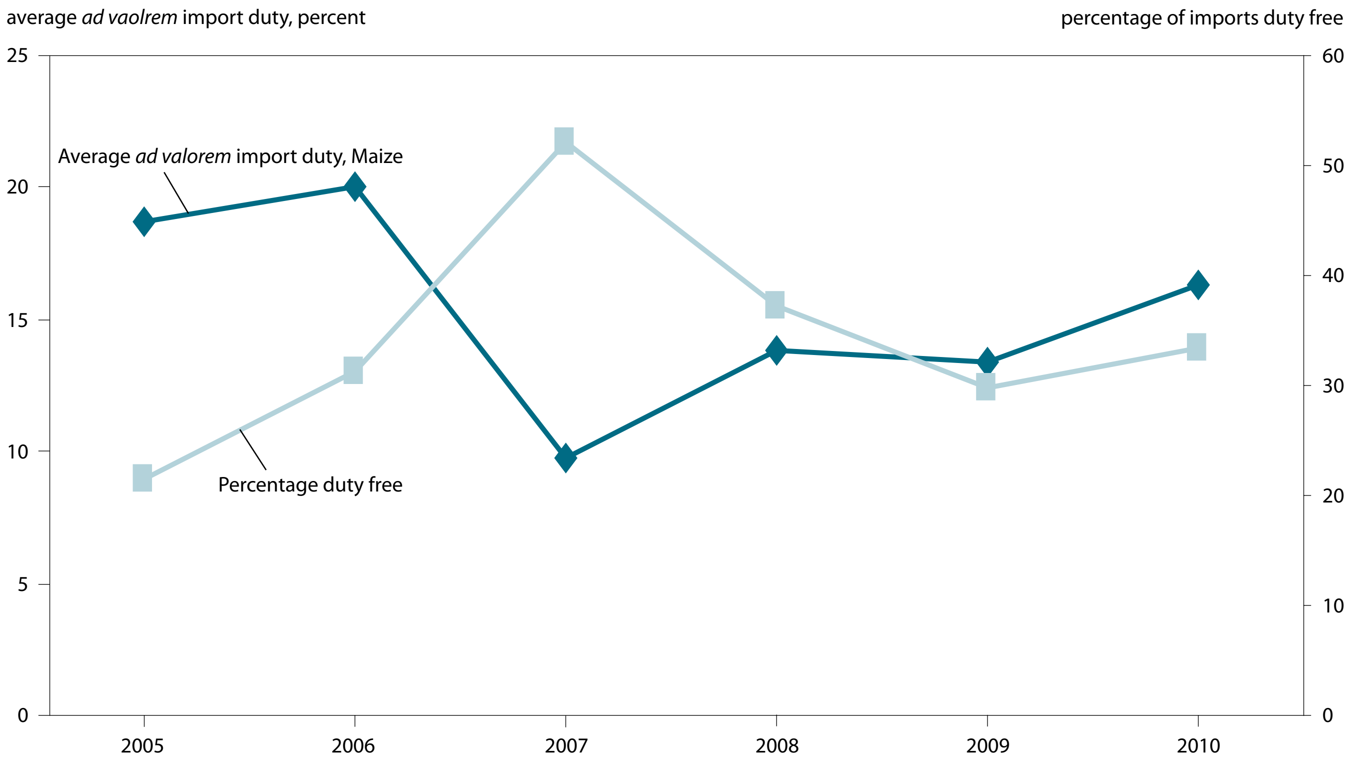
12. Drew Hinshaw, "Africa Needs "Green Revolution" to Buffer Food Prices, Lula Says," *Bloomberg Businessweek Online*, February 7, 2011.

13. Andrew England, "Qatar gets taste for food self-sufficiency," *Financial Times,* June 29, 2010.

14. Olivier de Schutter, "Food Crises: G20 needs Architects, not Firefighters," Project Syndicate, January 28, 2011.

15. "Medvedev, Putin's approval ratings go up after wildfires—polls," *RIA Novosti*, September 3, 2010.

