AgBioForum – Volume 2, Number 3 & 4 – 1999 – Pages 150-154

BIOTECHNOLOGY AND THE VALUE OF IDEAS IN ESCAPING THE MALTHUSIAN TRAP

Gregory Conko & Fred L. Smith, Jr.[1]

Agronomists have used increasingly sophisticated genetic manipulation of agricultural plants to ensure that food production has outpaced population growth. Biotechnology, the newest stage in that process, is jeopardized by unfounded concerns that it could harm human health or the environment. To continue feeding a growing population, world farmers and consumers must embrace biotechnology, or sacrifice other environmental priorities.

Key words: agriculture; biotechnology; developing countries; habitat preservation; Thomas Malthus; population growth; public policy.

On October 12, 1999 United Nations demographers lamented the symbolic birth of planet Earth's six-billionth resident. The world's population had doubled from three billion in less than 50 years. And though the rate of growth is slowing, population is projected to reach nine billion in another 50 years (Population Division, 1999). Many planners express the traditional Malthusian fears that the earth's ability to feed, clothe, and provide other necessities of life for humanity's growing numbers will soon be surpassed.

While it is indeed wise to recognize the challenge of feeding an additional three billion people, mankind's ingenuity has already provided us an indication of how this can be done. The solution is to ensure that we further liberalize the forces of institutional and technological change that have done so much over the last several centuries to enhance agricultural productivity. Biotechnology is certainly the most promising of these changes. Widespread use of the technologies for recombining plant DNA can help farmers feed the World's growing population, and provide substantial environmental benefits as well.

The fears raised about population growth are not new. Some 200 years ago, the Reverend Thomas Malthus wrote in his Essay on the Principle of Population that, if mankind's blind biological urges were left unchecked, population would increase in a geometric fashion and quickly exhaust the finite resources of nature. "The power of population is indefinitely greater than the power in the earth to produce subsistence for man" (Malthus, 1990). Land could be made more productive with more intensive cultivation, but with diminishing marginal returns. Eventual widespread famine was the inevitable fate of mankind.

[1]*Gregory Conko is an Economic Policy Analyst at the Competitive Enterprise Institute and Fred L. Smith, Jr. is the President of the Competitive Enterprise Institute.*

The Malthusian notion is intuitively appealing. Earth has a finite landmass, and much of it is unsuitable for agriculture or housing. If nothing changes -- if we continue to use resources as we do today -- then we will indeed "run out" of food. But we need not be content with our current state of knowledge, our current ability to use land to feed ourselves. Indeed, that point eventually came to be realized by Malthus himself. His later work noted that -- under the right circumstances and within appropriate institutional structures -- impending scarcity could stimulate creative responses to mitigate or curtail resource depletion (Petersen, 1990).

Productivity entails more than simply converting resources into useable products; it means using better ideas -- the products of man's ingenuity -- to make more with less. "The wellsprings of economic growth are new ideas. People actually improve their lives not through simply using more physical resources, like land, timber, or oil, but by discovering better ways of doing things and novel inventions" (Bailey, 1999). Ideas are invaluable resources because they can be shared, used again and again, and improved upon, all at no additional cost. Most importantly, "humanity cannot deplete the supply of new ideas, designs, and recipes" (Bailey, 1999).

And so it is with agricultural productivity. World farmers did not feed the vastly increased population over the last 50 years by devoting substantially more land or labor to agriculture. Increased food supplies reflect improved crop yields per hectare of arable land. Scientists, such as Norman Borlaug and M. S. Swaminathan, along with agronomists from the Consultative Group for International Agricultural Research centers, and a host of other academic and independent scientists working with government researchers and private corporations, have greatly improved the world's knowledge of how to breed better plants and animals, and how to produce and better use herbicides, pesticides, and fertilizers. In 1950, world average grain yields were only 1.1 tons per hectare. By 1992, they had risen to 2.8 tons per hectare (FAO, 1992).

But just as some fear the "Gene Revolution", so also did critics of the Green Revolution argue that change was disruptive to traditional societies, that the new technologies were too expensive or environmentally disruptive and hazardous for the peoples of the developing world (Shiva, 1992). Many critics feared that the large-scale use of synthetic pesticides, herbicides, and fertilizers would reduce biodiversity by introducing new toxins into the environment. Others feared that more productive agriculture might encourage the expansion of agriculture into more environmentally sensitive areas, reducing the availability of wildlife habitat.

