



We [should] expand our own perspective to include the economic consequences of the policies we promote.

Incorporating Health and Ecologic Costs into Agricultural Production

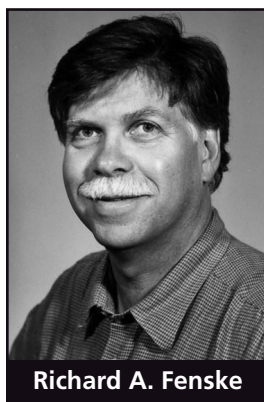
In his 1939 social history, *Factories in the Field* (1), Carey McWilliams explored the injustices of migratory farm labor in California. Yet his description of the rural California landscape at that time captures the essential characteristics of the predominant form of agricultural production in the United States today:

Travelers along the highways pass through orchards that seem literally measureless and gaze upon vast tracts of farm land stretching away on either side of the road to the distant foothills... Where are the farms? Where are the farm-houses?... Here a new type of agriculture has been created:... farming has been replaced by industrialized agriculture, the farm by the farm factory (1).

Large-scale, resource-intensive enterprises, often based on a single crop, have come to represent the norm in modern farming. Such farms tend toward intensification (more production per unit area), reduction in biodiversity, dependence on inputs not found locally (e.g., fertilizers and pesticides), and production of wastes that cannot be absorbed easily by the local ecosystem or community. Such practices have their counterparts in meat production in the form of confined animal feeding operations and the routine use of antibiotics.

Horrigan and colleagues at the Johns Hopkins University Center for a Livable Future refer to this type of production as “industrial agriculture” and contrast it with sustainable agriculture (2). They argue that industrial agriculture creates a wide range of negative health and ecologic consequences and that an agricultural production model based on the concept of sustainability provides a long-term alternative to current practices. This debate is a complex one, touching on social, economic, and ethical issues. A major criticism of conventional practices is that they fail to incorporate the true costs of production, treating human health and ecologic impacts as “externalities” within current economic models. This approach carries with it an implicit notion that producers are not responsible for such impacts and that entities such as government agencies will take on this burden. Such a view is fundamentally at odds with a public health model that attempts to incorporate the prevention of injury and illness into production processes.

There is clearly a need to develop measures of sustainability that incorporate the so-called externalities of health and ecologic impacts, and to conduct comparisons across agricultural systems. A significant step in this direction was reported recently by researchers at Washington State University (3) who evaluated the sustainability of conventional, organic, and integrated (mixed organic-conventional) apple production. In this study, Reganold et al. (3) used quantitative indices of soil quality, horticultural performance, fruit firmness and taste, and environmental impact, including pesticide use, and found that “the organic system ranked first in environmental and economic sustainability, the integrated system second, and the conventional system last.” Unfortunately, analyses of this kind are the exception, but they point toward new directions for environmental health research. To the extent that we in the public health community ask producers to integrate health and safety into the production process, so too should we expand our own perspective to include the economic consequences of the policies we promote.



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by the National Institute for Occupational Safety and Health (5).

Pesticides are perhaps the most easily identified health hazard in the agricultural workplace. Current evidence indicates that acute intoxications are at what can be considered epidemic levels worldwide. Virtually no countries have national reporting systems, so incidence rates are difficult to determine, and long-term health effects are generally not being monitored. The Focus article in this issue of *EHP* examines the use of pesticides in floriculture in Colombia and other tropical countries (6). The intensive use of pesticides in greenhouse environments can lead to substantial exposures for workers; however, the diversity of pesticides used at these worksites presents a special challenge for epidemiologic research because it is often impossible to attribute symptoms or disease to particular chemical exposures.

Substantial new documentation related to pesticide use, exposure, and resulting illnesses has been gathered in Central America over the past decade (7). Yet these regional data appear to have had little or no discernible impact on regulatory policies in these countries. This raises serious questions about the role of environmental research in risk management and deserves further examination. Finally, a recent study of cancer incidence in members of the United Farmworkers of America found that union members had elevated rates of leukemia, stomach cancer, and uterine cancers compared to the California Hispanic population (8). If it is determined that these cancers are related to workplace exposures or conditions, who will bear the costs associated with these illnesses? The Pew Hispanic Center estimates that 47% of the 2.5 million persons employed for wages on U.S. farms are undocumented (9). Because these workers are not enumerated and avoid contact with public agencies, characterization of health risks for this population is particularly challenging and will require special efforts to engage workers and communities in the design and implementation of epidemiologic and intervention studies.

