Feed the World:

The Challenge of Agricultural Development

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Feed the World: The Challenge of Agricultural Development

Douglas Southgate

As the 20th century drew to a close, low prices of primary commodities – the fuels, metals, foodstuffs, and other basic ingredients of economic activity – seemed to be the right and natural order of things.

After climbing to great heights during the late 1970s and for a few years afterwards, the market value of petroleum tumbled in the middle 1980s and stayed low for nearly two decades. As a result, moving goods and people was cheap, even from one country or continent to another. Inexpensive transportation, in turn, spurred international trade and investment, which were also facilitated by advances in information technology.

The global food economy experienced parallel trends. In 1985 and 1986, inflation-adjusted prices of agricultural commodities were 75 percent below mid-century levels. They remained low through the 1990s and for several years afterwards, which was enormously beneficial. Hundreds of millions of poor people who otherwise would have gone hungry were able to afford an adequate diet. In addition, cheap food enabled people to increase their purchases of other goods and services, thereby stimulating the economic diversification which is an essential feature of economic development. At the same time, savings increased, which in turn spurred investment and economic growth.

But two decades of low prices also created complacency among policymakers about commodity scarcity, with inexpensive access to the economy's basic ingredients taken for granted. So it was a shock during the past two years to see a tripling in the market value of petroleum, which shot up from $50/barrel in early 2007 and threatened to rise above $150/barrel in June 2008. Increases in food prices during the same period were nearly as dramatic. As late as July 2007, a bushel of wheat changed hands for $6 and soybeans were bought and sold for less than $10/bushel. Six months later, the prices of wheat and soybeans had risen above $10/bushel and $13/bushel, respectively.

The price of agricultural commodities has now fallen– in some cases, halved since the peak of the crisis. But for many, the crisis continues as prices are still above pre-crisis levels of 2007, or even 2005. This is especially true for developing countries where domestic and local food prices have not fallen significantly or are still rising. The

UN World Food Programme points to countries like Malawi where the price of maize has doubled in the past year.

The World Bank estimates that the food crisis has pushed between 130 and 155 million people back into absolute poverty in the last two years. Worse, it predicts that prices will stay high through 2015. The Africa Progress Panel fears that increased commodity prices will "destroy years, if not decades, of economic progress" (2008). This obliges us to consider the causes of mounting commodity scarcity, its consequences, as well as possible solutions.

This paper focuses on food, first surveying long-term trends in global demand and supply to put recent price changes into perspective. It evaluates various factors which underpin the high prices experienced in 2007 and 2008, including the conversion of crops into liquid fuels ("biofuels"). The paper concludes with lessons we should have learned recently about food scarcity and its alleviation. One crucial lesson is that governments must resist the temptation to meddle with market forces. Also, many parts of the world neglected technological improvements during the era of cheap food. Another important lesson is that in the long term, the avoidance of acute food scarcity depends on such improvements.

Demand Growth of Malthusian Proportions, 1950 to 2000

At first glance, the potential for a cataclysm of the sort described in the late 1700s by Thomas Malthus was never greater than during the second half of the 20th century, when the human population rose from 2.47 billion to 6.06 billion. However, closer examination of natural increase (i.e., the birth rate minus the death rate) leads away from the conclusion that human numbers have been spiraling out of control.

The first thing to understand about recent demographic expansion is that it traces to our "escape from hunger and premature death," to quote the title of a recent book by Nobel-laureate economist Robert Fogel (2004). With death rates declining faster than birth rates, natural increase has been inevitable. As Nicholas Eberstadt, of the American Enterprise Institute, puts it: "Rapid population growth commenced not because human beings suddenly started breeding like rabbits but rather because they stopped dying like flies" (1995, p. 21).

As they have escaped hunger and premature death, people have chosen to have fewer children. In addition, the total fertility rate (i.e., the number of births per woman) has declined because of other modern realities: improved living standards,

urbanization, declines in infant mortality, and (above all else) female economic empowerment. Indeed, a revolution in human fertility occurred in the late 20th century. As is widely known, the number of births per woman fell below the replacement rate (about 2.1) in China several years ago and currently stands at 1.8. However, fertility rates are comparable even in many developing nations which have not adopted anything resembling China's one-child-per-family policy: 2.0 in Chile, 1.8 in Thailand, 2.0 in Tunisia, and 2.1 in Vietnam.

