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Sustainability of Livestock and Poultry Agriculture

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Executive Summary:

"Sustainability" as applied to food production is a term that can have different meanings to different groups. To some the term means that modern, intensive, agriculture cannot be counted on to provide food in the long term. Groups who define the term in this manner believe that limits on farm inputs such a fuel, fertilizers and chemicals will eventually lead to a reduction in their use and availability, leading in turn to a collapse in the production system. "Sustainability" in this context would imply reducing use of off-farm inputs and reverting to production systems of an earlier time.

However, this definition of "sustainable" implies reduced food output while global population and food demand continue to grow. For purposes of this paper "sustainable" will be defined as the ability to produce an adequate, safe, and nutritious food supply while using resources, particularly land, efficiently and effectively. Using this definition implies that we need to sustain the human race with enough food to provide for a growing population. This will not be an easy task.

Almost half of the world lives in poverty[1], and faces difficulty in purchasing food for a adequate diet. More than 25% of the children in the developing world are underweight for their age[2]. Lack of improvement in food sector productivity could have severe negative consequences for much of the world's most vulnerable population. However, we have, at least until recently, been making progress on this front.

Increasing food production productivity has help improve the world's diet significantly over the last 40 years. According to FAO, in 1969-71 there are 937 million people with a diet that was not sufficient for normal daily activities. That number had declined to 826 million by 2002-2004. Significant progress, but we still have a major problem.

The limiting resource for increasing food production is suitable land. Over the past 50 years the world's population has outgrown increases in the amount of land used in agriculture. The amount of food producing land available per person has thus declined. While population growth is slowing, land used for agriculture is also peaking. Through 2050 the amount of agricultural land per person will grow slowly, at best. Increasing demand for food crops for biofuel production may severely exacerbate the long term issue with the balance between food demand and available land.

The cost of not increasing land productivity will be severe, especially for the poorest of the poor. If food prices increase in real terms, global living standards will decline. The share of income for non-food purchases will drop, and the non-food economy will shrink.

[1] World Bank. 2005 World Development Indicators. % of population with under $2 per day in purchasing power
[2] FAO. Found at http://www.fao.org/faostat/foodsecurity/MDG/MDG-Goal1_en.pdf

Those on the edge of starvation will suffer the brunt of the cost. Life expectancy will decline; child mortality rates and diseases of malnutrition will increase.

The alternative to increasing agricultural productivity is not a future we want to contemplate as desirable. Political and social unrest could lead to declines in living standards far beyond those that might come out of the food sector alone.

The Global Conflict – People and Incomes vs. Land

In 1798 Thomas Malthus published the first edition of *An Essay on the Principle of Population*. In this rather gloomy view of the ability of man to reproduce himself versus produce food for his sustenance he stated:

"The power of population is so superior to the power of the earth to produce subsistence for man, that premature death must in some shape or other visit the human race. The vices of mankind are active and able ministers of depopulation. They are the precursors in the great army of destruction, and often finish the dreadful work themselves. But should they fail in this war of extermination, sickly seasons, epidemics, pestilence, and plague advance in terrific array, and sweep off their thousands and tens of thousands. Should success be still incomplete, gigantic inevitable famine stalks in the rear, and with one mighty blow levels the population with the food of the world."

This statement has since been labeled “Malthusian Theory”. Basically it says that mankind will always increase in numbers as long as the food supply is sufficient. Malthus also proposed that population, if unchecked, increases at a geometric rate (i.e. 1, 2, 4, 8, 16, etc.), whereas the food-supply grows at an arithmetic rate (i.e. 1, 2, 3, 4, 5 etc.). Malthus did not see that very large amounts of land were available for agriculture, and food production was not going to actually limit the population in the short run.

In the late 19th and through the 20th century, as the world started to cope with more and more limited amounts of additional good land available for agricultural conversion, land productivity increased. Yields of basic crops responded as genetics, cultivation and fertilization came under scientific study. Animal agriculture also benefited from scientific study and development. The real cost of food declined dramatically, opening up the opportunity to develop entire new industries. Malthus, who did not foresee rapid scientific advances in agriculture, was beginning to look like he was very wrong. Events of the last few years may prove him simply a man well ahead of his time.

We succeeded in forestalling mass starvation and building a society far better fed that Thomas Malthus would have ever dreamed by application of science that did not exist in 1798. Still, given demographic trends that have continued over the last 210 years, and will persist into the foreseeable future, we cannot allow our attention to food production efficiency to diminish.

