Understanding the Links between Agriculture and Health

Agricultural Technology and Health

Michael Lipton, Saurabh Sinha, and Rachel Blackman

2020 VISION FOR FOOD, AGRICULTURE, AND THE ENVIRONMENT

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Agrotechnical progress comprises *research* by farmers and public and private providers; *invention*, discovery or development of a technique; and *adoption*, from innovation by early users to diffusion by learning or extension. It includes everything from the development of basic agricultural tools to biotechnology.

Agrotechnical progress has repeatedly driven revolutions in food production and transformed human development, from the Neolithic settlement, as former hunter-gatherers became farmers, to the Green Revolution in Asia, which brought unprecedented rises in food production (see Brief 2). Only since about 1750, however, has agrotechnical change been a main engine of steady human development, and only since the 1950s has it been deliberately harnessed toward such ends. Indeed, the irrigation and biochemical revolutions of the 1960s and 1970s, with all their imperfections, have led the world's greatest and fastest advance in human development.

THE TWO-WAY LINKS BETWEEN AGROTECHNOLOGY AND HEALTH

Research, invention, and adoption of agrotechnology have played an important role in improving human nutrition and health. Agrotechnology has introduced more effective plant breeds (such as high-yielding varieties), enhanced land management techniques (such as terracing), and improved water management tools (such as irrigation). The adoption of these techniques has benefited nutrition, largely through boosting crop productivity, thereby providing employment and income to rural populations and increasing local and global food supplies.

Pro-poor agrotechnology produces results suitable for low-risk, profitable adoption in conditions faced by many smaller and more asset-deprived farms. Such technology offers long-term benefits to the poor by increasing labor demand, lowering risks, enhancing access to cheap, reliable sources of energy and micronutrients, improving water use efficiency, and helping poor rural communities to acquire key assets. Normally, such economic gains carry clear health benefits. For example, cheaper and less variable micronutrients mean better immune function in times of higher disease incidence or work stress. More assets provide collateral, so poor households can borrow to meet sudden health costs or food price rises. Better water use efficiency reduces the scarcity and distance of essential drinking water. Increased labor demand improves health by raising hungry workers' income and thus their command over food. Policy choices may be needed, however, to minimize harmful side effects on health.

Just as agrotechnology can benefit health, good health can accelerate agrotechnical progress. Research and invention of agrotechnologies cannot benefit health unless farmers adopt them, and healthy farmers are likelier to seek out, afford, find, and try new technology.

AGROTECHNOLOGICAL HEALTH RISKS

Health gains from improved farm production and employment through improved income, nutrition, shelter, and access to water far outweigh negative health effects. But certain agrotechnologies can endanger health by affecting the natural environment, and the type and form of labor needed for agricultural production. These impacts should be anticipated (and health and agriculture policies coordinated) in order to identify effective ways of monitoring them, reducing the hazards, and developing treatments.

Tools and mechanization. Physical injury in farmwork is a threat to agricultural productivity and worker health (see Brief 8). The risks and effects differ depending on the technology used. A study in Bangladesh showed that 80 percent of female users of modern threshing technology suffered pain in their waist and legs for a few hours after threshing, but 20 percent of the farmers said that traditional threshing technologies had caused similar problems. Overall, investment in the new technology was felt to be worthwhile since it made the job easier.

Most physical injury incurred in agriculture is preventable. It is largely ignored, but probably causes more death, pain, and work loss (with much less offsetting output benefit) than agrochemicals and water resources development put together.

Water resources development. For families living near irrigation projects, this more convenient water source may reduce disease through cleaner water or greater availability, facilitating better hygiene. But if the irrigation water is contaminated, drinking it can spread infectious diseases such as cholera and lead to chemical poisoning through surface or groundwater transfer of agricultural and industrial chemicals. Stagnant water is also a breeding ground for disease vectors, especially mosquitoes (see Brief 6).

Use of agrochemicals. Pesticide use in crop cultivation is often higher than optimal for profit maximization, notably in rice cultivation (see Brief 8). Farmers' unawareness of the dangers of agrochemicals, combined with poor regulation and enforcement, often leads to poisoning. In Ecuador, chronic dermatitis was twice as common among potato workers as among controls. Many agrochemical poisonings are due to suicide, but apart from that, agrochemicals cause millions of poisonings each year, the vast majority in developing countries.

Fertilizer use also affects health. Nitrates and nitrites from fertilizer are among the most common contaminants in drinking water; nitrate contact with mouth bacteria causes nitrate poisoning. Yet excess fertilizers are often used inefficiently. In China, only 30 percent of fertilizer applications reach the crop; much of the rest ends up in water courses. In northern China, more than one-half of groundwater monitoring sites had nitrate levels above the allowable limit. Contamination aside, this harms health through inadequate water quantity and increases women's time and labor burden in finding alternative water sources.

More can and should be done to ensure safe and appropriate use of agrochemicals. Reducing pesticide use often improves health and usually cuts production costs. Likewise, when fertilizers get into drinking water instead of crops, both production costs and health suffer. In Indonesia, biological controls (within integrated pest management) have greatly reduced pesticide applications, improved health, and raised farm incomes.

