Understanding the Links between Agriculture and Health

Agriculture, Environment, and Health: Toward Sustainable Solutions

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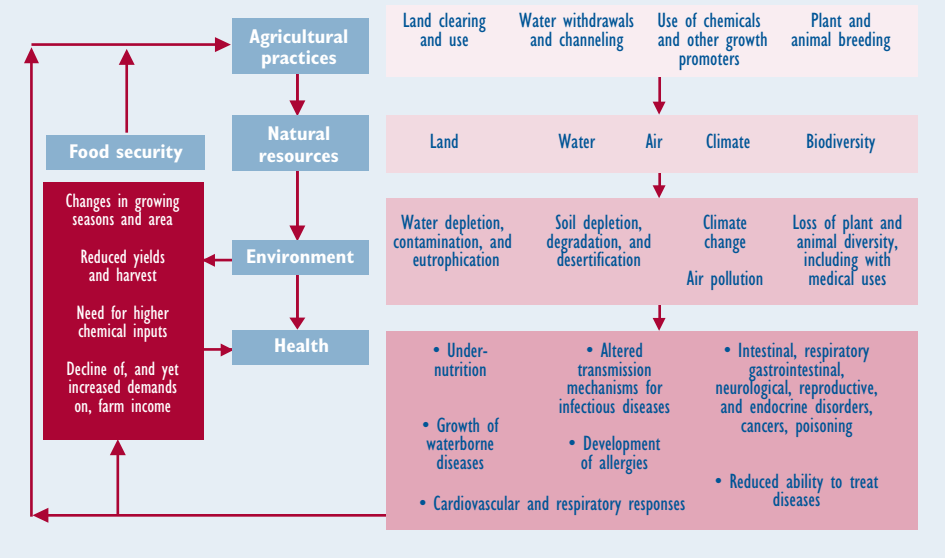
Agricultural production relies on environmental services to transform raw inputs into the nutritious and diverse food that humans rely on for survival. Although the practice of agriculture is essential for human health, careless and inappropriate agricultural practices can degrade and contaminate natural resources and in so doing, harm human health. Modified agricultural practices can help mitigate these problems. This brief provides an overview of the linkages between agriculture, environment, and health, some of which are dealt with in more detail in other briefs in this series.

IMPACTS OF INPUTS TO AGRICULTURAL SYSTEMS ON ENVIRONMENTAL AND HUMAN HEALTH

Agriculture is the oldest form of environmental management by humans. As shown in the figure, some agricultural practices can have negative environmental impacts. These impacts can affect human health directly or, via reduced food security, indirectly. In a bidirectional link, these food security and health outcomes feed back to affect agricultural practices.

Links between Agriculture, Environment, Food Security, and Health



Agricultural practices of particular relevance for health include land clearing and use, water withdrawals and channeling, plant and animal breeding, and the use of chemicals and other growth promoters. Many of these practices are associated with conventional, intensive farming in contrast to traditional, subsistence-oriented farming.

Land clearing and use. Clearance and use of land for crop and animal production contributes greatly to soil problems like salinization, sodification, depletion, and, in the extreme, desertification. The United Nations Environment Programme and others have estimated that, owing to poor farming practices, 38 percent of active farmland suffers from soil loss. The subsequent declines in production capacity have implications for food security. In Mali, for example, between 40 and 60 percent of harvest relies on fragile and low-fertility soils that cannot produce adequate food to meet food security needs.

Land clearance, arable farming, and animal production have been identified as factors contributing to climate change since they can lead to increased concentrations of carbon dioxide and methane in the atmosphere. Many studies now suggest that climate change has important implications for human health, notably cardiovascular and respiratory responses to changing temperature and altered transmission mechanisms of infectious disease. The World Health Organization (WHO) estimates that climate-change-induced temperature change leads to an estimated 10 percent higher risk of diarrhea in some regions. One key large-scale effect is the increased strength of hurricanes associated with global warming. In 1998 Hurricane Mitch in Central America caused almost 10,000 immediate deaths and resulted in widespread water- and vector-borne diseases.

In the other direction, models predict that climate change will adversely affect food production through its impact on agriculture. Of concern for developing countries is the potential for a decrease in grain yields that is expected to hit particularly hard in food-insecure regions. A recent study of the impacts of increased El Niño events shows declining yields of sorghum, millet, groundnuts, and maize in Southern Africa associated with these events. In extreme El Niño years, crop productivity dropped by 20–50 percent. The WHO estimates significant to small changes in malnutrition as a result of climate change. Recent studies challenge conclusions about declining yields globally and attempt to incorporate more realistic scenarios of adaptation, but they do not negate the possibility of significant pest and disease effects.

Land clearance is also associated with the loss of medicinal plants (see Brief 11) and declining biodiversity of plants, animals, and microbes that have the potential to advance medical research. Declining biodiversity—compounded by water withdrawals, agricultural chemicals, and plant and animal breeding and selection—also alters the balance of organisms in the ecosystem, which, like climate change, alters the transmission pathways of infectious diseases.

