Letters

Conservation and Agricultural Economics

R. M. Goodman *et al.* (Articles, 3 Apr., p. 48) overlook a major—but avoidable—indirect environmental threat posed by genetic engineering. Tropical wildlands and most of the earth's contemporary species still exist because humanity has not had organisms capable of converting all tropical land surfaces to profitable agriculture and animal husbandry. Within one to three decades, organisms modified through genetic engineering will be capable of making agriculture or animal husbandry, or both, profitable on virtually any tropical land surface. Agricultural inviability, the single greatest tropical conservation force, will be gone.

Where the soil is fertile and the climate good, almost all tropical forest has been lost. However, fertile soil and good climate are not intrinsic traits. Those descriptors mean that a plant or animal of use to humans can be profitably grown there. The earth's tropical forests were once about 40% rain forest and 60% dry forest. Today, the dry forest is essentially obliterated by agriculture and anthropogenic fires, while we still anguish over the ever-increasing loss of rain forest. Where dry forest once stood is where tropical humanity grows cotton, corn, rice, peanuts, cassava, sorghum, millet, beans, cows, and horses in high-yield lowland fields and pastures. When genetic engineering gives us crop plants and animals that thrive in the various tropical rain forest habitats, it is "goodbye, rain forest." The power to finally obliterate the wildlands that have always been an integral part of our intellectual and economic lives has finally appeared and is undergoing intense development.

Today's tropical wildland reserves were established by arguments that were not economically robust. These reserves are almost always on lands that have been subject to low pressure for agroconversion: steep slopes, inaccessible terrain, swamps, cation-poor soils. Now, the question changes to which and how much wildland acreage is to be explicitly unavailable for use by the next wave of genetically engineered plants and animals to sweep across the tropics. Such wildlands must be evaluated for conservation on a basis other than their potential cash production. No matter how valuable a park or reserve may be at the moment, a time will come when the potential cash production by agriculture on that land exceeds the cash production from that land in a wildland state (through tourism, seed and gene banks, education, intellectual stimulation, and so forth). The economic flush that will be generated in the tropics by genetic engineering will wash away most of the wildlands that are today protected only by economic inviability.

While the tropics will be a very dull place once the wildlands—their species and their fragile assemblages—have been removed, there is also a major economic concern. The new and self-replicating organisms will be in the hands of billions of tropical farmers and entrepreneurs. An enormous amount of wildland genetic information will be obliterated overnight. And it is precisely this diverse and exotic genetic information that will be most eagerly sought by the genetic engineering industry once we are past the stage of simply making better beef, beans, and corn. It is very much in the selfish interests of this growing industry to join forces with the conservation community. Goodman *et al.* anticipated this point with their statement: "We must preserve the raw material from which our successors will work" (p. 54).

This is not a call for the cessation of genetic engineering. Humanity has been using genetic engineering since the first grandmother saved the biggest bean seeds for next year's crop and a more docile wolf was kept as a camp animal. This is a call for mutualism between the forces of conservation and those of agricultural economics. Humanity cannot exist without its coevolved mutualists or without the wildlands from which they came.

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Response: We share with Janzen a profound concern about the future stability of tropical (and nontropical) habitats—for genetic, aesthetic, climatic, and many other reasons. The loss of wildlands, at least in part to agriculture, over the past century is a well-established fact. We are less certain than Janzen about the actual causes of this loss. And we are far less sanguine than he appears to be about the imputed power of genetic engineering to "obliterate the wildlands" and generate an "economic flush" in the tropics. Nevertheless, we agree that if the success of new genetic technology makes possible productive agriculture on lands now considered (for agriculture) marginal or inhospitable, we must find other compelling ways to prevent further losses of the treasures that wildlands represent to the future of humanity.

If we overlooked this "indirect environmental threat," it was frankly because we consider it so unlikely. A more likely scenario, in our view, would be that improvements in productivity and efficiency and reduction in production risks and postharvest losses might decrease the total amount of land needed to support a given population, thereby relieving rather than creating added pressure on land use. We may be naïve in thinking so, but we suspect that it is politics and population pressures more than agricultural technology that have actually caused the lamentable loss of dry forest wildlands in the past.

We wholeheartedly agree that agriculture and the conservation community should be allies. The recent reaction, especially in rural America, to agriculture's contribution to chemical pollution of the environment and the attention agriculture is now getting from national and international policy communities are two indications of movement in that very direction. And we think new genetic technology will have a central role in making possible what will become necessary—a steady movement toward long-term, sustainable, highly productive agriculture that will reliably support a stabilized world population.

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Biotechnology and the Environment

Frances E. Sharples' Policy Forum (13 Mar., p. 1329) is based mainly on selected analogies that have alarmist consequence, while the companion piece by Bernard D. Davis (13 Mar., p. 1329) is based on firm evolutionary and microbiological principles. Sharples ends by stating that she is not an alarmist; but she uses the example of the AIDS problem to indicate that a recombinant microorganism may produce something "with 'new' and unanticipated properties." At no time in the many decades of experience with mutated organisms and 15 years of experience with recombinant organisms has there been any evidence of a laboratory-altered organism causing a problem even remotely comparable to the AIDS virus.

Most of the examples Sharples uses to argue the "dangers" from testing recombinant microorganisms in the field are not relevant. For instance, feral goats and rabbits are not problems resulting from man's alteration of the animal's genes. Undomesti-