POLICY FORUM: GLOBAL FOOD SUPPLY

Food Production, Population Growth, and the Environment

Gretchen Daily, Partha Dasgupta, Bert Bolin, Pierre Crosson, Jacques du Guerny, Paul Ehrlich, Carl Folke, Ann Mari Jansson, Bengt-Owe Jansson, Nils Kautsky, Ann Kinzig, Simon Levin, Karl-Göran Mäler, Per Pinstrup-Andersen, Domenico Siniscalco, Brian Walker

There are two broad criteria by which one can judge humanity's success in feeding itself: (i) the proportion of people whose access to basic nutritional requirements is secure, and (ii) the extent to which global food production is sustainable. Even though the two are related, they have usually been discussed separately in popular writings. This has had unfortunate consequences. Writings on the sustainability of the food supply have often encouraged readers to adopt an all-or-nothing position (predicting a rosy or a catastrophic future), which has drawn attention from the economic misery endemic in large parts of the world. On the other hand, writings on the adequacy of the world's food supply frequently conclude with the truism that the nearly 1 billion people in poor countries who go to bed hungry each night do so because they are extremely poor. In short, the second "sustainability" approach has focused on aggregate food production and its future, whereas the first has isolated food-distribution failure as a cause of world hunger. Here we argue that these two questions should not be studied separately, that their link is revealed in the interactions between ecological and economic systems operating primarily at the geographically localized level, and that policy interventions must target this link.

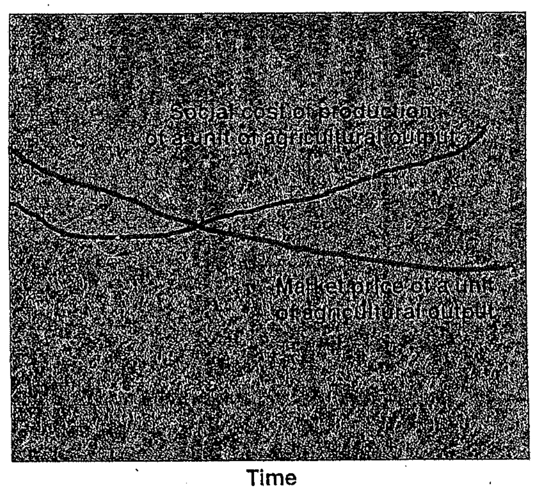
G. Daily and P. Ehrlich are in the Department of Biological Sciences, Stanford University, Stanford, CA, USA. P. Dasgupta is on the Faculty of Economics and Politics, University of Cambridge, Austin Robinson Building, Sidgwick Avenue, Cambridge CB3 9DD, UK (E-mail: Partha.Dasgupta@econ.cam.ac.uk); at the Beijer International Institute of Ecological Economics, Stockholm, Sweden; and at Resources for the Future, Washington, DC, USA. B. Bolin is at the Department of Meteorology, University of Stockholm. P. Crosson is at Resources for the Future. J. du Guerny is at the Food and Agriculture Organization, Rome, Italy. C. Folke, A. M. Jansson, and N. Kautsky are at the Department of Systems Ecology, University of Stockholm, and the Beijer International Institute of Ecological Economics, Stockholm. B.-O. Jansson is at the Department of Systems Ecology, University of Stockholm. A. Kinzig is at the Princeton Environmental Institute, Princeton University, Princeton, NJ, USA. S. Levin is at the Department of Ecology and Evolutionary Biology, Princeton University. K.-G. Mäler is at the Beijer International Institute of Ecological Economics, Stockholm, and the Stockholm School of Economics, Stockholm. P. Pinstrup-Andersen is at the International Food Policy Research Institute, Washington, DC. D. Siniscalco is at the Fondazione Eni Enrico Mattei, Milan, Italy. B. Walker is at CSIRO, Lyneham, ACT, Australia.

Global Sketches

World population has increased at a historically high average annual rate of 1.8% since 1950. However, cereal production (accounting for more than 50% of the energy intake of the world's poor today) has more than kept pace: It has increased from 275 kg per person in the early 1950s to 370 kg per person in the early 1980s. This change has been accompanied by improvements in a number of indicators of human well-being, such as gross output per head, infant mortality rate, life expectancy at birth, and literacy. Much of the complacency economists have displayed in recent years about food availability can be traced to these recorded improvements (*1*).

The problem with this complacency is that conventional indicators of the standard of living pertain to commodity production, not to the natural resource base on which all production depends. These indicators cannot say whether, for example, increases in gross national product (GNP) per head are being realized by a depletion of natural capital; in particular, whether increases in agricultural production are being achieved by a "mining" of soil, lowering of water tables, and impairment of other ecosystem services. Such impairment can easily go unrecorded, because the use of ecosystem services all too often involves transactions that are not mediated by an effective price system. So, for example, if individual farmers, when drawing water from an aquifer, ignore the fact that their extraction will increase others' future extraction costs because of a lowering of the water table, the social cost of agricultural production would exceed the farmers' private costs. Even though each farmer would typically impose only a small additional cost on others, the sum of the costs imposed by each on all others could well be substantial. This means that the real costs of agricultural production could exceed the market prices of agricultural produce. Indeed, their market prices could decline over time while the real cost of production rose (see the figure, where a hypothetical case is shown). By concentrating on current welfare measures such as GNP, market prices of agricultural produce, and life expectancy at birth, economists, journalists, and political leaders have for the most part wrongly bypassed the links that exist between population growth, increased material output, and the state of the natural resource base.