Figure 3 Average tariffs on Maize imports, 2005–10



developed countries, market protectionism and/or higher prices will be necessary for developing countries to achieve food sovereignty. Some countries, such as Malawi and Zambia, have transitioned from grain importers to grain exporters on the basis of successful, though controversial, subsidy programs. The costs of these subsidy programs are quite high, amounting to more than 60 percent of their agricultural budgets, which crowds out needed investment in agricultural research and road networks (IRIN 2008). While these policies seem prescient in times of high food prices, it remains to be seen whether Malawi and Zambia will be able to sustain these subsidy programs at lower food prices, as the political realities of producer subsidies make them extremely difficult to remove.

There are other problems that could arise from the pursuit of self-sufficiency. First, modern food production relies on inputs that are sourced from global markets. Closing off markets to food imports risks provoking retaliatory restrictions on inputs for which, in many countries, no domestic sources are available: 16 countries produce 95 percent of the world's phosphate (Morocco and Western Sahara hold over 75 percent of currently estimated world reserves); 13 countries produce virtually all of the world's potash. However, the most famous examples of self-imposed fertilizer export embargoes—the US ban on phosphate shipments to the Soviet Union in 1980 and the German potash embargo during World War I—occurred in radically different international environments than that which obtains currently: the United States was punishing its chief rival for the invasion of Afghanistan, while Germany was at war with its neighbors and trading partners. Today, most of the major input exporters are WTO members or observers.

Second, under the food sovereignty system, international markets for basic foodstuffs would become even thinner, as incentives to produce tradable agricultural surpluses in any given country would diminish. Autarky is an inherently risky proposition, and this risk increases proportionally with the number of other countries pursuing the same policies. These risks are poorly understood, as they stem not just from natural variability in food yields but also from the more general failure to reap gains from trade.

If a single food autarkic country has a poor harvest, there is implicit (though not costless) insurance against hunger via international markets and the ability to import. However, autarky reduces both imports and exports, which diminishes capacity to earn the foreign exchange necessary for accessing world markets. A truly food sovereign world would trade risks that stem from price volatility on international markets for risks that stem from self-insurance. Domestic grain reserves are a potential source of stability, but their cost can be significant (15–20 percent of the value of the stock per year (Lin 2008)), and extended periods of drought and/or successive crop failures can tax the limits of a country to self-insure in times of stress.

Third, food sovereignty, whatever its theoretical merits, is not a practical policy goal for many countries under most-likely climate change scenarios, at least with present levels of technology. The forecast future effects of climate change are disconcerting for global food production. The Intergovernmental Panel on Climate Change (IPCC) forecasts dramatic decreases (>20 percent) in rainfall across broad swaths of North Africa and the Middle East, Meso- and Central America and the Caribbean, Southern Africa, the eastern Amazon basin, and Western Australia, leading to an average decrease in the availability of water of 10–30 percent (IPCC 2007). In addition, dramatic rainfall increases (>20 percent) are forecast for the higher latitudes of the Northern hemisphere and the Horn of Africa (IPCC 2007).

In the aggregate, global output potential is forecast to decrease by between 6 and 18 percent in areas currently under cultivation by the 2080s

The IPCC also forecasts a 90 percent likelihood that variability in rainfall will increase, leading to more numerous heat waves and dry spells and heavy precipitation events and flooding. An increase in areas affected by drought is viewed as likely, as is the forecast that future tropical cyclones, such as hurricanes and typhoons, will become more intense and destructive. Moreover, the IPCC forecasts a similar likelihood of an increase in extreme sea level events, such as storm surges and abnormally high tides that will inundate coastal areas.