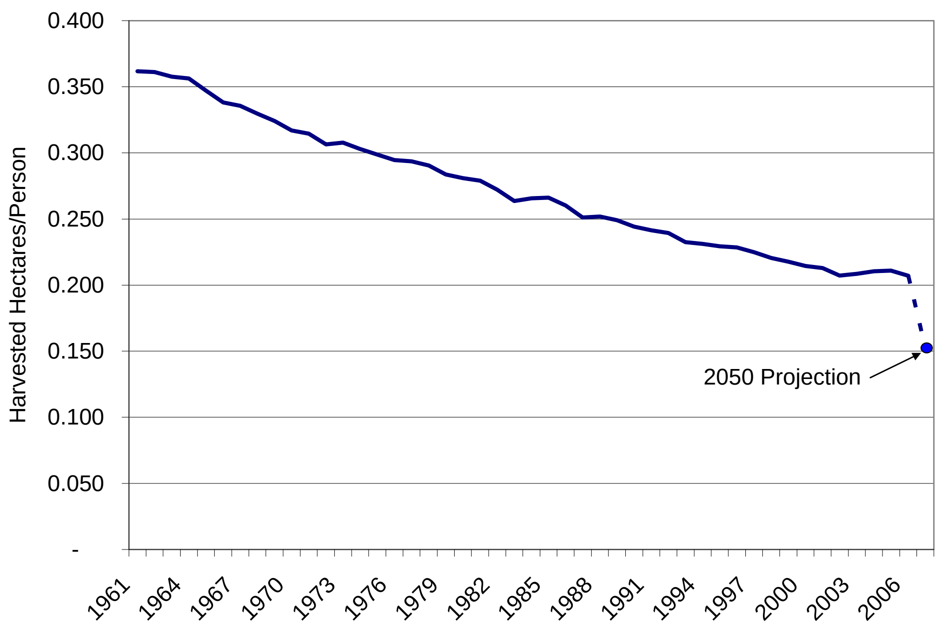
Land – The Ultimate Limiting Food Production Resource

Food production takes labor, equipment, technology, and natural resources, including land. Land, and lots of it, is required to produce the crops that are the basis for all food production. In addition, land is used for grazing cattle and sheep that are also important to the food supply. The amount of land available to us is limited by the earth's surface. Much of our land surface is not suitable for agriculture. It is too dry, too wet, too cold or too mountainous. Land that can be brought into cultivation today is generally of poorer quality and more environmentally sensitive than land that is already in agriculture.

Since 1961 the total global area harvested for all crops has increased from 1.11 to 1.35 billion hectares, a 22% increase[3]. Global population increased from 3.06 to 6.54 billion, a 114% increase. The ratio of farm land to people declined from 0.362 hectares (572 sq. ft.) in 1961 to 0.207 (328 sq. ft.) in 2007. By 2050, with a 9+ billion population, the ratio will be only 0.152 hectares (241 sq. ft., a 15.5' square, and about 50% of 1961). That means that each person on the planet in 2050 will have access the food from a plot of ground only about the size of the master bedroom in a middle class U.S. home.

Clearly, we are each eating off less land than in the past. With the steady increase in global population and little land left to enter agriculture the trend will continue. If per capita food consumption is to just hold its own at current levels we will need at least a 27% increase in overall agricultural productivity per hectare over the next 42 years. To improve living standards will take even more of an increase in per-hectare production.

Figure 1: Average Global Harvested Agricultural Land per Person, 1961-2006



As we have seen in China, and to a lesser extent in India, increases in income are powerful drivers of meat production (Figure 2). Income is also a major factor in the growth of global meat production. The best available measure of overall economic activity, and income, is Gross Domestic Product, corrected for inflation. The World

[3] FAO. FAOSTAT database, 4-18-08. Harvested area for all crops

Bank database, WDI Online, contains estimates of global GDP in constant 2000 U.S. dollars. The total GDP numbers from the World Bank were divided by U.N. population estimates to yield per capita GDP, trended to 2050, shown in Table 1.

Figure 2: Total Meat Production of China and India, 1961-2006[4]

