# *Environmentally Sustaining Agriculture: A Response*

by Fred Hitzhusen and Craig Davis

The underlying premise of Dennis Avery's argument is stated up front: "The biggest danger to the world's natural environment today is low-yield agriculture." Alternative assertions certainly exist. There are those who believe that growth in human population and the resulting increased consumption is the primary culprit. Others hold that increased consumption of energy, particularly the combustion of fossil and biomass fuels, is at fault. Finally, economic growth and sunspots also have their advocates as primary threats to the world's natural environment. It is unlikely that any of these single-factor causation assertions, including Avery's, is sufficient to explain the health status of something as complex as the global environment.

Let's look more closely at the Avery argument. He assumes that 9–10 billion (peak) future human inhabitants will adopt "modern" lifestyles and be rich enough to eat large quantities of resource-costly foods: meat, milk, eggs, fruits, and vegetables. Low-yield agriculture cannot meet this demand and is the primary cause of environmental degradation because it requires the conversion of more and more marginal land to cropland and thus displaces wildlife habitat. Avery's answer is to invest heavily in yield-increasing technologies on prime agricultural land and rely on global free trade to satisfy rapidly increasing food and fiber demands.

It is certainly more comforting to hear optimistic versus pessimistic futurist forecasts. However, Avery's future scenario is particularly dependent on major increases in per capita income among the world's poor; significant increases in environmentally benign, yield-increasing technologies for food and fiber production on prime agricultural lands; and a global free trade regime. It also assumes a peak global population of 9–10 billion and equates saving wildlife habitat on marginal lands with protecting the global natural environment. Let's take these points in order.

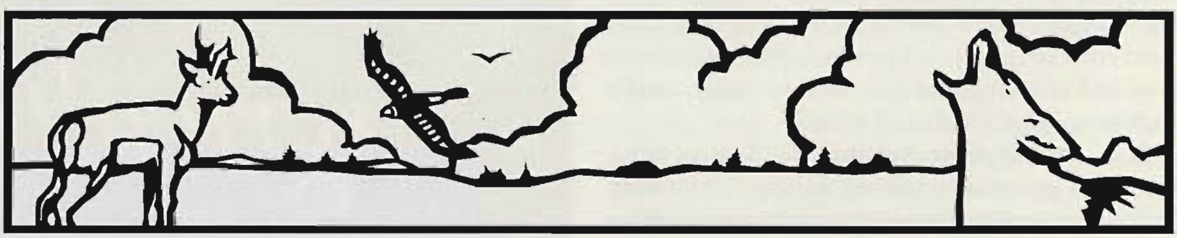
Per Pinstrup-Anderson of the International Food Policy Research Institute (IFPRI) points out the severity of poverty in today's world where more than a billion people earn less than a dollar equivalent a day and are unable to buy the food they need. In developing countries, more than 800 million people lack access to the food they need for healthy and productive lives. One-third of all preschool children in developing countries—185 million—are malnourished. This is a far cry from Avery's 9–10 billion future inhabitants on planet earth rich enough to adopt modern lifestyles and eat resource-costly foods grown primarily on prime agricultural lands in developed countries and purchased in global markets. A more pessimistic scenario is suggested by Goodland et al. where political realism rules out income redistribution and population stability and the world economy must expand by a factor of five or ten in order to alleviate poverty, which these authors see as ecologically unsustainable.

Pinstrup-Anderson and his colleagues argue that the poverty issue must be directly confronted by "expanding investments in less favored geographical areas, that is, areas with agricultural potential, irregular rainfall patterns, fragile soils and many poor people." The IFPRI researchers also call for investment in primary education and health care, clean water and sanitation, empowerment of women, improved access to productive resources, and expanded employment. These recommendations are very similar to those from the World Bank's *World Development Report of 1992* on development and the environment if one adds population programs, local participation, and open trade and investment policies.