Climate change will affect global food production in two important ways. First, climate change will affect both how much food is grown and where it is grown. Second, climate change will increase the frequency of localized crop failures due to more frequent extreme weather events such as droughts, flooding, extended cold and heat waves, and cyclonic storms (IPCC 2007). The first mechanism challenges the broad feasibility of food sovereignty for much of the globe, while the second highlights the dangers of a world food system in which production is highly geographically concentrated.

In the aggregate, global output potential is forecast to decrease by between 6 and 18 percent in areas currently under cultivation by the 2080s, depending on the rate at which atmospheric carbon stimulates plant growth (Cline 2007). However, these aggregate effects mask dramatic regional inequalities in agricultural production potential (see table 1). Some major exporting countries at higher latitudes, particularly the United States, Canada, Kazakhstan, New Zealand, Russia, and Ukraine, are forecast to increase agricultural yields. Yields in many tropical developing countries, including major rice exporters Thailand, India, and Vietnam, are forecast to decline, in some cases by up to 38 percent (Cline 2007). Overall, non-European developing countries are forecast to experience yield loses between 9 percent and 21 percent.

While expanding area under cultivation will offset some of these productivity losses, many countries, especially in Asia, North Africa and the Middle East, face significant land constraints. India, projected to be the world's most populous country by 2030, already uses over 80 percent of its cultivable land; Egypt, Iran and Turkey use over 100 percent, indicating that farming is only sustainable through irrigation, which requires significant investment in rural infrastructure.

Extreme weather events always present significant challenges for local production and livelihoods, but these localized weather events can have global consequences when they strike in major food-exporting countries and regions. Historic high temperatures and wildfires in Russia and the Ukraine destroyed crops in 28 regions, causing their 2010 grain harvest to drop by a third, spurring export bans and roiling world markets.[16] Former Yugoslav Republic of Macedonia, Kyrgyz Republic and Moldova had joined their neighbors in banning wheat exports. Drought in Australia and heat waves in California's San Joaquin Valley were further implicated in the 2007–08 price spike (Mittal 2009).

Climate change thus presents two problems that suggest diametrically opposed solutions. Greater concentration of production in countries with favorable climatic conditions and a robust trading system will be necessary for the world to feed itself. At the same time, erratic climatic patterns mean that geographic concentration of production poses significant risks, and these risks are forecast to increase substantially.

POLITICS, RATHER THAN MALTHUS OR MARKETS

There is a potential disconnect between the *two food securities*: food security as a component of human security (the most conventional definition, used by health organizations

16. Dmitry Zaks, "Russia may extend grain export ban: minister," *Agence France Presse*, February 22, 2011.

Table 1 Arable land availability and forecast productivity gains/losses due to climate change

Region/Country	Current percentage of Arable Land under cultivation, FAO estimates[a]	Percent of productivity loss/gain due to climate change, 2070–99[b]
Asia and the Pacific	***61.4***	***–7.2***
China	47.5	6.8
India	82.2	–28.8
Thailand	64.6	–15.1
Vietnam	60.2	–2.0
Central Asia	***59.0***	***21.1***
Kazakhstan	478.3	28.1
Europe	***55.6***	***4.1***
France	50.2	7.3
Germany	42.7	11.7
Netherlands	51.1	6.9
Russian Federation	46.8	6.2
North Africa and Middle East	***144.2***	***–9.4***
Egypt	2892.6	28.0
Iran	384.8	–18.2
Turkey	109.7	–3.6
North America	***48.5***	***–1.3***
Canada	36.3	12.5
Mexico	47.4	–25.7
USA	53.0	8.2
South and Central America	***13.9***	***–12.9***
Argentina	30.0	2.2
Brazil	9.2	–4.4
Sub-Saharan Africa	***14.2***	***–16.6***
Democratic Republic of the Congo	0.7	–1.9
Ethiopia	25.6	–20.9
Nigeria	49.4	–6.3

Sources:
a. FAO 2003a
b. Cline 2007, with additional calculations by author. Calculations based on estimates assuming gains from carbon fertilization.

and NGOs), and food security as a component of national security, national economic interests, and domestic political power. From the national interest perspective, market interventions are a key component of food security because they generate powerful constituencies that provide leaders with consistent bases of political support.