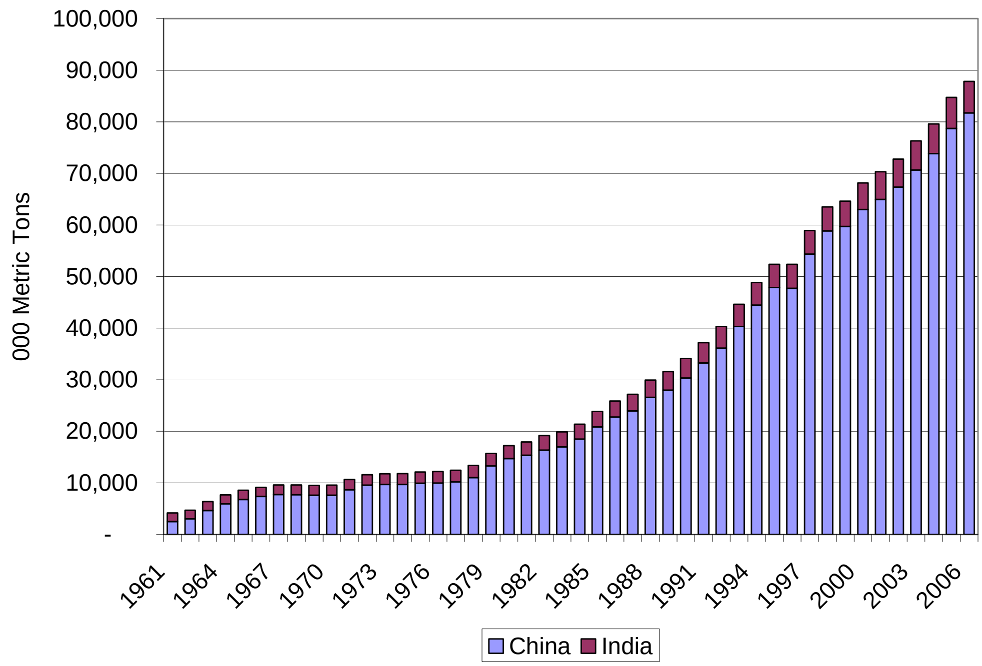


Table 1: GDP, Population and Per Capita GDP, Selected Years, 1965-2050
Population and GDP in 000's, 2006-2050 Projected

Year	***Per Capita GDP $2000***	***Population (000)***	***GDP $2000 (Mill.)***
1965	$2,825	3,337,974	$9,429,556
1970	$3,299	3,696,588	$12,194,430
1975	$3,581	4,073,740	$14,587,570
1980	$3,966	4,442,295	$17,616,910
1985	$4,136	4,843,947	$20,032,840
1990	$4,535	5,279,519	$23,944,060
1995	$4,727	5,692,353	$26,910,310
2000	$5,217	6,085,572	$31,745,760
2005	$5,654	6,464,750	$36,554,731
2010	$6,103	6,842,923	$41,765,656
2015	$6,588	7,219,431	$47,562,691
2020	$7,111	7,577,889	$53,888,672
2025	$7,676	7,905,239	$60,680,624
2030	$8,286	8,199,104	$67,934,006
2035	$8,943	8,463,265	$75,691,056
2040	$9,654	8,701,319	$83,999,657
2045	$10,420	8,907,417	$92,817,529
2050	$11,248	9,075,903	$102,083,102

[4] FAO, FAOSTAT.

The projections in Table 1 are a powerful indicator that income could drive potential total food and meat demand much higher than just population growth alone. A regression equation estimated for the relationship between per capita GDP and per capita meat production shows a near-perfect correlation between the two. Based on the period 1965 to 2005 the regression equation is:

Per Capita Meat Production = -2.842 + 0.758313*(Per Capita GDP)

$R^2 = 0.976$

The R^2 coefficient implies that 97.6% of the increase in per capita meat production is explained by increases in per capita GDP.

To estimate potential meat production to 2050 the combined forces of population growth and income growth were used to project first per capita then total global meat production. Results are shown in Table 2.

Table 2: Per Capita and Total Meat Production
2010-2050 Projected

Year	*Per Capita GDP $2000*	*Population (000)*	*GDP $2000 (Mill.)*	*Total Meat, 000 Tons*	*Per Capita Meat, kg*
1965	$2,825	3,337,974	$9,429,556	84,437	25.3
1970	$3,299	3,696,588	$12,194,430	100,624	27.2
1975	$3,581	4,073,740	$14,587,570	115,765	28.4
1980	$3,966	4,442,295	$17,616,910	136,682	30.8
1985	$4,136	4,843,947	$20,032,840	154,421	31.9
1990	$4,535	5,279,519	$23,944,060	179,958	34.1
1995	$4,727	5,692,353	$26,910,310	206,755	36.3
2000	$5,217	6,085,572	$31,745,760	235,121	38.6
2005	$5,654	6,464,750	$36,554,731	265,236	41.0
2010	$6,103	6,842,923	$41,765,656	296,199	43.3
2015	$6,588	7,219,431	$47,562,691	331,138	45.9
2020	$7,111	7,577,889	$53,888,672	368,316	48.6
2025	$7,676	7,905,239	$60,680,624	407,148	51.5
2030	$8,286	8,199,104	$67,934,006	447,475	54.6
2035	$8,943	8,463,265	$75,691,056	489,447	57.8
2040	$9,654	8,701,319	$83,999,657	533,234	61.3
2045	$10,420	8,907,417	$92,817,529	578,429	64.9
2050	$11,248	9,075,903	$102,083,102	624,530	68.8
1965-2005 Increase	100.2%	93.7%	287.7%	214.1%	62.2%
2005-2050 Increase	98.9%	40.4%	179.3%	135.5%	67.7%

The total meat production increase of 135.5% in Table 3 is well above the 27% increase in land productivity estimated above just to maintain living standards at current levels. **The implication is that demand pressures on our agricultural land resources over the next 42 years are going to intensify at an unprecedented rate.**