Industrial agriculture can also have significant impacts on communities. In an article in this issue of *EHP*, Steve Wing recounts his experiences with community-based research (10). He chronicles his investigations of air pollution, water pollution, and noxious odor production associated with industrial hog farming in North Carolina. His work sheds light on environmental justice aspects of such agricultural operations and explores the ethical issues that researchers face when working closely with a disenfranchised community. Community exposure to pesticides is the focus of another article in this issue (11); a study in Washington State's tree fruit

region indicates that children can be exposed to pesticide residues in their homes due to nearby agricultural spraying. Fenske et al. (11) also report that discontinuation of pesticide use can lead to substantial reductions in residential residue levels. Such community impacts from agricultural production remain largely undocumented, and the health and ecologic costs remain uncalculated.

What is the best approach for incorporating health and ecologic impacts into agricultural production systems? Several efforts are currently under way. First, sustainable agriculture offers both a philosophy and a set of practices to reduce these impacts (2). Environmental health scientists need to examine the effectiveness of this type of agriculture in reducing hazards for workers, communities, and consumers. Second, many companies have adopted new environmental management practices under the rubric of ISO 14000, as discussed by Tenenbaum (6). The success of such voluntary programs will require evaluation as well. Finally, the field of industrial ecology, sometimes referred to as the “science of sustainability,” may offer a broad framework for an accounting of the true costs of industrial activities (12). Industrial ecology is a concept first developed by the Ministry of Industry and International Trade in Japan and has since been explored by the National Academy of Engineering in the United States (13,14). It is based on the view that the increasingly complex interaction of technologic systems, culture, and the physical world will force us to develop new social and economic models that are capable of integration on a global scale and over many decades.

Implementation of any or all of these approaches will require the combined efforts of many disciplines, including the natural and social sciences, law, engineering, and economics. Without a more integrative framework, it is likely that health and ecologic impacts of agricultural production will continue to be mitigated on an ad hoc basis and that long-term solutions to these problems will remain elusive.

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REFERENCES AND NOTES

- McWilliams C. *Factories in the Field*. Boston MA: Little, Brown and Company, 1939.
- Horrigan L, Lawrence RS, Walker P. How sustainable agriculture can address the environmental and human health harms of industrial agriculture. *Environ Health Perspect* 110:445–456 (2002).
- Reganold JP, Glover JD, Andrews PK, Hinman HR. Sustainability of three apple production systems. *Nature* 4:10:926–930 (2001).
- Schenker MB. Preventive medicine and health promotion are overdue in the agricultural workplace. *J Public Health Policy* 17(3):275–305 (1996).
- NIOSH. *Simple Solutions: Ergonomics for Farm Workers*. Cincinnati, OH: National Institute for Occupational Safety and Health, 2001.
- Tenenbaum D. Cut flowers: green crop or brown? *Environ Health Perspect* 110:A240–A247 (2002).
- Wesseling C, Aragon A, Castillo L, Corriols M, Chaverri F, de la Cruz E, Keifer M, Monge P, Partanen T, Ruepert C, et al. Hazardous pesticides in Central America. *Int J Occup Environ Health* 7(4):287–294 (2001).
- Mills PK, Kwong S. Cancer incidence in the United Farmworkers of America (UFW), 1987–1997. *Am J Ind Med* 40:596–603 (2001).
- Martin P. Guest Workers: New Solutions, New Problems? Pew Hispanic Center, Washington DC, 2002. Available: http://www.pewhispanic.org/site/docs/pdf/study_-_philip_martin.pdf [cited 28 March 2002].
- Wing S. Social responsibility and research ethics in community-driven studies of industrialized hog production. *Environ Health Perspect* 110:437–444 (2002).
- Fenske RA, Lu C, Barr DB, Needham LL. Children's exposure to chlorpyrifos and parathion in an agricultural community in central Washington State. *Environ Health Perspect* 110:549–553 (2002).
- Allenby BR. *Industrial Ecology: Policy Framework and Implementation*. Upper Saddle River, NJ: Prentice Hall, 1999.
- Allenby BR, Richards DJ, eds. *The Greening of Industrial Ecosystems*. Washington, DC: National Academy Press, 1994.
- Ausubel JH, Langford HD, eds. *Technological Trajectories and the Human Environment*. Washington, DC: National Academy Press, 1997.

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