The number of births per woman in Eastern Europe and many parts of the Former Soviet Union has fallen to, or even below, numbers on the other side of the old Iron Curtain. There are 1.3 births per woman in Russia and the Czech Republic – indistinguishable from total fertility rates in Germany, Italy, and Spain. Sub-Saharan Africa is the only part of the world where total fertility rates have not declined very much; on average, women in the region bear 5.2 children (World Bank, 2008b).

As human fertility declines and population growth slows down, changes in per-capita consumption resulting from income growth are having a growing impact on trends in food demand. In recent decades, these changes have been especially pronounced in Asia, home to more than half of the human race and desperately poor as recently as the 1970s. As living standards have improved in China, Thailand, and other nations, consumption of livestock products has increased. Per-capita consumption of meat by the Chinese, for example, has doubled since the middle 1980s (Naim, 2008). In turn, these dietary changes have driven up the demand for corn and other feed grains consumed by cattle, hogs, chickens, and other livestock.

Economic expansion has happened not just in Asia but also in other parts of the developing world, where until very recently low living standards prevented people from eating enough. Under these circumstances, per capita consumption has been rising at a good clip, even as demographic pressure has subsided. Demand for agricultural commodities is sure to continue growing, at least for several more decades at least.

Demand growth does not inevitably diminish per-capita supplies of food or cause famine. If goods, services, inputs, and resources are allocated in markets that are competitive and free from government regulation, farmers and other individual actors can make the changes required to increase supplies, for example by adopting new technologies. This is precisely what happened during the 20th century.

The Supply Response

Significantly, unprecedented population growth and our growing individual appetites for food did not unleash an unmeasured expansion of farmland and pasture in recent decades. Granted, the area used to produce some commodities increased substantially. Data compiled by the U.N. Food and Agriculture Organization (FAO) indicate that plantings of soybeans and other oil crops, for example, grew by 94 percent between 1961 and 2001. Likewise, land used to produce fruits and vegetables at the turn of the 21st century was nearly double the area used for this purpose four decades earlier. However, the area planted to cereals and industrial crops (which are used to produce goods, such as clothing, rather than being eaten) grew by less than 5 percent between in 1961 and 2001. In 2001, 676 million acres (three-fifths of a total of 1,114 million planted to non-industrial crops) were used for cereal production, whereas in 1961, this figure was 648 million acres, out of a total of 923 million acres sown to non-industrial crops (Southgate, Graham, and Tweeten, 2007, p. 54).

Instead of being driven mainly by the geographic expansion of farming, production increases were primarily a consequence of higher agricultural yields. Globally, cereals account for more than 60 percent of the world's food supply. From the early 1960s to the late 1990s, per-hectare output of cereals was 3.0 metric tons, a doubling of average yield in that time period (Southgate, Graham, and Tweeten, 2007, p. 58). Primarily because of yield growth, food supplies increased faster than human numbers and food demand throughout this period.

For more than 15 years beginning in the mid-1960s, improvements in cereal yields were concentrated in south and southeast Asia, the main geographic focus of the Green Revolution. This advance was made possible by agricultural research and testing carried out over many years with support provided initially by the Rockefeller and Ford Foundations and later by donor agencies such as the World Bank and U.S. Agency for International Development. It resulted in new varieties of rice and wheat which produced more grain than traditional strains when fertilizer and irrigation water were applied to farm fields (Dalrymple, 1985).

The Green Revolution benefited small farmers, who readily adopted new varieties, as much as other producers. It also raised incomes for the poorest of the rural poor, who generally labor on others' farms and do not own their own farmland. Of course, the greatest benefit of the Green Revolution was to reduce food prices, including for people who otherwise would have starved (Dalrymple, 1985; Southgate,

Graham, and Tweeten, 2007, pp. 110-111). In light of these impacts, it is a gross distortion to suggest that the Green Revolution mainly served the interests of multinational corporations and ruling cliques.

The Green Revolution also had environmental consequences, both positive and negative. Chemical inputs are crucial to conservation tillage and no-till agriculture, the most earth-friendly and sustainable methods of farming. By using these inputs and avoiding soil erosion, the Green Revolution protected areas of marginal land and natural habitat from being farmed to produce equal quantities of food. Economist Indur Goklany estimates that if global agricultural productivity, and therefore yields, had been frozen at 1961 levels, we would have had to farm 82 percent of global land area instead of the 38 percent we farmed in 1998 to obtain the same amount of food. "In effect", Goklany explains, "an additional area equivalent to the size of South America-minus-Chile would have been ploughed-under" (Goklany, 2001).