Ecologists' findings suggest that a near-50% increase in world population, allied with a doubling of gross world product per head, would by 2030 create substantial additional stresses in both local and global ecosystems (*2*). Global demand for food could easily double over the period 1990–2030, with two-and-a-half– to threefold increases in the poorest countries. Of particular concern are Asia and Africa where, over the next 50 years, plant-derived food energy requirements are expected to increase by a factor of 2.3 and 5, respectively, with a more-than-sevenfold increase expected in some countries (*3*).



Hidden costs. A hypothetical example showing that apparent decreases in the market price of a commodity can be accompanied by an increase in the actual production cost if the social cost of the commodity is rising.

Such increases in food requirements mean that we must manage constraints on the supplies of production inputs and on the environmental consequences of the use of these inputs. Increases in food production will in great measure have to continue to come from increased yields from land already in production and from improved efficiency in the use of water already coopted by agriculture (*4*).

But there are obstacles here. First, working against the trend of increased production from transgenic crops, many of the genetic resources required for the development of such improved crops are being destroyed (*5*). Second, a number of the ecosystem services underpinning productivity are under increasing threat (*6*). Third, the environmental and human health consequences of fertilizer and pesticide application in intensive production systems are of growing concern (*7*). And fourth, extreme climatic events accompanying global climate change may be expected to present an additional threat to food security; for example, to pest control and crop yields (*8*).

Food Viewed Through a Local Lens

These obstacles are not present uniformly across the globe. Moreover, local problems of production and distribution can be difficult to counter even when global supplies are adequate, because the purchasing power of the poor is weak. To ask merely whether global food supplies can be sustainably increased to meet future requirements misses much of the question. Food scarcity manifests itself locally, so efforts to alleviate it must be tailored to local circumstances. To do otherwise is akin to doctoring a sick person on the basis of global health statistics.

Correct diagnosis of the problems at the population-food-environment nexus is usually a local matter, even though appropriate treatment may require regional and global support. For example, soil erosion may not currently be a serious threat to global agricultural capacity, but locally in various parts of the world it presents major problems to the people affected (*9*). Similarly, decisions concerning fertility, education, child care, food, work, health care, and the use of the local natural resource base are in large measure reached and implemented within households, which face constraints that are shaped in part by national and international policy. The influence of household decisions is felt through local interactions (for example, intra-village and village-town trades) and thence upward globally. Recent work has identified a variety of circumstances in which there exist positive, synergistic feedback mechanisms driving poverty, hunger, fertility, environmental degradation, and civic disconnection at the local level, even while national (and not merely global) income is rising (*10*). This suggests that, if we are to obtain a reliable projection of global food prospects, we need to adopt a local, contemporary lens.

Moving into a More Nonlinear Domain?

Such interactions as we have alluded to above may well be a signal that local food systems in many places are moving into a more nonlinear domain, in which local environmental pressures exerted by growing populations rise more than in proportion to the growth, other things being equal. Moreover, in agriculture, for example, the consequences of a given shock today to the production system would likely be proportionately greater than in earlier decades, for at least three reasons. First, the food system is losing genetic heterogeneity. Thus, the vulnerability of crops to atypical weather events or pest outbreaks will probably increase. Second, the world is becoming more tightly coupled through globalization, so that, in the absence of adequate international insurance arrangements, global fluctuations in food production could well have stronger effects on local food availabilities. Third, increased intensity of crop and livestock production and centralization of food processing leaves large regions vulnerable to disease outbreak and to reduced efficacy of antibiotics (*11*).

Policies

Threats to environmental security very often come allied to institutional failure. Thus, when thinking about environmental security, particular attention needs to be given to the institutions in which individuals, households, firms, and communities go about their business. Evidence suggests that open societies harboring secure property rights (be they private or communal) and avoiding flagrantly distortionary fiscal policies are not only desirable in themselves, they would also appear to be good for the sustainable management of the natural resource base.

One aspect of such institutional reform should be increased public investment in agriculture and in people in poor countries. Such investment needs to be directed at new technologies and institutions at the local level involving, among other things, health care, reproductive health, and education (the latter, when benefiting women, has been found to be an important determinant of fertility behavior). Evidence also directs attention to the importance of dissemination of technical knowledge to local populations and to the need for local populations to be in a position to adapt new knowledge to their particular circumstances. Greater public investment needs to be made in the global biophysical, hydrological, and institutional assets that are crucial to increasing yield—water-use efficiency; gene banks; local land races; and protection of wild crop relatives and biodiversity generally, both for genetic material and for ecosystem services.

It would be desirable also to establish local "foresight institutions," whose purpose would be to monitor key local trends in aspects of food production to inform local and global policy. Fine-tuning a system as complex as the food system and capitalizing on the potential for institutional changes to boost food production in a sustainable fashion will require much more detailed local information than is typically available today. For instance, trends in the effects of soil degradation on land productivity are extremely important but not well understood, and so are vigorously disputed (*9*). Similarly, the geographic occurrence and security of dwindling populations of wild crop relatives is poorly known.

Translation of data into a workable set of social indicators is also important. Such indicators enable policy debate to be conducted in an illuminating manner. In this context, "green accounting" and genuine progress indicators are needed. Developing the local capacity to collect and distribute information is integral to any sustainable development program.

References and Notes

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