Nowhere is this clearer than in US and EU ethanol policy. US ethanol subsidies were $7.7 billion in 2009, and the US ethanol industry consumed 40 percent of United States corn production. Globally, biofuel production consumed 6% of world cereals production (International Grains Council 2010). A World Bank research working paper estimates that biofuel production contributed more to the 2007–08 crisis than the weak dollar (which stimulates purchasing in markets with relatively stronger currencies), rising fuel costs, and rapid growth in China and India (Mitchell 2008).

Though initially driven by the goal of reducing the dependence on fossil fuels, ethanol now has its own political logic, which funnels benefits to ethanol producers in politically important Midwestern states. In particular, Iowa's position as the first step in the nominations for US presidential candidates makes stated support for ethanol a virtual prerequisite for the US presidency. As such, ethanol subsidies are politically rational but come with large externalities: biofuels pushed up the prices on food, both directly on resources used for energy, such as maize and vegetable oil, and indirectly because of substitutions in production or consumption.

Understanding this disconnect is key to understanding how market interventions, designed to preserve the latter "food security", have been perhaps the most persistent threat to the former type of food security.

These discussions also conflate acute and chronic food insecurity. *Chronic* food insecurity is a persistent lack of "sufficient, safe, nutritious food to maintain a healthy and active life," and is generally caused by extreme poverty (WHO 2010). *Acute* food insecurity refers to temporary gaps in access to the same, and

In the long term, removing agricultural subsidies would likely have a modest effect on world prices

may be caused by a variety of factors ranging from high prices to breakdowns in delivery systems, economic recessions, natural disasters, and extreme weather events, political turmoil, volatile derivative markets, and conflict itself. The recent food price spikes have led to widespread acute food insecurity. But most of the policy measures directed at shielding consumers from rising prices are not geared toward addressing more fundamental causes of chronic food insecurity. These would include poverty, lack of market access, and high levels of subsistence agriculture coinciding with environmental degradation and marginal lands.

Market interventions, particularly farm subsidies, have been massively successful at increasing food production in a few select cases. The European Union, United States, and Japan account for 91 percent of all domestic subsidy expenditures by WTO members, while the EU alone accounts for almost 90 percent of export subsidies (Schnepf 2005). Though the prevailing conventional wisdom is that the removal of subsidies in developed countries will provide broad benefits for the developing world, the food security logic of developed country subsidy policies is complex, as their removal would have both long-term and short-term effects. In the long term, removing agricultural subsidies would likely have a modest effect on world prices and would raise incomes in the developing world—but most of the benefits would accrue to large net exporters of agricultural products, such as Argentina, Brazil, and Thailand (Birdsall, Rodrik and Subramanian 2005).

However, the short-term effects are more ambiguous. While developed country subsidies distort incentives for developing country producers and increase food prices for domestic consumers, they also keep food prices artificially low in world markets. Thus, developed country subsidies increase aggregate food production, and subsidize consumption in developing countries while decreasing economic access to food, via suppressed incomes, in more rural areas. Policymakers in developing countries thus face a dilemma: in order to induce investment in agricultural production and promote economic development, prices need to be higher. But higher prices decrease urban real incomes, fuel grievances, erode support for governments, and lead in some cases to political turmoil.

As Nancy Birdsall and Arvind Subramanian point out, the current situation is the "worst of all possible worlds."[17] When markets are stable and prices low, we have huge market distortions that subsidize urban consumption in the developing world at the expense of taxpayers in wealthy countries and the rural poor, which does little to alleviate poverty, the root cause of chronic food insecurity. In times of crisis, markets for food break down as countries institute export restrictions, further exacerbating the problem and contributing to greater acute food insecurity. Achieving price stability and adequate supplies in times of high prices is thus a classic collective action problem: all governments theoretically benefit from relatively open markets, yet face domestic incentives to curtail market access. If food-importing countries believe that markets will not provide stable access to food, pressures to pursue problematic food sovereignty programs will no doubt rise.