Many of the negative environmental impacts can be explained by misguided policies. Some of the fertilizer and other chemical inputs applied to fields have found their way into rivers, lakes, and streams, thereby causing pollution. In addition, irrigation development led to the depletion of hydrologic resources. The subsidized prices at which agricultural chemicals were sold, in order to accelerate the Green Revolution, caused these inputs to be wasted and misallocated. By the same token, water has been priced at a fraction of its actual cost, and this created widespread inefficiencies and environmental damage which continue today (Southgate, Graham and Tweeten 2007, p. 111).

An entirely different complaint about the Green Revolution is that its benefits were not widely experienced throughout Sub-Saharan Africa, where much of the population subsists on root crops, plantains and other plants grown under rain-fed conditions. However, the population of Asia comprised an even larger portion of the human race 40 years ago then than it does today, and it was the poorest part of the world during the 1960s. Thus, it is difficult to quarrel with the decision to focus on increasing irrigated yields of staple grains grown under irrigated conditions in Asia.

The varying regional impacts of the Green Revolution are readily apparent in Table 1. Per-capita food production rose by nearly three-quarters in Asia between the early 1960s and the turn of the 21st century. Though not as dramatic, the relative improvement in South America was still sizable. In contrast, per-capita production in Africa was 6 percent lower in 1981 than it was twenty years earlier, and the decline continued during the next two decades. The African continent was the major

exception to the global trend toward the greater availability of food during the second half of the 20th century.

Table 1 - Changes in per-capita food production since the early 1960s

	As of 1981	As of 2001
Africa	- 6 percent	- 10 percent
Asia	+ 14	+ 73
South America	+ 15	+ 44
World	+ 12	+ 26

Source: Southgate, Graham, and Tweeten (2007), p. 67.

Projections for the 21st Century

Looking forward, what will the next 40 years look like in terms of growth in demand for food production and consumption? The answer to this question depends on demographic expansion during the period as well as increases in per-capita consumption.

Demographic projections issued by the U.N. Population Division (UNPD) in 2001 suggest that human numbers will grow from 6.06 billion in 2000 to 9.32 billion in 2050. A median forecast, consistent with long-term trends, suggests that per-capita consumption will rise by 0.3 percent per annum. Under this scenario, food demand will increase by 79 percent during the first half of this century, even with population growth of a little more than 50 percent (Southgate, Graham, and Tweeten 2007, p. 88).

To obtain a lower-bound forecast of food demand in 2050, it is appropriate to combine the lowest of the three UNPD demographic projections (7.87 billion) with 0.4 percent annual growth in per-capita consumption. This is because a sharp deceleration in population growth is likely to be observed only if living standards (and therefore female economic empowerment and other factors associated with low fertility) change dramatically, in which case average food consumption will also go up rapidly.

Under this scenario, the human population will reach a peak around the middle of this century and then begin a gradual decline. Yet if this happens (a scenario considered ideal by those who are apprehensive about human population growth), demand growth during the 50-year period would still approach 60 percent (Southgate, Graham, and Tweeten, 2007, p. 88).

Even more growth will occur if the deceleration in demographic expansion is more gradual. If faster population growth coincides with a slower improvement in human diets, then food demand in 2050 will be twice the level observed at the turn of the 21st century. This represents an upper bound on demand projections.

With this in mind, it is also worth exploring long-term trends in the market value of edible products. To do this exercise, we might assume that agricultural land use will not vary appreciably during the 21st century and that the yield growth registered since the early 1960s will continue through 2050. In addition, we can suppose that any gap of one percentage point between demand growth and supply growth would result in a price change of two percent, because neither consumption nor production is very sensitive to price changes (Southgate, Graham, and Tweeten 2007 p. 87). The results of combining these assumptions with the demand forecasts described above are presented in Table 2.

