Cultivating a Sustainable and Resilient Food Future**

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Summary
A growing awareness of the costs of industrial food in the latter half of the 20th century drove a search for solutions that emerged as the sustainable agriculture movement. Over this same time period, global movements regarding food accelerated in an increasingly specialized and concentrated global industrial food system. Current national and international policy clearly favors the continued consolidation and concentration of this system, despite widely accepted evidence that these characteristics create critical sustainability challenges, as well as new evidence that this specialization and consolidation creates barriers to the resilience of the global food system. This maladaptive path is doubly destructive: not only does it finance the continued development of the existing system, it also squanders the resources needed to finance a transition to a more sustainable global food system. Resilience science offers a novel framework and a set of concepts uniquely suited to the challenges of managing food systems under conditions of high uncertainty and dynamic change. Although research exploring food system resilience is only just beginning, initial results suggest that, compared with industrial food systems, sustainable food systems are more resilient while providing a host of other natural resources, social, and financial benefits to the communities they serve. A sustainable and resilient food future is possible through policies designed to transform the global industrial food system into a global network of food systems serving local and regional populations.

Current realities
The United States industrial food system has proven remarkably adaptable over the last 150 years, responding to a diversity of production conditions across North America to supply commodities to national and international markets. This success has been largely achieved through (i) continuous financial, natural, and social subsidies (e.g., direct and indirect payments designed to stabilize production, recover from disaster, and reduce environmental harms); (ii) public support for education, research and development that serves the agricultural industrial complex; (iii) natural resource subsides produced through the degradation of soil, water, and air quality, biodiversity, ecosystem services; and (iv) social resource subsidies through the degradation of the health and well-being of local communities both at home and abroad.

In the latter half of the 20th century, a growing awareness of the environmental and social harms of an increasingly specialized and concentrated U.S. food system led to a search for solutions that emerged as the sustainable agriculture and food systems movement. This work focused on understanding the sustainability challenges created by the changing structure, function, and purpose of the U.S. food system during a period of intense industrialization and globalization, which began to accelerate in the 1980s. In the early years of the 21st century, awareness of the multiple benefits of local and regional food systems to community well-being increased as physicians, dieticians, public health specialists, and municipal planners explored land use, transportation, and economic development issues, and advocated for increased access to healthy, nutrient-dense foods.

Recent empirical research confirms that sustainable systems are as productive as industrial systems, are less vulnerable to global environmental change, and have a greater capacity to restore the degraded natural and social resources that are crucial to community resilience. Sustainable food systems are now widely accepted as a core component of sustainable development strategies by many regional, national, and international organizations promoting sustainable and resilient development of rural and urban areas.

Despite widespread awareness of the multiple benefits of sustainable food systems and new evidence that the global industrial system is uniquely vulnerable to climate change and other 21st century challenges, national and international agricultural policy clearly favors the continued development of a global industrial food system. This puts global society squarely on a maladaptive path by investing in a food system that cultivates unprecedented vulnerability to global environmental change and threatens the sustainability and resilience of communities throughout the world.

Scientific opportunities and challenges

Resilience involves more than just the ability to "bounce back" from a disturbance, shock, or change. Resilience also means having the capacity to make adjustments that avoid or reduce potential damages and take advantage of the opportunities created by change. Resilience is the capacity of the system *to respond* to disturbances to avoid or limit damage, *to recover swiftly* when disturbances cause damage, and to *undergo transformation* when needed to sustain the system as conditions change.

With roots in complexity and systems science, resilience science offers a novel framework and a set of concepts uniquely suited to the challenges of managing social-ecological systems under conditions of high uncertainty. Resilience science is grounded in ecological theory and has a long history of development in natural resource management. Resilience science clarifies and extends sustainability concepts to include dynamic change and has identified a number of qualities that promote sustainability in natural and social-ecological systems: diversity, modularity, tightness of feedbacks, and high levels of all types of capital (e.g., natural, human, social, physical, and financial). These qualities enhance the capacity for self-organization, learning, and innovation, essential behaviors of resilient systems. Sustainable food systems and the communities they serve exhibit all of these qualities; industrial food systems do not.

Recently, scientists and practitioners have applied resilience theory to understand and manage so-called "wicked problems," such as climate change, poverty, and food security. A number of new analytical tools are currently under development to support the application of resilience theory to agricultural and food system design, assessment, and management including (i) a set of proposed food system design criteria; (ii) adaptive management; (iii) the application of the adaptive cycle to business and governance; and (iv) sustainability and resilience assessment based on ecological network analysis. These tools appear to be widely applicable, scale-neutral, and equally useful in education, research and development, private business, policy-making, and government program management.

Although the existing knowledge base in sustainable food systems supports resilience theory, the application of resilience science to food system design and management is novel. Until resilience concepts are validated through additional research and development, there are many legitimate concerns about the application of resilience theory in public policy and programs. Strong objections to resilience science are also expected to arise because its theories require the examination of several neoclassical economic assumptions, including the overemphasis on land and labor efficiency, myth of unlimited growth, utility of externalizing the costs of industrial harms, and disregard for the dangers of concentrated wealth and complex global networks.

Policy issues

Local and regional actions, supported by enabling policies at local, regional, national, and international levels, can put the global industrial food system on a path to a resilient food future. The recommendations below build on existing U.S. Department of Agriculture (USDA) programs and integrative initiatives, and international partnerships that engage local and regional governments, educational and research institutions, businesses, and community-based organizations to address six significant levers of change:

- Redirect USDA credit and crop insurance programs to support farmers and ranchers using ecosystem-based, diversified production and marketing practices, especially small and midsized farms supplying local and regional markets (e.g., Farm Service Agency's [FSA] Direct Operating Loans Program, Risk Management Agency's Whole Farm Revenue Protection Program).

- Expand incentives and rewards for producers that help protect and restore ecosystem services that enhance sustainability and resilience of U.S. food systems (e.g., Natural Resources Conservation Service's Agricultural Conservation Easement, Conservation Stewardship, and Regional Conservation Partnership Programs; FSA's Conservation Loan and Conservation Reserve Programs).

- Redirect economic development investments to promote the re-regionalization of the U.S. food system (e.g., Agricultural Marketing Service's Farmers Market and Local Food Promotion and Specialty Crops Block Grant Programs; National Institute of Food and Agriculture's [NIFA] Community Food Projects Program; Rural Business Cooperative Service's Value Added Producer Grants; Rural Business Development Grants' Local Foods, Local Places Initiative).

- Redirect agricultural education, research, and extension investments to support sustainable food systems (e.g., NIFA's Sustainable Agriculture, Research and Education Program; National Center for Appropriate Technology's National Sustainable Agriculture Information Service; Know Your Farmer, Know Your Food Initiative).

- Expand nutrition assistance and education programs that support sustainable food systems (e.g., Food and Nutrition Service's Farmers' Market Nutrition, Farm to School Grant, School and Community Gardens, and Department of Defense's Fresh Programs; NIFA's Food Insecurity Nutrition Incentive Grants Program; Healthy Food Financing Initiative).

- Redirect U.S. international development investments to support collaborative development of sustainable and resilient regional food systems worldwide (e.g., Global Partnership on Nutrient Management; Feed the Future; North American Pollinator Protection Campaign; Local and Regional Food Aid Procurement; U.S. Agency for International Development Sustainable Agriculture and Natural Resource Management Innovation Lab).

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