The same can be said for maintaining adequate stockpiles. Food is not a market that should clear; there is a significant global public good that arises from adequate stocks, which cushion consumption against short-term supply shocks and dampen prices and price volatility. Yet maintaining food stocks is a costly enterprise for any country due to stock deterioration, and globalization may have caused policymakers to become overly optimistic about relying on this implicit source of insurance without creating new mechanisms to ensure an adequate reserve. The ad hoc policies in this area have harmed more than helped. The largest increases in grain stocks from 2010–11, such as those in Ukraine and Russia, were achieved through export bans and came at the cost of higher world prices.

WHAT'S TO BE DONE

The most pressing challenges to current food security, and providing food security for future generations, are political and economic, rather than Malthusian. Moreover, some can

17. Nancy Birdsall and Arvind Subramanian, "Food and Free Trade," *Wall Street Journal Asia*, April 25, 2008.

be addressed in the short term, while others will take longer. Some solutions can be implemented unilaterally, while others will require international cooperation.

US and EU biofuel mandates divert needed grains from stomachs and stockpiles into gas tanks, and they do so inefficiently. Moreover, steep import tariffs on Brazilian sugar-based ethanol, which is much more bio-energetically and economically efficient to produce, require US consumers and taxpayers to trade off higher food prices against reduced dependence on foreign petroleum when no such tradeoff need be made. Currently, imported ethanol faces a 2.5 percent *ad valorem* duty in addition to a $0.54 per gallon surcharge, which is greater than the $0.45 per gallon tax credit under Volumetric Ethanol Excise Tax Credit (VEETC), or "blender's credit," that is the backbone of US ethanol policy. The import tariffs, surcharges, and VEETC are set to expire at the end of 2011, and should be allowed to do so. The domestic politics of doing so, however, are bound to be arduous, meaning that corn subsidies in some form are likely to stay. The US electorate's taste for the blender's credit, however, may be on the wane. On June 16, the Senate voted 73-27 to end the blender's credit, and though the amendment is unlikely to pass the House of Representatives for reasons both political and constitutional (tax bills must originate in the lower house), it should be taken as a positive sign.

If the US government and US taxpayers wish to subsidize corn production, it is better that said subsidy has the positive externality of generating consumable surpluses rather than the negative externality crowding out food production and causing higher food prices. Chief among the charms of this policy lever is the fact that it is one of the few things that the US government could do unilaterally to help bring down world food prices. Technology subsidies would be better put to use developing 2nd generation biofuels, which would mitigate the carbon footprint and land-use changes to an even greater extent than comparatively efficient—but still far from ideal—sugar- and rapeseed-based ethanol.

Also in the near term, the international community must act collectively to address export bans, which are individually rational but impose massive costs on the entire system. Article XI of the GATT allows for temporary quantitative export restrictions in order to " … prevent or relieve critical shortages of foodstuffs or other products essential to the exporting contracting party," and generally require WTO members to consult with and assess the potential effects on food-importing members, though this restriction only applies to developing countries that are net exporters of the commodity being restricted. This policy is toothless, as the disciplines are extremely vague.