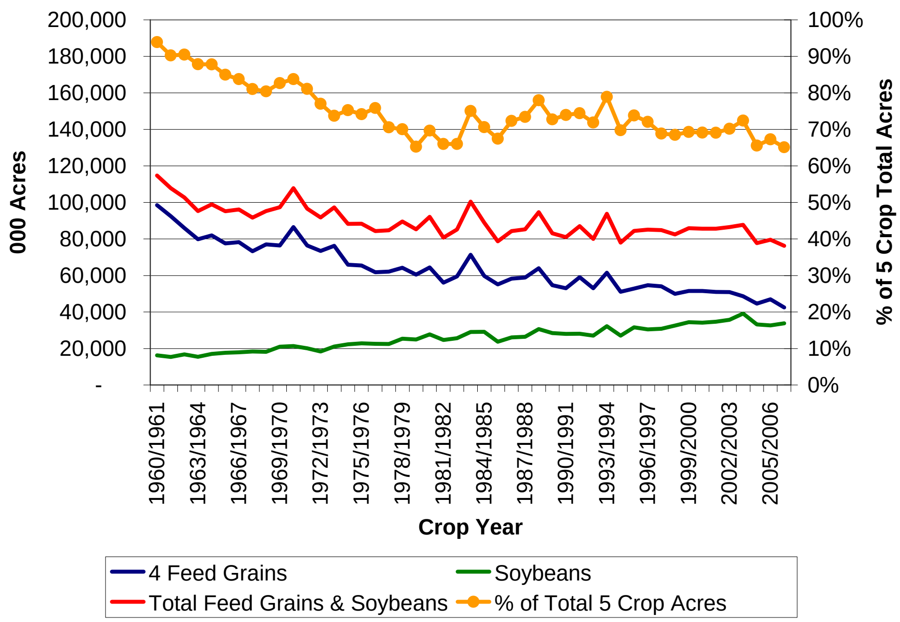
Sustainability of U.S. Meat Production

Meat production systems make potentially large demands on land for feed crop production and the use of extensive grazing lands for cattle and sheep. This section is an examination of the record of crop land use for production of the U.S. animal feed and meat supply over the period 1960 to 2006.

Traditionally, meat animal production efficiency is narrowly measured based on the use of feed and facilities to produce meat. In this paper we will focus on the use of land to produce meat. The measure of efficiency used is meat per acre of crop land used. The efficiency measure is that the entire system of crop production and animal conversion of crops to meat, not just the animals alone. When looked at is this manner the sustainability record of the U.S. meat production system shows remarkable gains over the last 45 years.

It is simple to calculate the acreage used for the feed grains and soybeans that are the major contributors to the U.S. livestock and poultry feed supply. We take the total tons of feed grains and soybean meal used for U.S. food animal feed and, using average yields, convert those tons back to acreage needed to produce the crops. The feed use estimates and yields are readily available from USDA[5]. Figure 3 shows the results.

Figure 3: Feed Grain[6] and Soybean Acres Used for Feed Production
1960/61 to 2006/2007 Crop Years



The trends show a declining acreage of feed grains, increasing acreage of soybeans, and a decline in total acreage needed for feed crop production. Since 1960/61 the total acreage of these five key crops needed to produce our livestock and poultry feed has

[5] USDA, FAS, PS&D Database
[6] Corn, sorghum, barley and oats

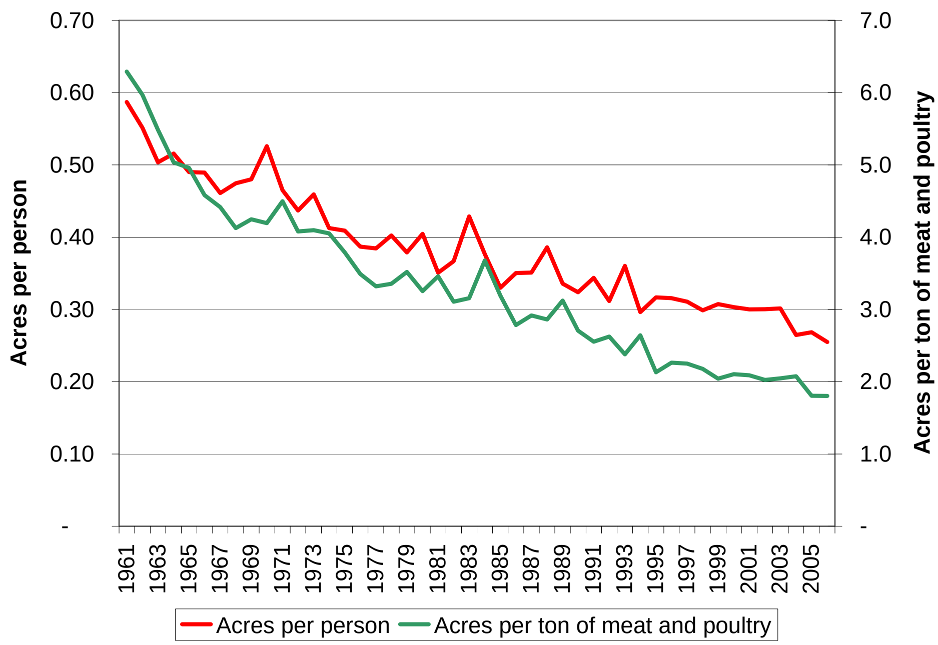
declined by 38.5 million acres. We have also seen a major decline in the percentage of plantings of those key crops that are used for U.S. feed production. In the early 1960s it took about 90% of our harvested acres of these crops for our domestic feed production, in the last decade that percentage has declined to under 70%.