If these results are any guide, there is little prospect of a 75 percent decline in real commodity prices, as happened between 1950 and 1985. A modest decline – 26 percent over five decades – will occur if the human population rises to 7.87 billion in 2050, even if annual growth in per-capita consumption accelerates to 0.4 percent. If per-capita consumption continues to go up by 0.3 percent per annum and if there is a 50 percent increase in human numbers, then inflation-adjusted prices in the middle of the 21st century will be 14 percent greater than in 2000. Yet another possibility is faster demographic expansion and slower growth in per-capita consumption, in which case real prices in 2050 will be more than 50 percent above their level at the turn of the 21st century.

Table 2 - Changes in real food prices, 2000 to 2050

Scenario	Change in Real Prices
Human population equals 7.87 billion in 2050 and annual percent growth in per-capita consumption averages 0.4 percent.	- 26
Human population equals 9.32 billion in 2050 and annual growth in per-capita consumption averages 0.3 percent	+ 14
Human population equals 10.93 billion in 2050 and annual growth in per-capita consumption averages 0.2 percent.	+ 54

Spiking Prices in 2007 and 2008

Some political figures, including at least one U.S. Senator, blamed price increases in 2007 and 2008 on speculators. Italy's Finance Minister condemned these market actors as the "plague of the twenty-first century" (Reuters, 2008). However, there is absolutely no evidence that some person, group, or firm started trying to buy up all available wheat, soybeans, etc. 12 to 18 months beforehand, in hopes of driving up prices so that inventories could be sold off later at a profit (Young, 2008). Given the sheer size of the global food economy, it is virtually impossible to "corner the market" in this way, as buyers and sellers of farm products understand full well.

Accusations of "speculation" would be worth considering if there were no other explanation for recent price increases. This is not the case, however – certainly not in the world's largest economy and leading source of agricultural exports. The U.S. dollar has lost nearly half its value relative to the euro in recent years, falling from a peak of €1.15 in 2001 and early 2002 to €0.65 in early 2008. In light of this devaluation, is it any wonder that more dollars must now be offered in exchange for any given amount of food?

The real mystery is why dollar-denominated prices of farm products were relatively stable from 2002 to 2006, a period when the dollar's slide was unmistakable. Perhaps commodity markets were only waiting for the right trigger. Drought struck Australia in 2006 and again in 2007, which resulted in lower wheat exports. Bad weather also reduced production in the European Union, Ukraine, and Canada. These and other shortfalls in output help to explain a reduction (from 30 percent in the late 1990s to 15 percent in early 2007) in the ratio of available stocks of grain to current use.

Another trigger for higher food prices has been the increase in oil prices. For a very straightforward reason, the latter increase is a direct consequence of monetary devaluation in the United States. International petroleum prices are always expressed in dollars and, as the U.S. currency loses value, exporting countries demand more dollars for every barrel they supply. As described in the next section of this paper, expensive energy has affected the food economy in various ways, generally driving up prices of edible products.

Economic agents of various sorts have responded to increases in food prices by engaging in behavior that is entirely rational, although it is sometimes disparaged as "speculative". For example, the decline of the U.S. dollar has taken a toll on stocks and

other financial assets. This has prompted U.S. investors to venture into markets for agricultural products and other primary commodities. As they have done so, commodity prices have risen.

Investors trying to deal with currency devaluation and its aftermath are not the only people who buy commodities in anticipation of higher prices. Political scientist Robert Paarlberg (cited in Young, 2008) points out that countless Asian households have been hoarding rice. Likewise, importers who are fearful of prices continuing to rise have accelerated grain purchases. Paarlberg offers the opinion that this kind of anticipatory buying probably has had an effect on global commodity values, at least when these values have been increasing.

Politicians, especially those from the United States, should resist the impulse to be censorious about additional funds flowing into commodity markets, "panic-buying," and so forth. After all, they are responsible for the very policies (fiscal and monetary) that devalue the dollar, with far-reaching repercussions in the global marketplace. When a Senator or Congressman decries the impacts of speculation on energy or food prices, he or she is, in effect, trying to divert attention and avoid blame.

Energy and Agriculture

Farming has always been an energy-intensive activity. In places where machinery powered by diesel and other fuels has replaced implements that are pulled, pushed, or otherwise wielded by human beings and their livestock, production costs have become sensitive to energy prices. These prices even have an impact in regions where agriculture remains largely un-mechanized – for example, in those parts of Asia where large numbers of rural laborers perform tasks at low wages that otherwise could be done with machinery. In these settings, land fertility tends to be the limiting factor of production, so fertilizer is routinely applied. In almost every step from conception to delivery, fertilizer requires energy – which explains why world fertilizer prices rose along with petroleum prices by more than 200 percent in 2007 (IDFC, 2008).