Of course, the Green Revolution has created some new environmental problems. But it has reduced others. The higher yields made possible by the Green Revolution have allowed farmers to concentrate production on the best cropland. On balance, Green Revolution technologies have promoted environmental values by feeding billions of people without the need for much additional land – an important achievement in advancing the overall goal of biodiversity.

By one estimate, improved crop yields from these Green Revolution technologies have prevented the conversion of some 3.6 billion hectares of land to agricultural uses since 1961. That would have nearly doubled world cropland from 34 percent of the earth's surface (excluding Antarctica) to 61 percent (Goklany, 1999). "If our technologies had remained stuck in the past and if somehow the world's population had nevertheless been able to grow to its current level, the impact of humanity on the natural environment would have been calamitous" (Bailey, 1999). Technology has proved both economically and ecologically valuable.

Yet even during the era of sustained ecological and economic progress, the Neo-Malthusians continuously warned of impending doom. In the very midst of the Green Revolution, Stanford University biologist Paul Ehrlich wrote in his 1968 bestseller, The Population Bomb, that "The battle

to feed all of humanity is over. In the 1970s the world will undergo famines – hundreds of millions of people are going to starve to death in spite of any crash programs embarked upon now" (Ehrlich, 1968).

The world has experienced severe famines in this century, but they have not been caused by a general lack of food (and have not taken hundreds of millions of lives). Rather, they have resulted from political turmoil and non-democratic governments. The work of Nobel Prize-winning economist Amartya Sen demonstrates the importance of liberal democracy, the rule of law, and respect for individual rights in ensuring the coordination and delivery of basic economic goods (Sen, 1981). At current levels, world food production could provide more than 2,500 calories every day for all six billion people (Goklany, 1999). Ensuring true food security in a world of nine or ten billion, however, will require more than just redistribution.

As if on cue, modern Malthusians have renewed their doomsday message. Yes, we have kept up to date, but *now* (they insist) all possible productivity gains have been exhausted. *Now* disaster lies just around the corner. Consider the recent writing of WorldWatch Institute founder Lester Brown;

> History will likely see the four-decade span from 1950 to 1990 as the golden age in raising world cropland productivity. But the slowdown since then does not come as a surprise, given the inability of scientists to develop a second generation of high-yielding grain varieties that will again double or triple yields. (Brown, *et al*., 1999).

It will be possible to achieve additional productivity improvements through conventional hybridization. But cross-breeding is a lengthy and imprecise process, and many improvements simply may not be possible with these older techniques. Alternatively, recombinant DNA engineering is much more flexible, precise, and powerful than these earlier methods of genetic manipulation. Because desirable genes coding for specific phenotypical expression from one species can now be more readily identified and integrated into more distant plants and animals, it is very likely that biotechnology could generate the necessary yield increases.

To date, commercially cultivated biotech crop plants have been targeted at farmers in the developed world. The most common ones have been altered to tolerate glyphosate, bromozinil, and glufosinate herbicides or to express a *Bacillus thuringiensis* protein, building a pesticide into the plant itself. The future of biotechnology, however, lies in addressing the special problems faced by farmers in the developing world.

Scientists have already identified genes for resistance to common plant diseases and viruses, for drought and cold tolerance (Wambugu, 1999), and for metals and salt tolerance (Moffat, 1999), and, in some cases, have successfully transferred them into crop plants. Once commercially available, farmers in developing countries, where the soils are poor and the climates harsh, are likely to experience dramatic gains. These improvements are especially important, because as developing nations advance economically, they are unlikely to be satisfied with subsistence-level diets. Though world population is expected to increase by only half, the larger, wealthier population of the year 2050 can be expected to demand more than twice the amount of food produced today (Goklany, 1999).

We should note that the exact rate of productivity improvement is important. If the average annual increase in per hectare productivity is just one percent, the world would have to bring more than 300 million hectares of new land into agricultural use by the year 2050 to meet expected demand; in contrast, a productivity increase of 1.5 percent could double output without the need for additional cropland (Goklany, 1999).