The future prospects of more environmentally benign, yield-increasing techniques for food and fiber may be better than the prospects for elimination of poverty. However, agricultural intensification or yield-increasing technologies do bring potential water quality problems from increased sediments, fertilizers, and pesticides even if soil erosion is reduced by focusing on prime agricultural lands. Research by Zhao, Hitzhusen, and Chern found land degradation (wind and water erosion, salinization, loss of organic matter, compaction, etc.) in twenty-three developing countries resulted in slower growth in agriculture and food production from 1971 to 1980. Only price distortions retarded growth more. Furthermore, their research did not account for the off-site effects of land degradation. Hitzhusen, Veloz et al., and others have found that the off-site environmental economic impacts of agricultural intensification and land degradation frequently exceed the on-site impacts. A more inclusive accounting stance that recognizes entire watersheds and aquifers is necessary if economically and ecologically sustainable food production systems are to be developed.

In his discussion of the biodiversity foundations for his proposals, Avery exposes his lack of understanding of biodiversity and its causes, confusing the conservation of wildlife and wild lands with the more general and critical concerns of conserving overall biodiversity. His ecological arguments are built exclusively on the work of ecologist Michael Huston, who has documented examples of the generally accepted inverse relationship between soil productivity and plant species diversity. Houston shares Avery's views on the potential for saving species diversity by intensively farming the most fertile lands.

Margules and Gaston, among others, challenge Houston for what they see as his use of plant species diversity as a "surrogate" for biological diversity. The correlation between soil productivity and plant species diversity does not hold for many or most other species. Bird diversity, for instance, is not at all related to plant species diversity or, therefore, to soil productivity. MacArthur and MacArthur have shown that diversity of bird species seems to be a function of the structure of the vegetation. Big trees harbor more bird species than do smaller trees. Different bird species will occupy different levels within the tree canopy, or some bird species will occupy limbs close to the trunks, whereas others will live farther out. Indeed, Huston



acknowledges in his *Science* article that there are other "important components of biodiversity, such as large marine vertebrates, predatory birds and mammals that seem to reach their highest diversity in productive areas." It should be noted that these creatures are examples of the "wildlife" that Avery plans to preserve by converting the most productive lands to intensive agriculture. Huston, however, suggests that "conservation of these components of biodiversity may require a decision to set aside land that could otherwise be used for productive agriculture."

The construction of social policy on the basis of selective use of what we understand about the causes of biological diversity is poor science and makes for poor policy. The biological or species diversity that exists or could exist on any plot of land is a function of a myriad of interacting physical and biological factors, only one of which is soil productivity (see Meffe and Carroll, National Research Council, Putnam, and Wilson for general reviews). On a broad scale, species diversity generally increases as one moves from the poles to the equator or from high elevations to low, and within any region, larger areas generally will have higher diversity than smaller areas. Species diversity also tends to be higher where the landscape and vegetation structure is heterogeneous, as mentioned above for bird species. Stable climatic conditions tend to foster increased species diversity, and biologically productive sites tend to support greater overall species diversity, although there are notable exceptions to these generalities. Moderate disturbance can also enhance species diversity, but diversity also tends to be higher on sites that have been stable for long periods of time. So, species diversity at any site at any time is a function of climate, latitude, elevation, soil productivity, biological productivity, spatial and temporal heterogeneity, temporal stability, and disturbance regimes. It is not surprising that ecologists and biologists do not always agree on causes and effects and have great difficulty predicting how best to protect and enhance biodiversity. Certainly, caution and prudence should be used in promoting social policy changes in the face of such scientific uncertainty.

In summary, few can argue with Avery's notions that low-yield agriculture, in contrast to high-yield agriculture, requires more cropland to produce the same amount of food, that we need more agricultural research, and that more open trade promotes more efficient resource use and economic growth, at least in aggregate or per capita terms. Our main criticisms are that he understates the potential downstream environmental impacts of agricultural intensification, overlooks the extreme difficulty of fostering and targeting economic development to reduce extensive poverty in much of the developing world, and grossly oversimplifies the complexity of the underlying causation of species distribution and abundance. As a result, his policy recommendations fall short of resolving serious global poverty and environmental problems. **C**

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