Plant breeding also matters in this context. Plant type improvement on poor people's farms is almost unambiguously good for human development, but must be selected to decelerate inappropriate

use of agrochemicals. In China, India, and South Africa, where farmers had been forced to choose between low cotton yields (due mainly to bollworm) and increasingly massive pesticide applications, transgenic Bt cotton has had substantial health benefits *and* raised farm income, including that of poor smallholders.

THE EFFECTS OF HUMAN HEALTH ON AGRICULTURAL TECHNOLOGY

The impacts of human health on agrotechnology are complex and often mediated by the seasonal nature of both illness and labor demand. Temperature and rainfall determine survival and breeding patterns of mosquitoes, and thus incidence of malaria. The rainy season also sees a greater incidence of diarrheal diseases. Nutrition in preharvest seasons tends to be worse, increasing susceptibility to illness. Such threats to human health often coincide with times of high seasonal labor requirements. This situation has implications for the use of agrotechnology because seasonal labor bottlenecks and illness during certain seasons can affect adoption of technology, either positively, as households improve technology out of necessity, or negatively, as households facing labor shortage and lower income due to illness are forced to spend resources on health care and have little left to invest in technologies that ease labor constraints. Where external inputs are used, money might be diverted away from these toward paying health care expenses.

Illness during the slack season is especially likely to deplete farm labor for long-run investments, such as conservation. Households made poorer by illness and needing to save seasonal labor are likely to target activities that give quick returns.

HIV/AIDS illustrates how disease affects agrotechnology (see Brief 7). HIV/AIDS-related expenditures can reduce farm households' spending on productivity-enhancing inputs, especially given that the labor used to apply such inputs might not be available owing to death and time spent caring for the sick and attending funerals. HIV/AIDS also affects the relationship between labor and technology. HIV/AIDS-stricken rural households often invest in labor-substituting technology, which is less likely to be affected by ill health than labor-intensive technology. This situation stimulates labor-saving technology, in particular long-lasting machinery such as tractors. This stimulation is perverse: it worsens poverty by skewing technical progress in ways that reduce demand for labor and hence wage rates; it absorbs savings and capital, which are scarce in poor countries; and in the medium term, it reduces employment for working-age populations, which are growing fast even in HIV/AIDS-affected countries.

MAXIMIZING THE HEALTH BENEFITS OF AGROTECHNOLOGY

Pro-poor agrotechnology can offer long-lasting health benefits to the poor. Since the 1980s, however, agrotechnology has become less pro-poor. Research has moved to the private sector without adequate pro-poor changes in the incentive structure facing this sector or in public-private partnerships. This shift has reduced yield and employment growth in smallholder food production, and concomitantly the impact of agrotechnology on poverty reduction and health.

What policies can enable agrotechnology to accelerate its thrust toward sustainable human development, less poverty, and better nutrition and health? Overall, policies should be based on the recognition of the mutual linkages between agricultural research, discovery, and diffusion on the one hand, and health, education, and empowerment on the other. Investing in health will benefit health not only directly, but also indirectly through the adoption of pro-poor, pro-health agrotechnology. Likewise, investing in appropriate agrotechnology will not only stimulate agricultural progress, but will also benefit health and poverty reduction.

In the health sector, rural health services should be improved and action taken to anticipate and reduce any negative health effects of agrotechnology. As for agrotechnology, if it is to improve its promise of enhancing human nutrition, health, and wealth, it is crucial to expand applied and basic agroscience in the international public sector. An important example is research to increase the micronutrient content of the main food staples, such as provitamin A–rich orange-fleshed sweet potatoes (conventionally bred) and golden rice (transgenic), recently expanded in the HarvestPlus program of the Consultative Group on International Agricultural Research (CGIAR). In addition, for the health needs of small farmers and laborers—as well as poor consumers—to influence research decisions, governments need to develop (1) institutions and incentives to promote such people's participation and communication with the formal research community; (2) competition among private research providers; and (3) public research in activities that respond to farmers' needs but are unlikely to attract formal private research. ■

The brief is an adaptation of Michael Lipton, Saurabh Sinha, and Rachel Blackman, "Reconnecting Agricultural Technology to Human Development," *Journal of Human Development* 3, no. 1 (2002): 123–152.

For further reading see M. Lipton and E. de Kadt, *Agriculture-Health Linkages* (Geneva: World Health Organization, 1988).

Michael Lipton (mlipton@onetel.com) is research professor of economics, Poverty Research Unit, Sussex University, Brighton, UK. Saurabh Sinha (saurabhsinha04@yahoo.com) is a senior technical adviser for the United Nations Development Programme in Kabul, Afghanistan. Rachel Blackman (Rachel.Blackman@tearfund.org) is creative subeditor for Tearfund, Teddington, UK.

International Food Policy Research Institute **www.ifpri.org**
2033 K Street, N.W. • Washington, D.C. 20006-1002 • U.S.A.
Phone: +1-202-862-5600 • Fax: +1-202-467-4439 • Email: ifpri@cgiar.org