Soybean acreage increased in part because soybean yields have increased at a lower rate than those of feed grains. Also, by increasing the share of poultry meat in the U.S. diet we have raised the average soybean meal content of all feed over time. The shift to poultry has also increased average animal feed conversion efficiency in the process, helping reduce the acreage needed for feed grains.

While reducing land used for feed crop production may seem like quite an achievement, it is very far from the whole story. What is missing in Figure 3 is the fact that while reducing land use, we also saw increases in both the U.S. population and total meat and poultry product production. A better measure of resource efficiency is per capita land use similar to what was calculated for global food production earlier.

It took an average of almost 0.6 acres per person to produce enough feed for our livestock and poultry production in 1961. By 2006 that ratio dropped to about 0.255 acres. In other words, today it takes less than half as much land on a per person basis to produce our meat, dairy and poultry supply than was the case in 1960/61 (Figure 4). Again though, this is not the total story.

Figure 4: U.S. Feed Grain/Soybean Acres Used Per Person and Per Ton For Meat and Poultry Production, 1961-2006



Along with increases in population our U.S. production of meat and poultry has also increased, and even faster than the population. More of that production is exported now than was the case in 1961, and it is consumed elsewhere, but it is still consumed. **In**

2006 each ton of meat and poultry production took only 28.6% the land area that was needed in the early 1960s. The decrease is a result of both increasing crop yields and improvements in average feed efficiency of the major meat producing species.

As pointed out above, on average each person on the planet today has 0.207 hectares (0.51 acres) of land used for agricultural production. In the U.S. only 0.26 acres is required for each person's animal feed production[7], leaving 50% of the acreage for other agricultural uses. Those who accuse the U.S. of "wastefully" producing "excess" animal protein are simply wrong about the incredible record of the production systems used by the sector. In fact, from a land use perspective, the progress made in U.S. meat production system has contributed to, not detracted from, global food production sustainability.

The Challenge of Biofuels to Food Production Sustainability

In addition to demand increases for food we are now seeing a new, and potentially very large, demand placed on the world's land resources. With rapidly rising prices of energy, commercially viable production of biofuels is now a reality. However, biofuels cannot make a large difference in energy production. The fact is that global production and consumption of petroleum is about 10 times the size of global grain production in terms of energy produced. Using crops as inputs we simply cannot produce enough grain and oilseeds to replace a meaningful amount of petroleum-based fuels.

Prices of agricultural commodities that can be used for fuel production have risen to, and above, their value as fuels. Developed countries, including the U.S., are heavily subsidizing the use of food products (mainly corn, sugar and edible oils) for use by biofuel producers. Those subsidies have artificially boosted the prices of all grains and oilseeds to well beyond prices historically seen for food use. As a result of combined market and subsidy effects prices of most basic grain and oilseed food commodities have doubled, or more, over the last two years.

Even without producing much additional energy the biofuels sector is already using large amounts of our most productive lands. In the U.S. alone we will use about 30% of the 2007 corn crop for ethanol production during 2008. That 30% is almost 4% of the world's grain crop and is about 27 million acres of fertile Midwest farmland. In addition, we will use about 11% of the soybean oil from the 2007 crop to produce biodiesel. That represents production from another 7 million acres for a total of 34 million, or 10% of all crop acreage in the U.S.[8] That 10% of acreage replaces about 3% of our gasoline and diesel use.

U.S. biofuel production is only about 33% of total world biofuel output in 2008[9]. On a global scale the acreage used by this rapidly developing new demand source will place

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[7] A portion of which not only feeds the U.S., but the rest of the world in the form of U.S. meat and poultry exports
[8] USDA. http://usda.mannlib.cornell.edu/usda/current/wasde/wasde-04-09-2008.txt
[9] http://online.wsj.com/article/SB120631198956758087.html

added stress on food production and land resources. Biofuels have the potential to impose substantial environmental damage on fragile non-agricultural lands converted to agriculture or biofuels and reduce the living standards of the world by raising food costs.