Water withdrawals and channeling. Agriculture is the largest user of water in the world and alters, depletes, contaminates, and eutrophies water bodies—all of which have implications for human health. Water-associated infectious disease kill approximately 3.2 million people per year, and a significant fraction can be traced back to agriculture-imposed changes in vector habitat and water quality. In the tropics, irrigation has led to increased habitat and breeding sites for vectors that transmit malaria and schistosomiasis (see Brief 6). Throughout the developing world, the use of polluted water in agriculture leads to the spread of viruses and parasites and consequently,

diarrheal diseases. From a nutritional standpoint, water development for rice production compromises access to fish by local populations (see Brief 10).

Use of chemicals. Modern agriculture relies increasingly on chemical inputs, notably fertilizers and pesticides, to meet increasing global demand for food and feed. The health impacts of agricultural chemicals are a function of their degree of accumulation in environmental sinks—soil, air, water, plants—and the degree to and form in which humans are exposed to them. It has been estimated, for example, that only 0.1 percent of pesticides actually reaches pests, while the remainder stays in the environment or on food. Overuse of pesticides is also related to declining biodiversity, such as of pollinating bees. Though difficult to measure, both processes have health implications. Much more measurable are the acute effects on agricultural workers using pesticides: millions suffer ill-health effects of pesticides every year, especially in developing countries (see Brief 8). Direct and indirect exposure to agricultural chemicals has been linked to intestinal, respiratory, gastrointestinal, neurological, reproductive, and endocrine disorders, as well as cancers and poisoning.

Plant and animal breeding and selection. Plant breeding and selection are associated with the disappearance of the vast majority of traditional seed varieties from commercial sale over the past 25 years. The reduction of landrace seed varieties in favor of cross-bred modern varieties may threaten food security. Given the concentration of industrial farming on a small number of crops and the increasing use of patented seeds, farmers have few incentives to maintain seed banks of lesser-used food crops. This situation can leave poor farmers vulnerable in the event of higher prices for seeds, as well as exposing all farmers to systemic shocks from natural or market events that adversely affect the dominant crops. Plant breeding and selection also contribute to declining biodiversity.

IMPROVING THE ENVIRONMENT AND HEALTH THROUGH AGRICULTURE

Although some agricultural practices have negative environmental and health implications, they can also be adapted to reduce such outcomes. Greater use of agricultural methods with positive environmental and health implications could promote positive agriculture-environment-health synergies.

"Sustainable agriculture" refers to agricultural systems that aim to reduce or eliminate environmental harms while maintaining adequate food and feed production. Sustainable agricultural practices include:

- reducing fertilizer inputs and replacing them with organic fertilizers or other methods of fixing nitrogen for soil enrichment;
- combining plant varieties, mixed cropping, or increased rotations to avoid monocropping; and
- employing biodiversity-friendly methods such as wildlife corridors or mixed farming areas, and using more indigenous species.

As a philosophy, sustainable agriculture did not incorporate a human health dimension until recently. Sustainable agricultural approaches have been developed to mitigate environmental impacts, but they also reduce human health risks through reduced degradation and contamination of soil and surface water, reduced CO_2 emissions into the atmosphere, and increased biodiversity. Particular forms of sustainable agriculture with potential health benefits include organic agriculture (land husbandry techniques and biological and manual methods instead of chemical inputs), integrated pest management (IPM—biological, cultural, and other less chemically intensive approaches to pest management), conservation agriculture (improved soil management), and plant breeding that promotes biodiversity.

The opportunities in agriculture to apply these techniques are many. In West Africa, for example, where a new breed of rice increases yields without fertilizer, rice farmers are using sustainable growing methods that reduce chemical use and exposure. In Asia, several varieties of rice grown together appear to reduce the need for pesticides and increase disease resistance. West African farmers are working with researchers to grow a wild species of bush mango that fruits sooner than cultivated species—and in the process restores some of the natural biodiversity of the region. More work is needed to heighten awareness of the health benefits of such approaches.

CONCLUSION

To implement sustainable solutions, more specific knowledge of the linkages between agriculture, environment and health is needed, particularly on the human health effects of specific agricultural activities and the cumulative and interactive impacts of multiple environmental changes. And while acute health impacts are relatively identifiable, better knowledge of the chronic health problems that arise from unhealthy agricultural practices is required.

In the meantime, action is needed at the policy level. Policies aimed at environmental protection or resource conservation already exist in many countries. These policies should be enforced and also examined and possibly retooled to ensure that they are maximizing human health benefits. Although any positive health outcomes would be revealed only over the long term, such approaches are needed as human health becomes a higher priority in agricultural decisionmaking. After all, agriculture relies on the productivity of the environment for its survival, and humans rely on agricultural productivity for their survival. ■

For further reading see E. Chivian, ed., *Biodiversity: Its Importance to Human Health* (Cambridge, MA: Harvard Medical School, 2002); L. Cohen, S. Larijani, M. Aboelata, and L. Mikkelsen, *Cultivating Common Ground: Linking Health and Sustainable Agriculture* (Oakland, CA: Prevention Institute, 2004); *Millennium Ecosystem Assessment, Ecosystems and Human Well-Being: Synthesis* (Washington, DC: World Resources Institute and Island Press, 2005); V. Ruttan, "The Transition to Agricultural Sustainability," *PNAS* 96, no. 11 (1999): 5960–5967; World Health Organization (WHO), *Climate Change and Human Health: Risks and Responses* (Geneva, 2003).

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