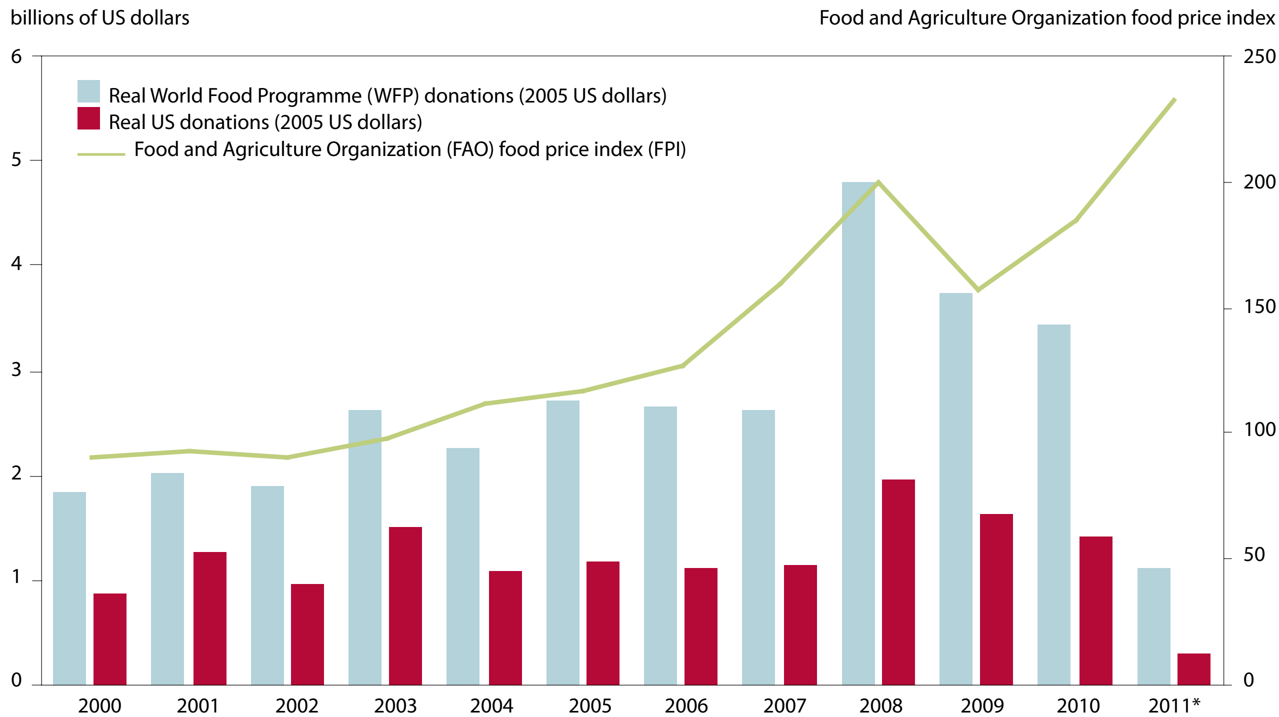
In light of the domestic political and social benefits export bans can confer, there must be some sort of grand bargain that can ensure that export restrictions go the way of import restrictions, which had been on a downward trend until 2007. One possible solution would be to replace producer subsidies in developed countries with disavowal of export restrictions—or at the least, integrating food trade more fully into the WTO's dispute settlement mechanisms, which would allow WTO members to impose retaliatory tariffs. Current proposals before the G20, and in the Doha round, fall well short of this magnitude of policy change. However, there is a mismatch between the costs and benefits of this trade. The costs would be borne primarily by agricultural producers in developed countries and incumbent politicians in food-exporting developing countries, while the primary direct beneficiaries would be producers in middle-income countries and urban consumers in import-dependent developing countries. The United States, as both a major food exporter that has resorted to export bans in the past (export bans on wheat in 1979) and a key provider of producer subsidies, will need to be the linchpin of any such negotiations.

The only long-term solution to achieving price normalcy is to increase growth in production faster than growth in demand,

Finally, the near-term must see renewed investment in organizations like the World Food Programme (WFP), which addresses acute food insecurity, particularly in conflict- and famine-affected areas. In the midst of the last crisis, the international community responded by nearly doubling contributions to the WFP; as the current crisis began in 2010, contributions fell in real terms (see figure 4). Considering the relatively small dollar amounts involved, receding from commitments to providing safety nets to those in most dire need is inexcusable. Yet this is precisely what is happening. The US budget deal, which averted a general government shutdown on April 8, saw net cuts to US foreign food assistance: US FY 2011 spending on foreign food assistance was pared back to FY 2010 levels; some $273 million less than requested by the Obama Administration.