At this point it is not possible to accurately forecast the impact of biofuels on long term sustainability of global food production. Already, however, we are seeing major stress in the developing world. Professors C. Ford Runge and Benjamin Senauer of the University of Minnesota recently stated[10]:

> In a study of global food security we conducted in 2003, we projected that given the rates of economic and population growth, the number of hungry people throughout the world would decline by 23 percent, to about 625 million, by 2025, so long as agricultural productivity improved enough to keep the relative price of food constant. But if, all other things being equal, the prices of staple foods increased because of demand for biofuels, as the IFPRI projections suggest they will, the number of food-insecure people in the world would rise by over 16 million for every percentage increase in the real prices of staple foods. That means that 1.2 billion people could be chronically hungry by 2025 -- 600 million more than previously predicted.

The Price of Failure to Increase Food Production Sustainability

Our most basic needs, food, housing and clean water, are the cornerstones of human civilization. Arguably, much of the economic progress of developed areas of the world has been achieved by making food less expensive and more abundant. In developing countries a high proportion of labor and income are still required just to produce basic food, leaving little for other goods and services.

In advanced countries a small proportion of labor is needed to produce food, and more income can be devoted to other goods and services. In modern economies typically well under 5% of the population is employed in basic agricultural production and less than 20% of consumer spending is required for food. In the U.S. only about 1% of the population is employed on farms and about 10% of income is spent on food. Of that 10% over half is spent on meals away from home, adding significantly to the total food bill.

Food demand is notoriously price-inelastic. That is, a 1% decline in per capita food production will result in a much larger percentage increase in food prices. If we do not increase food production per unit of land the per capita food supply will fall. In that case real (inflation corrected) food prices will rise.

What are the potential consequences rising real food costs?

In developed economies we would mainly see living standards decline somewhat as income is diverted to food and away from all other goods and services. That is, we would have less real income to spend on discretionary items such as recreation, travel, and entertainment.

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[10] C. Ford Runge and Benjamin Senauer. "How Biofuels Could Starve the Poor". *Foreign Affairs*. May/June 2007

In the U.S. food accounts for 13.8% of the Consumer Price Index market basket[11] and consumption spending in 2007 was about $10 trillion[12]. A 10% increase in real food prices would absorb approximately $138 billion of 2007 purchasing power from the non-food economy and would reduce real GDP by about 1%. While this is a real loss, it would not cripple the economy.

The impact of rising basic food production costs in the developed world would also be buffered by the high amounts of value-added services added to the retail value of commodities. The value of agricultural commodities in a purchased loaf of bread the U.S. is very small, less than 5%. Meat and poultry have a much higher share of farm commodity cost, and would bear the brunt of higher production costs. We would also likely see consumers move to purchases of more basic foods and lower value-added food products. The away-from-home food sector could be particularly hard hit.

Even in the richest of countries there is poverty, and that segment of the population is at highest risk from rising food costs. What would be an inconvenience for the majority could be malnutrition for those on the lowest rung of even the richest societies.

In low income countries the effects of rising real food costs are potentially devastating, especially for those in urban areas who rely on purchased food. There is little of the value-added buffer seen in the developed world. Food purchases are much more basic, and highly correlated with commodity costs such as wheat, corn and rice.

Social impacts of higher commodity costs are already being seen. In late 2007 and early 2008 we have seen food riots break out in many Third World countries[13].

Regardless of the cause – biofuels or lack of increases in land productivity – failure to meet the world's increasing food demand could cause widespread political and social unrest. Decades of food supply progress and increases in living standards are at risk. Unless we can find a way to manufacture productive land to grow more food the only way forward is to make the best use of the land we have.

Failure to do so will fulfill the Malthusian vision of a hungry world with a global population limited by the ability to produce food.

Solutions Imply Increased, Not Decreased, Land Productivity

The conflict between increasing food demand and limited land resources can be solved in one of only two ways. We either need to reduce the rate of growth of demand or increase production. Production can be increased by either increasing productivity or bringing more land into production.

Demand-Side Strategies: Food demand is driven by two major forces, population and income. Annual population growth rates are declining, but we still project about a 38%

[11] Bureau Of Labor Statistics. "CPI Detailed Report-March 2008". P. 9
[12] Bureau of Economic Analysis. Survey of Current Business. April, 2008. P. D-3
[13] http://www.cnn.com/2008/WORLD/americas/04/14/world.food.crisis/

increase between now and 2050. If we do not increase food production, population growth will likely be less than 38% due to increased death rates and reduced life expectancy in high risk, low income, populations. The consequences of reducing food demand via a population reduction and starvation strategy are likely not acceptable.

Income increases will drive per capita food demand (especially animal protein demand) higher, as shown in Table 2. Forcing changes in food demand behavior will be difficult, and could involve reducing basic freedoms of individual market choice. Reducing global economic growth to alleviate pressures on food demand is not an attractive alternative either.