Recombinant DNA (rDNA) techniques offer realistic hope of also improving the nutritional benefits of many foods. Though the bulk of research has focused on increasing crop yields, improving nutritional value is of key importance. Staple crops are good sources of energy, but they are not good sources of micronutrients. The diet of more than three billion people worldwide includes inadequate levels of many important micronutrients such as iron and vitamin A. Deficiency in just these two micronutrients can result in severe anemia, impaired intellectual development, blindness, and even death (DellaPenna, 1999).

Farmers in the developing world often do not have the luxury of growing a variety of produce. Fortunately, research into improving nutritional value of staple crops is well underway. Perhaps the most promising recent advance in this area is the development of a rice variety that has been genetically enhanced to increase the level of bioavailable iron and to add beta carotene. The research was funded primarily by the New York-based Rockefeller Foundation, which has promised to make the rice available to developing world farmers at little or no cost (Rockefeller Foundation, 1999).

Although the complexity of biological systems means that some promised benefits of biotechnology are many years away, the biggest threat that hungry populations currently face are restrictive policies stemming from unwarranted fears that plants genetically enhanced through rDNA technology pose a unique threat to human health or the environment. Recombinant DNA-engineered foods have been among the most closely scrutinized products in memory. They are carefully tested for adverse environmental effects and for possible human allergenicity and toxicity. Biotechnology crops are planted on more than 70 million acres worldwide, and biotechnology foods have been consumed in the United States, Australia, and Europe for several years without any recorded adverse effects (Wambugu, 1999). In short, there is no scientifically valid reason to believe that the processes of genetic recombination (as opposed to certain conceivable products) pose any heightened risk.

All change poses some risk. But the minor risks that exist with innovation must be balanced against the massive risks of technological stagnation. The Malthusians have never been right – but the policies they promote could indeed create the disaster they fear. We live in an “Alice In Wonderland” world where we must run to stay in place – we must run much faster to get ahead. For the last few centuries, mankind has indeed run ever faster and has benefited accordingly.

We cannot, of course, be certain that these gains will persist – that mankind’s imagination and ingenuity will not flag. But mankind has faced comparable challenges throughout history. Man creates problems, but he also solves problems. In the relatively free societies that have led the world in the last few centuries, man’s ability to imagine and implement technological advances has made it possible to better feed, clothe, and supply energy to ever more people throughout the world. Ensuring that biotechnology remains a viable tool to continue this process is critical. Yet, that requires that the anti-technology policies promoted by our modern Malthusians be defeated.

References

Bailey, R. (1999). The progress explosion: Permanently escaping the Malthusian trap. In R. Bailey (Ed.). Earth Report 2000: The True State of the Planet Revisited (pp. 1-21). New York: The Free Press.

Brown, L.R., Flavin, C., French H., *et al*. (1999). State of the World 1999. New York: W.W. Norton & Company.

DellaPenna, D. (1999, July 16). Nutritional genomics: Manipulating plant micronutrients to improve human health. Science, 285, 375-379.

Ehrlich, P. (1968). The population bomb. New York: Sierra Club-Ballantine.

FAO (1992). FAO production yearbook 1992. Rome: Food and Agriculture Organization.

Goklany, I.M., (1999). Meeting global food needs: The Environmental trade-offs between increasing land conversion and land productivity. Technology, 6, 107-130.

Malthus, T.R. (1990). An essay on the principle of population. (P. James, Ed.). London: Cambridge University Press. (Original work published 1798).

Moffat, A.S. (1999, July 16). Engineering plants to cope with metals. Science, 285, 369-370.

Petersen, W. (1990). Malthus: The reactionary reformer. The American Scholar, 59: Spring, 280.

Population Division (1999). The world at six billion, (Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, Working Paper ESA/P/WP 154). New York: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat.

Rockefeller Foundation (1999, August 3). New rices may help address vitamin A and iron deficiency, major causes of death in the developing world, Press Release, New York: Rockefeller Foundation.

Sen, A. (1981). Poverty and famines: An Essay on entitlement and deprivation. New York: Oxford University Press.

Shiva, V. (1992). The violence of the Green Revolution: Third world agriculture, ecology and politics. London: Zed Books.

Wambugu, F. (1999, July 1). Why Africa needs agricultural biotech. Nature, 400, 15-16.