There is another way that energy prices influence the prices of edible products. After being grown on farms, agricultural commodities must be moved to markets, processing facilities, etc. and then are moved again to the homes, restaurants and other facilities where those products are consumed. Certainly, consumers are affected during periods when fuel used to drive trucks, trains and ships becomes relatively expensive, during 2007 and 2008 for example.

Another linkage between energy and agriculture relates to the search for alternative energy sources, which becomes more vigorous when the cost of conventional fuels grows in relative terms. Some of the alternative fuel sources are agricultural, including the conversion of commodities such as sugar and corn into alcohol (or ethanol) as well as the production of biodiesel from African palm and other oil crops.

Serious interest in agriculture as a source of liquid fuels started in the 1970s, when the nominal price of petroleum rose from $3/barrel to nearly $40/barrel. More recently, some countries and environmental groups have advocated the development of biofuels as a way to reduce atmospheric concentrations of carbon dioxide and other greenhouse gasses, associated with the extraction and combustion of fossil fuels. The European Union has set a goal that biofuels comprise at least 5.75 percent of all transport fuel by 2010 (Commission of the European Communities, 2006). As recently as July 2007, the Sierra Club called for increasing U.S. ethanol production from 7.5 billion gallons in 2012 to 36 billion gallons in 2022 (Anonymous, 2007). Of course, farmers' organizations have promoted biofuel development enthusiastically, especially during periods of low commodity prices.

In the United States, the conversion of corn into ethanol is encouraged in two ways. First, a tariff of approximately $0.50/gallon is levied on imports from Brazil and other tropical countries. This policy keeps the U.S. price above the world level, which is generally in line with the lower cost of manufacturing ethanol from sugar. Second, fuel containing alcohol is exempted from federal excise taxes, of approximately $0.05/gallon. This creates an effective subsidy for ethanol of $0.50/gallon if, as is typical, fuel contains a blend of 90 percent refined petroleum products and 10 percent alcohol. The annual cost to the U.S. Treasury is $7 billion (Doornbosch and Steenblik, 2007, p. 6). Public subsidies in Canada and the European Union amount to $4 billion (van Loon, 2008).

There is sharp disagreement about the impacts of biofuel development. Those who argue that the impacts are minimal point out that, in spite of rapid expansion of the U.S. ethanol industry after 2002 in response to rising oil prices, the industry uses less than 4 percent of the world's grain supply (Westhoff, 2008). Other analysts have the opposite view. Mitchell (2008), for one, points out that the increase in annual corn use (50 million tons) from 2004 to 2007 by the U.S. ethanol industry was comparable to the contemporaneous increase in annual global corn production (55 million tons). Expanded biodiesel output during the same period in Europe, the United States, Brazil,

Indonesia, and other places accounted for one-third of the increase in global use of oil crops. Mitchell (2008) concludes that biofuel development accounts for three-quarters of the growth in agricultural commodity prices between January 2002 and February 2008, when one factors in the effects of that development on grain stocks, shifts in land use, "speculative activity," and export restrictions.

A balanced judgment about the price impacts of biofuel development was recently offered by the Director General of the International Food Policy Research Institute. Observing that "a moratorium on grain-based biofuels would quickly unlock these commodities for use as food," Joachim von Braun contended that "this measure might bring corn prices down globally by about 20 percent" (2008). Since corn farming draws on the same land and other inputs used to produce other crops, other commodity values would be affected as well. For example, von Braun suggests that a moratorium on converting cereals into ethanol would diminish wheat prices by 10 percent (IFPRI, 2008).

Market Rigidities Created by Government Policies

Mitchell's (2008) conclusion that biofuel development is primarily responsible for substantially higher food prices is attention-grabbing. However, its validity is undermined by the assumptions that evidently underpin his analysis.

One of these assumptions is that speculation in commodity markets is entirely a consequence of converting farm products into ethanol and biodiesel. To say the least, this judgment is questionable. As already indicated, the recent bidding up of commodity values by U.S. investors, Asian households, and others was driven by various factors, not least devaluation of the dollar.