Higher prices would actually help change consumption patterns, and are an important part of the demand side of the solution. To the extent that producing animal-based food is more land-intensive, and expensive, than vegetable-based food the price mechanism will give consumers an incentive to reduce growth rates of meat consumption. The income-based projections for per capita meat supplies in Table 2 do not account for potential effects of increased prices. If meat prices rise relative to other foods the projections in Table 2 will be too high.

Supply-Side Strategies: Strategies aimed at increasing food production revolve around the limiting resource, land. Either we need more land devoted to food production, or we need to produce more from current agricultural land, or both.

Increasing food production by bringing more land under cultivation is limited by the availability of suitable land and the productivity of marginal lands. Much of the remaining potential for agricultural land is in environmentally sensitive rain forests and wetlands. Increasing crop land via irrigation of arid and semi-arid area is expensive. Limited groundwater supplies and buildup of salt in arid soils also make increased irrigation unsustainable in the long run.

Nonetheless, increases in real food prices will result in clearing of forests and conversion of marginal lands to crops. We are already seeing documented increases in rates of deforestation in Brazil[14] and Indonesia[15] caused by higher commodity prices. Cleared acreage is going into soybeans, rice, palm oil and pasture. In addition, in Argentina and Brazil pastures are being converted into crop land. Indonesian wetlands are being drained for palm oil and rice plantations.

Increases in crop land will help increases food supplies, but there is not enough land to meet the additional demand for food, much less increase per capita supplies. A major part of the supply-side strategy has to be increased productivity of all land employed in food production.

Productivity of land needs to be looked not just as yields of crops per acre, but rather from a total food production system viewpoint. Yields are a key factor, but what happens to food crops after they leave the farm is also a key to increasing food output.

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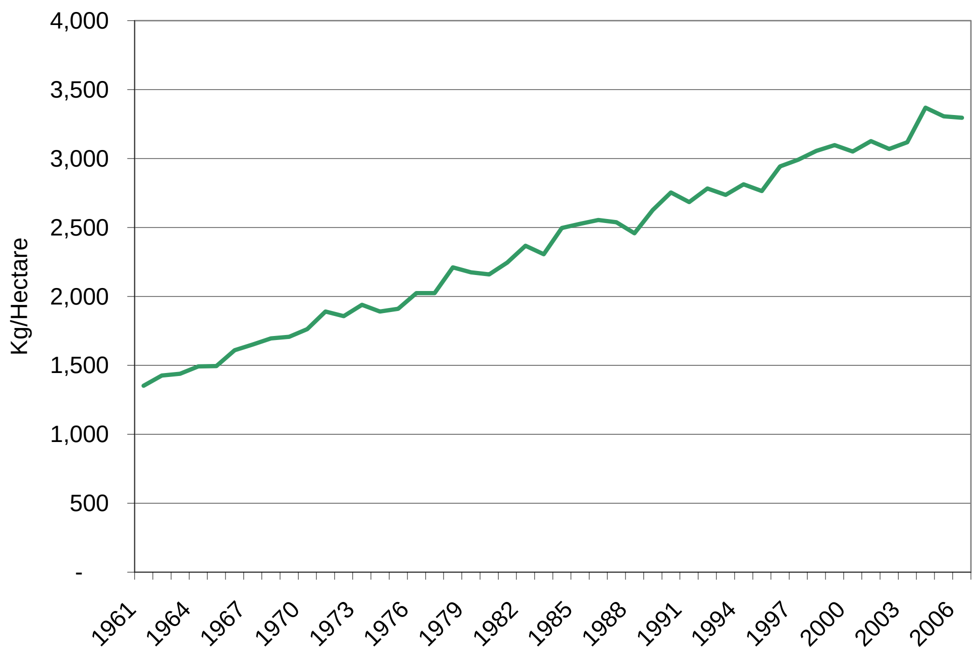
[14] BBC. http://news.bbc.co.uk/2/hi/americas/7206165.stm
[15] http://news.mongabay.com/2008/0117-biofuels.html

Crop Yields: Genetic and agronomic advances have been increasing food crop yields at a steady rate since the 1960s. FAO data show that average yields for cereal grains have grown from 1,352 kilos per hectare in 1961 to 3,296 in 2006 (Figure 5). The average compound rate of yield growth was about 2% per year, enough to more than offset population growth.

Figure 5: Global Average Cereal Grain Yields per Harvested Hectare[16]



Maintaining, or increasing, the future rate of yield increases for cereal grains will be one key to providing an adequate food supply. Future advances in yields will likely require increased use of direct genetic modification of plant traits and breeding for increased drought, disease and insect resistance. Breeding for salt resistance would open the possibility of use of sea water for irrigation.