The only long-term solution to achieving price normalcy is to increase growth in production faster than growth in demand, which would allow buffer stocks to return to adequate levels. Doing so can only be achieved with some mixture of increasing yields and increasing land under cultivation. Yet this will require some subversion of the price mechanism in order to achieve necessary increases in output without causing acute food insecurity. Grain producers responded to surging prices in 2007–08 with the largest two-year increase in area under cultivation (4.5

Figure 4 Food prices and World Food Programme donations, 2000–11



*as of April 3, 2011

percent) in over forty years, leading to lower prices in 2009 and the largest global stockpiles since 2003. The price increase necessary to incentivize such a change, however, had a heavy human and political toll. Moreover, generating large stockpiles is individually irrational, even as these stockpiles are needed to buffer against rapid price increases.

Renewed buffer stocks could be achieved via continued producer subsidies and/or public investment in yield-increasing technologies. The current system sees the vast majority of producer subsidies, over 90%, go to farmers in the United States, European Union, and Japan, with a large portion of the benefit passed on to consumers in the developing world. Yet producer subsidies to farmers in developing countries would likely produce much larger productivity gains and alleviate poverty, which is the leading cause of chronic food insecurity. Comparatively wealthy taxpayers in the United States have been subsidizing consumption in the developing world for years; perhaps the time has come to think about subsidizing developing world production instead.

Public investment in yield-increasing technologies in the developing world is badly needed, especially in Africa. Total public R&D expenditures in Latin America and Asia and the Pacific, two regions that benefitted greatly from the green revolution of the 1960s and 70s, have increased significantly since 2000: China spent $4.3 billion (in 2005 PPP prices) in 2007; Brazil, with a population of 193 million, spent only slightly less than Sub-Saharan Africa, with a population of 700 million (Beintema and Stads 2011). When public and private R&D investment is combined, expenditures in 40 upper-income countries still dwarf those of the middle- and low-income countries combined. The silver lining to the FY 2011 US budget for food and agriculture aid is the $100 million marked for the Global Agriculture & Food Security Program (GAFSP), a new World Bank-guided initiative aimed at improving technical capacity and strategic food security planning in countries in Africa and Asia most threatened by widespread hunger.

The need to increase yields through specialization and more intense use of technology—which, in the short term, would imply greater geographic concentration of production in developed countries—must also be weighed against the risks posed by climate-related disasters. The 2011 Japan earthquake and tsunami raised fears about global supply chains that stem from geographic concentration of production, particularly in electronics and car parts. If global food production were similarly geographically concentrated, localized flooding, drought, and other natural disasters could significantly threaten global food availability. The higher-latitude countries that stand to benefit from climate change—at least in terms of agricultural productivity and increasing potential cultivable land—cannot be the only ones to make gains. And if the rest of the gains from technology accrue to middle-income and rapidly developing countries like Brazil, Argentina, Thailand, India and China, the poverty-alleviating effects of increased production will not reach those countries in most desperate need.

But who will pay? Many middle-income countries appear to be subsidizing their own technological advancement, and some lower-income countries have instituted producer subsidy programs. Sub-Saharan Africa is desperately in need of a technology-driven green revolution but lacks either the wherewithal or the political will to fund it intensely, outside of Botswana and Mauritius, two countries whose politics and levels of development make them outliers. Thus, there is a significant role for the United States and European Union is promoting public spending on agricultural R&D in Sub-Saharan Africa.

Food prices and food price volatility in the 21st century have brought Malthusian concerns back to the forefront, and food sovereignty back in vogue as a policy goal. While there are significant hurdles to ensuring an adequate food supply, they stem not as much from constraints imposed by our natural environment as from political and economic constraints on developing a better international food system that can ensure adequate nutrition for all.

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