Mitchell's (2008) explanation of restricted exports is even more difficult to understand. In a free market scenario, exports ought to increase in various parts of the world in response to price increases, which have resulted because biofuel development has enhanced the demand for agricultural commodities. More specifically, the normal reaction to increased demand in countries with a comparative advantage in agriculture would not be to reduce production and exports, as suggested implicitly by Mitchell (2008). Rather, the normal reaction would be exactly the opposite, as producers would exploit the commercial opportunities created by higher prices.

In fact, farmers in poorer countries stand to gain the most from freer trade in agriculture. Having ready access to markets would allow them to exploit their

comparative advantage – the fact that they can produce food more cheaply than their counterparts in wealthier countries. Trade would enable them to increase incomes and to specialize. Unfortunately, many of these farmers cannot compete because of tariffs, benefits and quotas. This is true, be it in the EU and the US with agricultural subsidies that prop up large farmers to the disadvantage of consumers and other international producers; or throughout Sub-Saharan Africa where high tariffs on agricultural commodities artificially increase the price of food, and ultimately benefit the political elite.

According to the World Bank (2008a), more than thirty nations, including several with the potential to be major suppliers in international commodity markets, adopted export restrictions in response to the food crisis. Despite a recent easing of international commodity prices, export bans remain in 28 countries. As a result of these restrictions, prices are too high, to the detriment of food consumers everywhere.

In a number of countries, limits on exports represent the latest governmental assault on supply response and production incentives in the agricultural sector. An excellent case in point is the Ukraine, where output of crops and livestock as well as rural life suffered severely during the 20th century because of communism.

Two Cases in Point: Ukraine and Argentina

The Ukrainian countryside has undergone a fitful transition from the system of collective farming that Josef Stalin introduced (with tremendous loss of life among the peasantry, one must never forget) beginning in the late 1920s. Nearly a decade passed between the collapse of the Soviet Union and the transfer of farms to private owners, in 2000 and 2001. As recently as 2006, only 1.8 million titles had been distributed, equaling just 20 percent of all titles to be issued. The process was further jeopardized by a now-repealed law requiring inhabitants to pay for registering their land titles (USAID, 2006). In addition, Ukrainian authorities have kept grain prices below international levels by using export quotas and exercising their control over a large share of the country's marketing infrastructure, such as grain elevators and harbor facilities (von Cramon-Taubadel *et al*., 2008). Thus, the country's transition to a market-based food economy is far from complete.

The Ukraine is a net exporter of agricultural products. However, this is no great feat for a country so favored by nature that it was a pioneering exporter in the international grain trade, during the mid-1800s (Morgan, 1979, pp. 27-28). The

country's untapped agricultural potential is indicated by differences in grain yields in 2005 between the Ukraine (2.62 tons/hectare) and neighboring countries where the market economy is better established in rural areas, such as Hungary (5.53 tons/hectare) and Poland (3.23 tons/hectare) (World Bank, 2008b). On top of this, the Ukraine government was among the three dozen or so around the world that restricted grain exports in response to higher prices in 2007 and 2008. Thus, the Ukraine not only has failed to help keep recent price spikes in check, but has added to their severity.

Argentina is another country with conditions that are conducive to agriculture but meddlesome governments hamper their productivity. Along with the Ukraine, the Midwestern United States, and a handful of other places, the Argentine *Pampas* comprise one of the world's great temperate-zone breadbaskets. In terms of political influence, however, agriculture is at a disadvantage. An important part of the explanation is demographic, since the rural segment of the national population is small – just 8 percent (World Bank, 2008b).

Argentine agriculture has been hindered for decades by currency over-valuation, taxes, and at times quantitative restrictions on exports of beef (purchases of which comprise a non-trivial share of expenditures by a typical Argentine household). The consequences of these policies are indicated by a long-term decline in agricultural land use. In the early 1960s, nearly 1,380,000 km^2 (half the national territory) were dedicated to crop and livestock production. By 1980, the area being farmed or ranched had fallen to 1,280,000 km^2. Currently, this area stands at 1,290,000 km^2, of which only a small proportion –90,000 km^2 – is planted to cereals (World Bank, 2008b). Almost certainly, extensive tracts that are well suited to wheat, soybeans, etc. are not being farmed at present.