Soil fertility is also a key to increasing crop yields. Reliance on chemical fertilizers will continue, but efficiency of their use can be increased with modern application equipment. Soil fertility is also sensitive to cultivation practices. Reduced and no-till production systems can dramatically reduce erosion soil nutrient losses and increase long term yield potential.

Organic production systems typically have yields that are less than those that use chemical fertilizers and crop protection chemicals. Increasing production of low-yield, high cost, organic crops would be detrimental to efforts to meet global food needs.

A recent winner of the annual U.S. corn yield contest had a yield of 21.8 tons per hectare (347 bushels per acre), 125% more than the national average. The potential to

[16] FAO. FAOSTAT. Average rice, wheat, coarse grains and miscellaneous grains yields. 4-23-08

increase yields is present even in current genetics. The key may lie as much in capturing current yield potential as it does in improvements in genetics.

Reduced Crop Waste and Loss: Field, harvest, and post-harvest losses significantly reduce the amount of crops that actually make it to the end of the food supply chain and into consumed food products. Diverse losses to insects, plant diseases, rodents, birds, spoilage, civil wars and simply discarding of unused food may account for 25% or more of potential production[17]. Reducing this waste would go a long way toward increasing available food supplies.

One controversial technology that could both reduce spoilage and increase food safety is irradiation. Extended shelf life and reduced refrigeration requirements of irradiated foods could significantly reduce waste and lower transportation and storage costs.

Government Policy: Agricultural policies in many 3rd world countries actually discourage producers from participating in the food market. Excessive taxes, price controls and land policies can provide disincentives to food production.

Developed country policies that subsidize food exports can reduce production incentives in countries receiving the subsidized food. Biofuels subsidies such as the U.S. ethanol mandates, tax credits and tariffs may encourage additional production, but are a net subtraction from food supplies.

Increasing Efficiency of Post-Harvest Crop Utilization: Crops, once harvested, must be transformed into foods for human consumption. Crops that are consumed in raw form or minimally processed have little room for efficiency improvement other than reduced spoilage and waste.

Crops that are heavily processed or used in animal agriculture feeds could benefit from increased post-harvest efficiency. Research has had a major long term impact on the efficiency of feed use in animals. Improved genetics, animal husbandry systems and diets have reduced the amount of feed required to produce a given amount of pork or chicken by about half over the last century. Improvements in animal efficiency have the same effect on the food supply as increasing crop yields. That is, more efficient meat production means more food is produced per acre.

Unfortunately, these improvements in animal production have not been universally adopted. Beef, pork and poultry production systems in many developing countries are far less efficient than is technically possible. For example, Russian broiler chicken farms can use 50% more feed per kilo of broiler produced than is the standard in the U.S. and Europe[18]. Bringing the efficiency of animal production up to current standards would reduce wasted feed and increase food supplies in areas of the world that are most in need.

[17] EarthTrends.org. http://earthtrends.wri.org/features/view_feature.php?theme=8&fid=13
[18] http://www.tacisinfo.ru/en/case/poultry/index.htm

Improving farm animal heath through more effective disease prevention and treatment can also reduce wasted feed and increase food production. A viral disease outbreak affecting pigs in China that started in 2005 has killed millions of animals[19]. The effect on the Chinese pork supply has been so severe that retail pork prices have doubled and the inflation rate is at a 12 year high. Pig death losses have been so severe that pig feed consumption has actually declined. Nonetheless, disease outbreaks still represent lost food production.

Production aids used in animal agriculture also play a role in increasing food production per acre. Feed additives that include vitamins, minerals, amino acids and growth enhancers all reduce the amount of feed required to produce animal protein. Use of animal health one product – Rumensin – is estimated by FarmEcon LLC to have reduced corn fed to U.S. cattle by about 75 million metric tons between its introduction in 1975 and the end of 2007. In perspective, 75 million tons would provide 450,000,000 people 1 pound of corn per day for a year. A small 5% improvement in U.S. feed efficiency in hogs would free up about 1.7 million metric tons of corn per year, or the production from 430,000 acres of U.S. corn.

Improving meat and poultry production per acre utilized represents an enormous opportunity to augment world food supplies without the need to use more land.

Summary

Opportunities to increase food supply sustainability via increased land productivity are many and varied. No doubt, recent increases in food commodity prices will help provide price signals that will change consumption patterns and reduce waste. The same price increases will provide producers the means and incentives needed to implement current best production practices on a wider basis.

Still, much remains to be learned about increasing food production from the resources we have at hand. Biofuels represent a totally new challenge to sustainable food supplies, and have the potential to derail the progress of the last 50 years.

The record of progress in food production over the last century has been nothing short of remarkable. We will need to duplicate that effort over the next century, or run the risk of living in a hungrier, less secure, world.

[19] The Economist. http://www.economist.com/world/asia/displaystory.cfm?story_id=9687970