There is little immediate chance of a recovery in agricultural land use, generally, or the area planted to grain and oil crops, specifically. The recent discouragement of farm exports by authorities in Buenos Aires is probably the most widely cited example today of an inappropriate response to high prices. President Cristina Fernández's proposal to raise taxes (*retenciones*) on soybean exports to 55 percent was defeated last year in the Congress only because her Vice President cast a negative vote. This is a rare victory for Argentina's farmers, who historically have been politically fragmented. Nevertheless, substantial taxes and quantitative restrictions remain in place, much to the detriment of price stability at the global level.

Output Losses Resulting from Policy-Induced Distortions

Considerable research has been undertaken, and is still under way, to quantify the impacts of biofuel development on markets for agricultural commodities. Currently, much less attention is being devoted to assessing the consequences of misguided policies like those which have suppressed supply response in places like Argentina and the Ukraine. Without a doubt, these consequences are sizable, even on a global scale.

With respect to the Ukraine, von Cramon-Taubadel *et al*. (2008) conclude that "in an appropriate policy environment, (cereal) yields could be doubled, from 2.3 tons per hectare to between 4 and 5 tons per hectare produced at internationally competitive prices" (p. 175). Assuming no change whatsoever in the area planted to grain in the country (a little less than 30 million hectares), the resulting increase in annual output would be "60 to 70 million tons" (p. 175) – well over half the 102 million tons that the United States will convert into alcohol fuels during the 2008-09 crop year (Matthew Roberts, Ohio State University, personal communication, 13 October 2008).

If Argentina's farmers were liberated from policy-induced distortions so that full advantage could be taken of existing technology, Argentine agriculture could likewise increase its grain exports significantly. Simply raising its yields to levels achieved in Uruguay, just across the Río de la Plata, would allow approximately half a ton more to be produced on each of the nine million hectares currently planted to cereals in the country. It should be possible to expand this area to 15 million hectares or more, and for average yields in Argentina to match the 4.15 tons/hectare produced in Uruguay (World Bank, 2008b). If this conservative estimate of the potential for increased grain production in Argentina were exploited, then annual output would increase by 30 million tons, if not more.

To summarize, the losses in annual grain output caused by bad public policy in just two nations, Argentina and the Ukraine, are comparable to the corn that the United States is now channeling to ethanol production. When losses incurred in other countries for similar reasons are factored in, the magnitude of the problem is put in sharp relief.

Lagging Research and Development

At global summit convened in Rome in June 2008, U.N. Secretary General Ban Ki-moon underscored the deleterious impacts of policies such as Argentina's. He also directed the world's attention to the full range of factors which have caused higher food prices, including but certainly not limited to biofuel development (Ban, 2008).

The Secretary General paid special attention in his remarks to support for agricultural research and development. His assessment that current funding is deficient is consistent with all available evidence. Public-sector budgets appear to have peaked during the 1980s, approximately when the 20-year period of low commodity prices commenced (Pardey and Beintema, 2001). During the last decade of the 20th century, government funding held steady in affluent nations. Meanwhile, budgets fell in the developing world, presumably because governmental authorities regarded technological progress in agriculture as a low priority as long as food was cheap.

In the United States and a few other affluent nations where intellectual property rights are generally respected, private firms such as Monsanto have invested large sums in agricultural biotechnology. To an extent, this private investment substitutes for expenditures by the public sector benefiting crop and livestock production. Three developing nations – Brazil, China, and India – provide substantial support for research and development, including biotechnology. But elsewhere in the developing world, this support has dwindled to very low levels (Pardey and Beintema, 2001).

Reflecting the consensus among specialists in agricultural development, Secretary General Ban calls for a renewed commitment to research and development. The "overall price tag for national governments and international donors," he states, "could exceed $15 to 20 billion annually, over a number of years." He adds that half this amount is needed "to realize a Green Revolution in Africa" (Ban, 2008).

Without quarreling about the fundamental need for the investment advocated by the Secretary General, one must remember that additional spending alone is not sufficient to create technological progress in agriculture. The research institutions responsible for research and development as well as extension (i.e. technology transfer) must be held accountable for their results as well.

Sadly, numerous examples exist of unaccountable institutions which create few benefits for crop and livestock producers. During the 1960s and 1970s, for example,

international development agencies provided substantial funding for agricultural extension in Africa. The main impact of this initiative was to recruit 36,000 extension agents, many of whom had political connections (Eicher and Rukuni, 2003). Yet the actual impacts on crop and livestock production are debatable.

Even the institutional framework in the United States is not ideal for agricultural research and development. Instead of being allocated on a competitive basis, public monies for investigation are parceled out among land-grant colleges and universities, of which there are one or perhaps a few in each of the fifty states. With every congressional delegation standing ready to defend the state's institutions, grants are not directed to the best research scientists and laboratories, as would happen if funds were allocated competitively.

An obvious institutional remedy is to establish or strengthen intellectual property rights, of the sort that provide a reward for innovation. Biotechnological advances in the United States demonstrate the benefits of this approach. Where innovation produces something useful that cannot be patented or copyrighted, public funding makes sense. But, to repeat, the best way to allocate government monies is usually through some sort of competitive process. Otherwise, the returns on public investment will be diminished due to political influences.

Something else that governments must do to foster technological improvement in agriculture is not to impose needless restrictions on the genetically-modified (GM) products created thanks to agricultural biotechnology. Sadly, encumbrances of this sort are still being put in place. Just recently, for example, the German government banned GM corn that has been engineered to resist pests (BBC, 14 April 2009). Since corn growers who do not use this variety must instead apply more pesticides, the environmental consequences of this restriction are undoubtedly negative. So are the production impacts.

Secretary General Ban is correct to call for a renewed commitment to agricultural research and development, especially in Sub-Saharan Africa. His strong advocacy contrasts sharply with the general inattention to technological improvement exhibited by too many leaders during the time of cheap food. However, increased spending is not enough to bring about this progress. Institutions charged with agricultural research, development, and extension must be reformed, to make them accountable for their results.

Likewise, governments need to provide and uphold the institutions which enable markets to function, such as property rights and the enforcement of contracts.

Without the rule of law, the market cannot truly exist and producers and consumers are unable to respond efficiently to shifts in demand and supply.

Summary and Conclusions

Since the middle of the 20th century, human numbers and the demand for food have increased at an unprecedented pace. However, food supplies have grown even faster, in part because of the geographic expansion of agriculture, but mainly because of yield increases. Thanks to agricultural development during and since the Green Revolution, food became less scarce, as indicated by a 75 percent decline in real prices of wheat, rice, and other cereals between 1950 and 1985.

Anyone who recently has shopped for food is fully aware that food is not as cheap as it was just a few years ago. Multiple factors have contributed to price increases, which have varied from place to place. For example, the United States has experienced a larger price spike than Europe, mainly because the dollar has lost value relative to other currencies. Devaluation of the dollar also has coincided with higher oil prices, which in turn have driven up the cost of producing and transporting food.

The early years of the 21st century were the end of a two-decade period of low commodity prices. Cheap food combined with relatively low prices for other commodities (energy, metals, etc.) contributed to economic growth in various ways. Aside from alleviating hunger, low prices for edible products allowed for more purchases of non-food items, which stimulated economic diversification, as well as increased savings, which accelerated economic growth. In addition, low transport expenses promoted specialization and trade, which brought prosperity to places that embraced globalization.

Low food prices also have encouraged farmers to find new uses for their crops, including as an energy source. Farmers have convinced governments in the United States and elsewhere to encourage biofuel development with subsidies and protection from imports, so global commodity markets have been affected. Although the findings presented by some analysts are exaggerated, the diversion of a large share of the U.S. corn crop and the conversion of oil crops into biodiesel in various countries has created upwards pressure on prices.

Regardless of whether increases in prices were catalyzed by the declining dollar, biofuel development, or something else, they have been aggravated by the economic suppression of agriculture in Argentina, the Ukraine, and many other nations. Since

2007, this suppression took the form of export restrictions, adopted by a large number of countries.

In his June 2008 address, U.N. Secretary General Ban Ki-moon rightly criticized these restrictions. He also emphasized that a renewed commitment to agricultural research and development is needed, in Sub-Saharan Africa and other parts of the world. Without this research and development, which includes the application of agricultural biotechnology and which requires institutional reform as well as the financial investment that Secretary General Ban advocates, the world's supply of food will not keep up with rising food demand.

There was unprecedented growth in population and food demand between 1950 and 1985. Although not expected to be as sizable, increases will continue during the twenty-first century. The challenges posed by demographic expansion and humanity's desire for dietary improvement have been met in the past and are by no means insurmountable today. With free markets and free trade, available resources will be allocated and food demands will be satisfied efficiently. Furthermore, more food can be obtained from existing resources if investments in research and development result in technological progress.

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